


# Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2

## Response to Comments for Joint Rulemaking



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Office of Transportation and Air Quality  
U.S. Environmental Protection Agency

And

National Highway Traffic Safety Administration  
U.S. Department of Transportation

## **Introduction**

On June 19, 2015, the Administrator of the U.S. Environmental Protection Agency (EPA) and the Secretary of the Department of Transportation (DOT) jointly signed a Notice of Proposed Rulemaking (NPRM) to propose a national program that would establish the next phase of greenhouse gas (GHG) emissions and fuel efficiency standards for medium- and heavy-duty vehicles. This “Phase 2 program” would significantly reduce carbon emissions and improve the fuel efficiency of heavy-duty vehicles, helping to address the challenges of global climate change and energy security. On July 13, 2015, the NPRM was published in the Federal Register, and following an extension, the public comment period closed on October 1, 2015. During this time EPA and the National Highway Traffic Safety Administration (NHTSA) held two public hearings, one in Chicago, IL on August 6, 2015 and one in Long Beach, CA on August 18, 2015. EPA and NHTSA later issued a Notice of Data Availability (NODA) on March 2, 2016 to provide an opportunity to comment on new information being made available by EPA and by NHTSA related to the proposed Phase 2 program. The comment period for the NODA closed on April 1, 2016. This joint Response to Comments (RTC) document addresses written comments and testimony received during both public comment periods. In the spirit of our commitment to meaningful collaboration with stakeholders and the public to identify and understand the opportunities and challenges involved with this next level of fuel-saving technology, we address late comments (i.e., comments received after the comment periods were closed) to the extent that they were received in time to include in this document.

We received over 230,000 comments written comments on the proposed Phase 2 rules. The comments and responses are organized by topic (see Table of Contents) to help the reader find comments and responses of interest. The general layout of each RTC subsection is organized such that excerpts of comments based on a particular topic are first provided, and then our responses to either individual excerpts or groups of comments represented by the excerpts follows. Whether responding to a single comment or a group, the agencies’ responses are separated from the comments with the following section header:

### **Response**

The excerpts include either portions of a commenter’s submission on a particular topic, or the entirety of the commenter’s submission if the breadth of the comments were narrow enough. In general, we have associated comments with a specific commenter in responding to comments. However, due to the large number of comments that addressed similar issues, as well as the volume of the comments received, we do not claim to have identified for each response every comment or commenter addressed by the response. A complete list of organizations and individuals that provided comments is contained in this document below. This RTC addresses citizen comments that raised unique substantive issues. Tens of thousands of citizens also commented through mass e-mail campaigns; these comments are not included individually, but rather examples are provided.

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## List of Commenters

| <b>Commenter</b>  | <b>Comment Document ID</b>  |
|---|---|
| A de F Limited  | EPA-HQ-OAR-2014-0827-0763<br>EPA-HQ-OAR-2014-0827-0763-A1<br>EPA-HQ-OAR-2014-0827-0809<br>EPA-HQ-OAR-2014-0827-0809-A1<br>NHTSA-2014-0132-0029<br>NHTSA-2014-0132-0029-A1                       |
| ABC Bus Companies, Inc.   | EPA-HQ-OAR-2014-0827-1326<br>EPA-HQ-OAR-2014-0827-1326-A1<br>EPA-HQ-OAR-2014-0827-1326-A2<br>EPA-HQ-OAR-2014-0827-1430<br>EPA-HQ-OAR-2014-0827-1430-A1<br>EPA-HQ-OAR-2014-0827-1430-A2          |
| Achates Power, Inc.   | NHTSA-2014-0132-0049<br>NHTSA-2014-0132-0049-A1   |
| Advanced Engine System Institute (AESI)                                   | EPA-HQ-OAR-2014-0827-1152<br>EPA-HQ-OAR-2014-0827-1152-A1<br>EPA-HQ-OAR-2014-0827-1152-A2   |
| Afton Chemical  | EPA-HQ-OAR-2014-0827-1129<br>EPA-HQ-OAR-2014-0827-1129-A1<br>EPA-HQ-OAR-2014-0827-1129-A2   |
| Alcoa   | EPA-HQ-OAR-2014-0827-1216<br>EPA-HQ-OAR-2014-0827-1216-A1   |
| Alliance of Automobile Manufacturers and Association of Global Automakers | EPA-HQ-OAR-2014-0827-1271<br>EPA-HQ-OAR-2014-0827-1271-A1   |
| Alliance of Idle Mitigation Technologies                                  | EPA-HQ-OAR-2014-0827-1311<br>EPA-HQ-OAR-2014-0827-1311-A1   |
| Allison Transmission, Inc.  | EPA-HQ-OAR-2014-0827-1284<br>EPA-HQ-OAR-2014-0827-1284-A1<br>EPA-HQ-OAR-2014-0827-1284-A2<br>NHTSA-2014-0132-0100<br>NHTSA-2014-0132-0100-A1<br>NHTSA-2014-0132-0119<br>NHTSA-2014-0132-0119-A1 |
| Aluminum Association  | EPA-HQ-OAR-2014-0827-1260<br>EPA-HQ-OAR-2014-0827-1260-A1<br>NHTSA-2014-0132-0089<br>NHTSA-2014-0132-0089-A1  |

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| American Automotive Policy Council                       | EPA-HQ-OAR-2014-0827-1238<br>EPA-HQ-OAR-2014-0827-1238-A1<br>NHTSA-2014-0132-0103<br>NHTSA-2014-0132-0103-A1   |
| American Bus Association (ABA)                           | EPA-HQ-OAR-2014-0827-1139<br>EPA-HQ-OAR-2014-0827-1139-A1  |
| American Bus Association et al.                          | EPA-HQ-OAR-2014-0827-1293<br>EPA-HQ-OAR-2014-0827-1293-A1  |
| American Chemistry Council (ACC)                         | EPA-HQ-OAR-2014-0827-1147<br>EPA-HQ-OAR-2014-0827-1147-A1<br>EPA-HQ-OAR-2014-0827-1147-A2<br>EPA-HQ-OAR-2014-0827-1151<br>EPA-HQ-OAR-2014-0827-1151-A1   |
| American Council for an Energy-Efficient Economy (ACEEE) | EPA-HQ-OAR-2014-0827-1280<br>EPA-HQ-OAR-2014-0827-1280-A1<br>NHTSA-2014-0132-0097<br>NHTSA-2014-0132-0097-A1   |
| American Gas Association (AGA) et al.                    | EPA-HQ-OAR-2014-0827-1223<br>EPA-HQ-OAR-2014-0827-1223-A1<br>NHTSA-2014-0132-0098<br>NHTSA-2014-0132-0098-A1   |
| American Iron and Steel Institute                        | EPA-HQ-OAR-2014-0827-1275<br>EPA-HQ-OAR-2014-0827-1275-A1<br>EPA-HQ-OAR-2014-0827-1275-A2<br>EPA-HQ-OAR-2014-0827-1275-A3<br>EPA-HQ-OAR-2014-0827-1275-A4<br>EPA-HQ-OAR-2014-0827-1275-A5<br>EPA-HQ-OAR-2014-0827-1275-A6<br>EPA-HQ-OAR-2014-0827-1275-A7<br>EPA-HQ-OAR-2014-0827-1275-A8<br>EPA-HQ-OAR-2014-0827-1275-A9<br>EPA-HQ-OAR-2014-0827-1275-A10<br>EPA-HQ-OAR-2014-0827-1275-A11<br>EPA-HQ-OAR-2014-0827-1275-A12 |
| American Lung Association                                | NHTSA-2014-0132-0087<br>NHTSA-2014-0132-0087-A1  |
| American Power Group Inc (APG)                           | EPA-HQ-OAR-2014-0827-1197<br>EPA-HQ-OAR-2014-0827-1197-A1  |
| American Reliance Industries, Co. (ARI)                  | EPA-HQ-OAR-2014-0827-1300<br>EPA-HQ-OAR-2014-0827-1300-A1  |



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| American Trucking Associations (ATA)              | EPA-HQ-OAR-2014-0827-0923<br>EPA-HQ-OAR-2014-0827-0923-A1<br>EPA-HQ-OAR-2014-0827-1243<br>EPA-HQ-OAR-2014-0827-1243-A1<br>NHTSA-2014-0132-0035<br>NHTSA-2014-0132-0035-A1<br>NHTSA-2014-0132-0108<br>NHTSA-2014-0132-0108-A1 |
| American Trucking Associations (ATA) and NHTSA    | NHTSA-2014-0132-0063<br>NHTSA-2014-0132-0063-A1  |
| Aperia Technologies                               | NHTSA-2014-0132-0104<br>NHTSA-2014-0132-0105   |
| Association for the Work Truck Industry (NTEA)    | EPA-HQ-OAR-2014-0827-1187<br>EPA-HQ-OAR-2014-0827-1187-A1  |
| Association of American Railroads                 | EPA-HQ-OAR-2014-0827-1273<br>EPA-HQ-OAR-2014-0827-1273-A1<br>EPA-HQ-OAR-2014-0827-1273-A2  |
| Autocar, LLC                                      | EPA-HQ-OAR-2014-0827-0761<br>EPA-HQ-OAR-2014-0827-0761-A1<br>EPA-HQ-OAR-2014-0827-1233<br>EPA-HQ-OAR-2014-0827-1233-A1   |
| Avista Oil AG et al.                              | EPA-HQ-OAR-2014-0827-1266<br>EPA-HQ-OAR-2014-0827-1266-A1<br>EPA-HQ-OAR-2014-0827-1266-A2<br>EPA-HQ-OAR-2014-0827-1278<br>EPA-HQ-OAR-2014-0827-1278-A1   |
| Barcode Technology Solutions                      | EPA-HQ-OAR-2014-0827-0764  |
| Bay Area Air Quality Management District (BAAQMD) | EPA-HQ-OAR-2014-0827-1136<br>EPA-HQ-OAR-2014-0827-1136-A1<br>NHTSA-2014-0132-0061<br>NHTSA-2014-0132-0061-A1<br>NHTSA-2014-0132-0074<br>NHTSA-2014-0132-0074-A1  |
| Behrendt, Diane                                   | EPA-HQ-OAR-2014-0827-0949<br>EPA-HQ-OAR-2014-0827-0949-A1  |
| Bendix Commercial Vehicle Systems, LLC            | EPA-HQ-OAR-2014-0827-1241<br>EPA-HQ-OAR-2014-0827-1241-A1  |
| BlueGreen Alliance                                | EPA-HQ-OAR-2014-0827-1246<br>EPA-HQ-OAR-2014-0827-1246-A1<br>EPA-HQ-OAR-2014-0827-1246-A2<br>NHTSA-2014-0132-0088<br>NHTSA-2014-0132-0088-A1   |

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| Business for Innovative Climate & Energy Policy | NHTSA-2014-0132-0095<br>NHTSA-2014-0132-0095-A1  |
| BYD Motors                                      | EPA-HQ-OAR-2014-0827-1182<br>EPA-HQ-OAR-2014-0827-1182-A1<br>NHTSA-2014-0132-0084<br>NHTSA-2014-0132-0084-A1   |
| California Air Resources Board (CARB)           | EPA-HQ-OAR-2014-0827-1265<br>EPA-HQ-OAR-2014-0827-1265-A1<br>EPA-HQ-OAR-2014-0827-1267<br>EPA-HQ-OAR-2014-0827-1267-A1<br>EPA-HQ-OAR-2014-0827-1267-A2<br>EPA-HQ-OAR-2014-0827-1268<br>EPA-HQ-OAR-2014-0827-1268-A1<br>EPA-HQ-OAR-2014-0827-1321<br>EPA-HQ-OAR-2014-0827-1321-A1<br>EPA-HQ-OAR-2014-0827-1321-A2<br>NHTSA-2014-0132-0091<br>NHTSA-2014-0132-0091-A1<br>NHTSA-2014-0132-0092<br>NHTSA-2014-0132-0092-A1<br>NHTSA-2014-0132-0093<br>NHTSA-2014-0132-0093-A1<br>NHTSA-2014-0132-0116<br>NHTSA-2014-0132-0116-A1<br>NHTSA-2014-0132-0116-A2<br>NHTSA-2014-0132-0125<br>NHTSA-2014-0132-0125-A1 |
| California Interfaith Power and Light           | EPA-HQ-OAR-2014-0827-0919<br>EPA-HQ-OAR-2014-0827-0919-A1<br>EPA-HQ-OAR-2014-0827-0919-A2  |
| California Trucking Association                 | EPA-HQ-OAR-2014-0827-1264<br>EPA-HQ-OAR-2014-0827-1264-A1  |
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| Capacity Trucks, Inc.                           | EPA-HQ-OAR-2014-0827-1303<br>EPA-HQ-OAR-2014-0827-1303-A1  |
| Caterpillar Inc                                 | EPA-HQ-OAR-2014-0827-1189<br>EPA-HQ-OAR-2014-0827-1189-A1  |
| Caterpillar Inc, et al.                         | EPA-HQ-OAR-2014-0827-1215<br>EPA-HQ-OAR-2014-0827-1215-A1  |

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| Center for Neighborhood Technology | EPA-HQ-OAR-2014-0827-0785    |
|                                    | EPA-HQ-OAR-2014-0827-0785-A1 |
| Chemours Company FC, LLC           | EPA-HQ-OAR-2014-0827-1231    |
|                                    | EPA-HQ-OAR-2014-0827-1231-A1 |
| City of Bloomington                | NHTSA-2014-0132-0060         |
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| City of Carmel, IN                 | EPA-HQ-OAR-2014-0827-0925    |
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| City of Lawrence, Indiana          | EPA-HQ-OAR-2014-0827-1226    |
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| City of South Bend, Indiana        | EPA-HQ-OAR-2014-0827-1009    |
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| City of West Hollywood             | NHTSA-2014-0132-0056         |
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| Clarke Power Services              | EPA-HQ-OAR-2014-0827-1005    |
|                                    | EPA-HQ-OAR-2014-0827-1005-A1 |
| Clean Fuels Ohio (CFO)             | EPA-HQ-OAR-2014-0827-1192    |
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| Cleantech San Diego                          | EPA-HQ-OAR-2014-0827-1234<br>EPA-HQ-OAR-2014-0827-1234-A1   |
| Climate 911                                  | EPA-HQ-OAR-2014-0827-1179<br>EPA-HQ-OAR-2014-0827-1179-A1   |
| Cline, C and J                               | EPA-HQ-OAR-2014-0827-0803<br>EPA-HQ-OAR-2014-0827-0803-A1<br>EPA-HQ-OAR-2014-0827-0803-A2   |
| Coalition on the Environment and Jewish Life | EPA-HQ-OAR-2014-0827-1249<br>EPA-HQ-OAR-2014-0827-1249-A1<br>EPA-HQ-OAR-2014-0827-1249-A2   |
| Competitive Enterprise Institute et al.      | EPA-HQ-OAR-2014-0827-1251<br>EPA-HQ-OAR-2014-0827-1251-A1<br>EPA-HQ-OAR-2014-0827-1251-A2   |
| Consumer Federation of America (CFA)         | EPA-HQ-OAR-2014-0827-1336<br>EPA-HQ-OAR-2014-0827-1336-A1   |
| Controlled Power Technologies, Inc.          | EPA-HQ-OAR-2014-0827-1307<br>EPA-HQ-OAR-2014-0827-1307-A1<br>EPA-HQ-OAR-2014-0827-1310<br>EPA-HQ-OAR-2014-0827-1310-A1<br>EPA-HQ-OAR-2014-0827-1313<br>EPA-HQ-OAR-2014-0827-1313-A1                       |
| Convoy Solutions LLC                         | EPA-HQ-OAR-2014-0827-1281<br>EPA-HQ-OAR-2014-0827-1281-A1   |
| Con-way Inc.                                 | EPA-HQ-OAR-2014-0827-0924<br>EPA-HQ-OAR-2014-0827-0924-A1   |
| Corwin, Michael                              | EPA-HQ-OAR-2014-0827-0730<br>EPA-HQ-OAR-2014-0827-0730-A1   |
| Cummins, Inc.                                | EPA-HQ-OAR-2014-0827-1298<br>EPA-HQ-OAR-2014-0827-1298-A1<br>EPA-HQ-OAR-2014-0827-1322<br>EPA-HQ-OAR-2014-0827-1322-A1<br>EPA-HQ-OAR-2014-0827-1322-A2<br>NHTSA-2014-0132-0110<br>NHTSA-2014-0132-0110-A1 |
| Daimler Trucks North America LLC             | EPA-HQ-OAR-2014-0827-1164<br>EPA-HQ-OAR-2014-0827-1164-A1<br>EPA-HQ-OAR-2014-0827-1340<br>EPA-HQ-OAR-2014-0827-1340-A1  |
| Dana Holding Corporation                     | EPA-HQ-OAR-2014-0827-1138<br>EPA-HQ-OAR-2014-0827-1138-A1   |
| Diesel 2 Gas, Inc.                           | EPA-HQ-OAR-2014-0827-1198   |

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| Diesel Technology Forum   | EPA-HQ-OAR-2014-0827-1171<br>EPA-HQ-OAR-2014-0827-1171-A1<br>EPA-HQ-OAR-2014-0827-1171-A2  |
| Doran Manufacturing   | EPA-HQ-OAR-2014-0827-1165<br>EPA-HQ-OAR-2014-0827-1165-A1  |
| Earth Day Coalition (EDC)   | EPA-HQ-OAR-2014-0827-1169<br>EPA-HQ-OAR-2014-0827-1169-A1  |
| East Yard Communities for Environmental Justice (EYCEJ)<br>Eaton Vehicle Group                  | EPA-HQ-OAR-2014-0827-0843<br><br>EPA-HQ-OAR-2014-0827-1194<br>EPA-HQ-OAR-2014-0827-1194-A1   |
| Edison Electric Institute   | EPA-HQ-OAR-2014-0827-1327<br>EPA-HQ-OAR-2014-0827-1327-A1<br>EPA-HQ-OAR-2014-0827-1327-A2  |
| Edison Solar Inc.   | EPA-HQ-OAR-2014-0827-1176<br>EPA-HQ-OAR-2014-0827-1176-A1  |
| Effenco Hybrid Solutions  | EPA-HQ-OAR-2014-0827-1148<br>EPA-HQ-OAR-2014-0827-1148-A1  |
| Electric Drive Transportation Association (EDTA)  | EPA-HQ-OAR-2014-0827-1217<br>EPA-HQ-OAR-2014-0827-1217-A1  |
| Energy Ohio Network   | EPA-HQ-OAR-2014-0827-1331<br>EPA-HQ-OAR-2014-0827-1331-A1  |
| Enevo Inc.<br>Engine Research Center  | EPA-HQ-OAR-2014-0827-1285<br>EPA-HQ-OAR-2014-0827-1141<br>EPA-HQ-OAR-2014-0827-1141-A1   |
| Enhanced Protective Glass Automotive Association (EPGAA)  | EPA-HQ-OAR-2014-0827-1024<br>EPA-HQ-OAR-2014-0827-1024-A1<br>NHTSA-2014-0132-0050<br>NHTSA-2014-0132-0050-A1   |
| Enovation Controls (ENC)  | EPA-HQ-OAR-2014-0827-1203<br>EPA-HQ-OAR-2014-0827-1203-A1<br>EPA-HQ-OAR-2014-0827-1247<br>EPA-HQ-OAR-2014-0827-1247-A1<br>EPA-HQ-OAR-2014-0827-1247-A2   |
| Environment America and other local citizens across America<br>Environmental Defense Fund (EDF) | EPA-HQ-OAR-2014-0827-1295<br>EPA-HQ-OAR-2014-0827-1295-A1<br><br>EPA-HQ-OAR-2014-0827-1312<br>EPA-HQ-OAR-2014-0827-1312-A1<br>EPA-HQ-OAR-2014-0827-1312-A2<br>EPA-HQ-OAR-2014-0827-1312-A3<br>EPA-HQ-OAR-2014-0827-1312-A4 |

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| E-ONE   | EPA-HQ-OAR-2014-0827-1185<br>EPA-HQ-OAR-2014-0827-1185-A1<br>EPA-HQ-OAR-2014-0827-1253<br>EPA-HQ-OAR-2014-0827-1253-A1  |
| EOS Climate   | EPA-HQ-OAR-2014-0827-1170<br>EPA-HQ-OAR-2014-0827-1170-A1   |
| Exa Corporation                                     | EPA-HQ-OAR-2014-0827-1328<br>EPA-HQ-OAR-2014-0827-1328-A1<br>EPA-HQ-OAR-2014-0827-1328-A2   |
| FedEx Corporation                                   | EPA-HQ-OAR-2014-0827-1302<br>EPA-HQ-OAR-2014-0827-1302-A1   |
| Fire Apparatus Manufacturers' Association<br>(FAMA) | EPA-HQ-OAR-2014-0827-1163<br>EPA-HQ-OAR-2014-0827-1163-A1   |
| First Industries Corporation                        | EPA-HQ-OAR-2014-0827-1143<br>EPA-HQ-OAR-2014-0827-1143-A1<br>EPA-HQ-OAR-2014-0827-1143-A2<br>EPA-HQ-OAR-2014-0827-1144<br>EPA-HQ-OAR-2014-0827-1144-A1<br>EPA-HQ-OAR-2014-0827-1144-A2<br>EPA-HQ-OAR-2014-0827-1145<br>EPA-HQ-OAR-2014-0827-1145-A1<br>EPA-HQ-OAR-2014-0827-1145-A2<br>EPA-HQ-OAR-2014-0827-1153<br>EPA-HQ-OAR-2014-0827-1153-A1<br>EPA-HQ-OAR-2014-0827-1178<br>EPA-HQ-OAR-2014-0827-1178-A1<br>EPA-HQ-OAR-2014-0827-1232<br>EPA-HQ-OAR-2014-0827-1232-A1<br>EPA-HQ-OAR-2014-0827-1288<br>EPA-HQ-OAR-2014-0827-1288-A1<br>EPA-HQ-OAR-2014-0827-1289<br>EPA-HQ-OAR-2014-0827-1289-A1<br>EPA-HQ-OAR-2014-0827-1294<br>EPA-HQ-OAR-2014-0827-1294-A1<br>EPA-HQ-OAR-2014-0827-1324<br>EPA-HQ-OAR-2014-0827-1324-A1<br>EPA-HQ-OAR-2014-0827-1324-A2<br>EPA-HQ-OAR-2014-0827-1339<br>EPA-HQ-OAR-2014-0827-1339-A1<br>EPA-HQ-OAR-2014-0827-1429<br>EPA-HQ-OAR-2014-0827-1429-A1<br>NHTSA-2014-0132-0066<br>NHTSA-2014-0132-0066-A1<br>NHTSA-2014-0132-0118<br>NHTSA-2014-0132-0118-A1<br>NHTSA-2014-0132-0123<br>NHTSA-2014-0132-0123-A1<br>NHTSA-2014-0132-0124 |



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| Gaines, Linda                          | EPA-HQ-OAR-2014-0827-1357<br>EPA-HQ-OAR-2014-0827-1357-A1   |
| GATR Truck Center                      | EPA-HQ-OAR-2014-0827-1010<br>EPA-HQ-OAR-2014-0827-1010-A1<br>EPA-HQ-OAR-2014-0827-1010-A2<br>NHTSA-2014-0132-0058<br>NHTSA-2014-0132-0058-A1        |
| GE Transportation                      | EPA-HQ-OAR-2014-0827-1297<br>EPA-HQ-OAR-2014-0827-1297-A1   |
| Genther, Inc.                          | EPA-HQ-OAR-2014-0827-1133<br>EPA-HQ-OAR-2014-0827-1133-A1   |
| GILLIG LLC                             | EPA-HQ-OAR-2014-0827-1156<br>EPA-HQ-OAR-2014-0827-1156-A1<br>NHTSA-2014-0132-0078<br>NHTSA-2014-0132-0078-A1  |
| Gilroy, JD<br>Great Dane               | EPA-HQ-OAR-2014-0827-0751<br>EPA-HQ-OAR-2014-0827-0907<br>EPA-HQ-OAR-2014-0827-0907-A1<br>EPA-HQ-OAR-2014-0827-1219<br>EPA-HQ-OAR-2014-0827-1219-A1 |
| Green Truck Association (GTA)          | EPA-HQ-OAR-2014-0827-1188<br>EPA-HQ-OAR-2014-0827-1188-A1   |
| Harrison Truck Centers                 | NHTSA-2014-0132-0059<br>NHTSA-2014-0132-0059-A1   |
| He, Leard, McConnell                   | NHTSA-2014-0132-0109<br>NHTSA-2014-0132-0109-A1<br>NHTSA-2014-0132-0115<br>NHTSA-2014-0132-0115-A1  |
| Honeywell Fluorine Products            | EPA-HQ-OAR-2014-0827-1191<br>EPA-HQ-OAR-2014-0827-1191-A1<br>EPA-HQ-OAR-2014-0827-1279<br>EPA-HQ-OAR-2014-0827-1279-A1                              |
| Honeywell Transportation System (HTS)  | EPA-HQ-OAR-2014-0827-1230<br>EPA-HQ-OAR-2014-0827-1230-A1   |
| Hoosier Environmental Council          | EPA-HQ-OAR-2014-0827-1245<br>EPA-HQ-OAR-2014-0827-1245-A1   |
| Houston-Galveston Area Council (H-GAC) | EPA-HQ-OAR-2014-0827-1142<br>EPA-HQ-OAR-2014-0827-1142-A1<br>EPA-HQ-OAR-2014-0827-1142-A2   |

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| Idle Smart   | EPA-HQ-OAR-2014-0827-1128<br>EPA-HQ-OAR-2014-0827-1128-A1<br>NHTSA-2014-0132-0064<br>NHTSA-2014-0132-0064-A1  |
| idleAIR  | EPA-HQ-OAR-2014-0827-1250<br>EPA-HQ-OAR-2014-0827-1250-A1<br>EPA-HQ-OAR-2014-0827-1250-A2<br>EPA-HQ-OAR-2014-0827-1308<br>EPA-HQ-OAR-2014-0827-1308-A1  |
| Innovus Enterprise LLC                               | EPA-HQ-OAR-2014-0827-1116<br>EPA-HQ-OAR-2014-0827-1116-A1<br>EPA-HQ-OAR-2014-0827-1119<br>EPA-HQ-OAR-2014-0827-1119-A1<br>EPA-HQ-OAR-2014-0827-1119-A2  |
| Institute for Policy Integrity                       | EPA-HQ-OAR-2014-0827-1296<br>EPA-HQ-OAR-2014-0827-1296-A1   |
| Institute for Policy Integrity at NYU School of Law  | EPA-HQ-OAR-2014-0827-1195<br>EPA-HQ-OAR-2014-0827-1195-A1   |
| International Council on Clean Transportation (ICCT) | EPA-HQ-OAR-2014-0827-1180<br>EPA-HQ-OAR-2014-0827-1180-A1<br>EPA-HQ-OAR-2014-0827-1180-A2<br>EPA-HQ-OAR-2014-0827-1180-A3<br>EPA-HQ-OAR-2014-0827-1180-A4<br>EPA-HQ-OAR-2014-0827-1180-A5<br>EPA-HQ-OAR-2014-0827-1180-A6<br>EPA-HQ-OAR-2014-0827-1180-A7<br>EPA-HQ-OAR-2014-0827-1180-A8<br>EPA-HQ-OAR-2014-0827-1180-A9<br>EPA-HQ-OAR-2014-0827-1180-A10<br>EPA-HQ-OAR-2014-0827-1180-A11<br>EPA-HQ-OAR-2014-0827-1180-A12<br>EPA-HQ-OAR-2014-0827-1180-A13<br>EPA-HQ-OAR-2014-0827-1180-A14<br>EPA-HQ-OAR-2014-0827-1180-A15<br>EPA-HQ-OAR-2014-0827-1180-A16<br>EPA-HQ-OAR-2014-0827-1180-A17<br>EPA-HQ-OAR-2014-0827-1180-A18<br>EPA-HQ-OAR-2014-0827-1180-A19<br>EPA-HQ-OAR-2014-0827-1180-A20<br>EPA-HQ-OAR-2014-0827-1180-A21<br>EPA-HQ-OAR-2014-0827-1180-A22<br>EPA-HQ-OAR-2014-0827-1180-A23<br>EPA-HQ-OAR-2014-0827-1180-A24<br>EPA-HQ-OAR-2014-0827-1180-A25<br>NHTSA-2014-0132-0083<br>NHTSA-2014-0132-0083-A1<br>NHTSA-2014-0132-0083-A2 |

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|   | NHTSA-2014-0132-0083-A3  |
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|   | NHTSA-2014-0132-0083-A23   |
|   | NHTSA-2014-0132-0083-A24   |
|   | NHTSA-2014-0132-0083-A25   |
| International Foodservice Distributors Association  | EPA-HQ-OAR-2014-0827-1258<br>EPA-HQ-OAR-2014-0827-1258-A1  |
| International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) | EPA-HQ-OAR-2014-0827-1248<br>EPA-HQ-OAR-2014-0827-1248-A1<br>EPA-HQ-OAR-2014-0827-1248-A2  |
| Investor Network on Climate Risk  | NHTSA-2014-0132-0113<br>NHTSA-2014-0132-0113-A1  |
| Isuzu Motors Limited  | EPA-HQ-OAR-2014-0827-1263<br>EPA-HQ-OAR-2014-0827-1263-A1  |
| Los Angeles Cleantech Incubator (LACI)  | EPA-HQ-OAR-2014-0827-1291<br>EPA-HQ-OAR-2014-0827-1291-A1  |
| Lubrizol Corporation  | EPA-HQ-OAR-2014-0827-1193<br>EPA-HQ-OAR-2014-0827-1193-A1<br>EPA-HQ-OAR-2014-0827-1325<br>EPA-HQ-OAR-2014-0827-1325-A1<br>NHTSA-2014-0132-0086<br>NHTSA-2014-0132-0086-A1<br>NHTSA-2014-0132-0120<br>NHTSA-2014-0132-0120-A1 |
| Mannix, Brian   | EPA-HQ-OAR-2014-0827-1222<br>EPA-HQ-OAR-2014-0827-1222-A1  |

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| Manufacturers of Emission Controls Association (MECA)                                      | EPA-HQ-OAR-2014-0827-1131<br>EPA-HQ-OAR-2014-0827-1131-A1<br>EPA-HQ-OAR-2014-0827-1210<br>EPA-HQ-OAR-2014-0827-1210-A1<br>EPA-HQ-OAR-2014-0827-1210-A2<br>EPA-HQ-OAR-2014-0827-1210-A3   |
| Mass Comment Campaign sponsored by anonymous 1 (email) - (23)                              | EPA-HQ-OAR-2014-0827-1341<br>EPA-HQ-OAR-2014-0827-1341-A1  |
| Mass Comment Campaign sponsored by Center for Biological Diversity (web) - (4,429)         | EPA-HQ-OAR-2014-0827-0914<br>EPA-HQ-OAR-2014-0827-0914-A1<br>EPA-HQ-OAR-2014-0827-1167<br>EPA-HQ-OAR-2014-0827-1167-A1   |
| Mass Comment Campaign sponsored by CREDO Action (web) - (56,914)                           | EPA-HQ-OAR-2014-0827-1117<br>EPA-HQ-OAR-2014-0827-1117-A1<br>EPA-HQ-OAR-2014-0827-1117-A2<br>EPA-HQ-OAR-2014-0827-1117-A3<br>EPA-HQ-OAR-2014-0827-1117-A4<br>EPA-HQ-OAR-2014-0827-1117-A5<br>EPA-HQ-OAR-2014-0827-1117-A6<br>EPA-HQ-OAR-2014-0827-1117-A7<br>EPA-HQ-OAR-2014-0827-1117-A8<br>EPA-HQ-OAR-2014-0827-1117-A9<br>EPA-HQ-OAR-2014-0827-1118<br>EPA-HQ-OAR-2014-0827-1118-A1<br>EPA-HQ-OAR-2014-0827-1118-A2<br>EPA-HQ-OAR-2014-0827-1118-A3<br>EPA-HQ-OAR-2014-0827-1118-A4<br>EPA-HQ-OAR-2014-0827-1118-A5<br>EPA-HQ-OAR-2014-0827-1118-A6 |
| Mass Comment Campaign sponsored by Environment America (email) - (20,229)                  | EPA-HQ-OAR-2014-0827-1227<br>EPA-HQ-OAR-2014-0827-1227-A1<br>EPA-HQ-OAR-2014-0827-1227-A2  |
| Mass Comment Campaign sponsored by Sierra Club (email) - (26,917)                          | EPA-HQ-OAR-2014-0827-0814<br>EPA-HQ-OAR-2014-0827-0814-A1  |
| Mass Comment Campaign sponsored by the Environmental Defense Fund (email) - (60,831)       | EPA-HQ-OAR-2014-0827-1229<br>EPA-HQ-OAR-2014-0827-1229-A1<br>EPA-HQ-OAR-2014-0827-1229-A2<br>EPA-HQ-OAR-2014-0827-1229-A3  |
| Mass Comment Campaign sponsored by The League of Conservation Voters (LCV) (web) - (6,603) | EPA-HQ-OAR-2014-0827-1228<br>EPA-HQ-OAR-2014-0827-1228-A1  |
| Mass Comment Campaign sponsored by the Pew Charitable Trusts (web) - (4,452)               | EPA-HQ-OAR-2014-0827-1252<br>EPA-HQ-OAR-2014-0827-1252-A1  |

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| Mass Comment Campaign sponsored by Union of Concerned Scientists (email) - (28,135) | EPA-HQ-OAR-2014-0827-0913<br>EPA-HQ-OAR-2014-0827-0913-A1   |
| Mazza & Sons, Inc.  | EPA-HQ-OAR-2014-0827-0915<br>EPA-HQ-OAR-2014-0827-0915-A1   |
| Meritor, Inc  | EPA-HQ-OAR-2014-0827-1254<br>EPA-HQ-OAR-2014-0827-1254-A1<br>NHTSA-2014-0132-0080<br>NHTSA-2014-0132-0080-A1<br>NHTSA-2014-0132-0082<br>NHTSA-2014-0132-0082-A1 |
| Michaels and Knappenberger  | EPA-HQ-OAR-2014-0827-1206<br>EPA-HQ-OAR-2014-0827-1206-A1   |
| Michelin North America, Inc.  | EPA-HQ-OAR-2014-0827-1224<br>EPA-HQ-OAR-2014-0827-1224-A1<br>EPA-HQ-OAR-2014-0827-1286<br>EPA-HQ-OAR-2014-0827-1286-A1  |
| Mississippi Furniture Xpress (MFX)  | EPA-HQ-OAR-2014-0827-1338<br>EPA-HQ-OAR-2014-0827-1338-A1<br>NHTSA-2014-0132-0122<br>NHTSA-2014-0132-0122-A1  |
| Momentum Wireless Power   | EPA-HQ-OAR-2014-0827-0755<br>EPA-HQ-OAR-2014-0827-0755-A1<br>EPA-HQ-OAR-2014-0827-0804<br>EPA-HQ-OAR-2014-0827-0804-A1<br>EPA-HQ-OAR-2014-0827-0804-A2          |
| Mondial Automotive  | EPA-HQ-OAR-2014-0827-1337<br>EPA-HQ-OAR-2014-0827-1337-A1<br>NHTSA-2014-0132-0114<br>NHTSA-2014-0132-0114-A1  |
| Motiv Power Systems   | EPA-HQ-OAR-2014-0827-1184<br>EPA-HQ-OAR-2014-0827-1184-A1   |
| Motor & Equipment Manufacturers Association (MEMA)                                  | EPA-HQ-OAR-2014-0827-1274<br>EPA-HQ-OAR-2014-0827-1274-A1   |
| Motorcycle Industry Council, Inc. (MIC)   | EPA-HQ-OAR-2014-0827-1158<br>EPA-HQ-OAR-2014-0827-1158-A1   |
| Moving Forward Network  | EPA-HQ-OAR-2014-0827-1130<br>EPA-HQ-OAR-2014-0827-1130-A1<br>EPA-HQ-OAR-2014-0827-1130-A2   |
| MPI Solar   | EPA-HQ-OAR-2014-0827-1473<br>EPA-HQ-OAR-2014-0827-1473-A1   |

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| NAFA Fleet Management Association  | EPA-HQ-OAR-2014-0827-0916<br>EPA-HQ-OAR-2014-0827-0916-A1<br>EPA-HQ-OAR-2014-0827-1011<br>EPA-HQ-OAR-2014-0827-1011-A1<br>NHTSA-2014-0132-0111<br>NHTSA-2014-0132-0111-A1  |
| National Association of Clean Air Agencies (NACAA)   | EPA-HQ-OAR-2014-0827-1157<br>EPA-HQ-OAR-2014-0827-1157-A1<br>NHTSA-2014-0132-0076<br>NHTSA-2014-0132-0076-A1   |
| National Association of Manufacturers (NAM)  | EPA-HQ-OAR-2014-0827-1323<br>EPA-HQ-OAR-2014-0827-1323-A1<br>EPA-HQ-OAR-2014-0827-1323-A2  |
| National Automobile Dealers Association (NADA)   | EPA-HQ-OAR-2014-0827-0807<br>EPA-HQ-OAR-2014-0827-0807-A1<br>EPA-HQ-OAR-2014-0827-0909<br>EPA-HQ-OAR-2014-0827-0909-A1<br>EPA-HQ-OAR-2014-0827-1309<br>EPA-HQ-OAR-2014-0827-1309-A1<br>NHTSA-2014-0132-0042<br>NHTSA-2014-0132-0042-A1 |
| National Biodiesel Board   | EPA-HQ-OAR-2014-0827-1240<br>EPA-HQ-OAR-2014-0827-1240-A1<br>NHTSA-2014-0132-0106<br>NHTSA-2014-0132-0106-A1   |
| National Propane Gas Association (NPGA)  | EPA-HQ-OAR-2014-0827-1272<br>EPA-HQ-OAR-2014-0827-1272-A1  |
| National Ready Mixed Concrete Association (NRMCA)  | EPA-HQ-OAR-2014-0827-1146<br>EPA-HQ-OAR-2014-0827-1146-A1  |
| National School Transportation Association (NSTA)  | EPA-HQ-OAR-2014-0827-1301<br>EPA-HQ-OAR-2014-0827-1301-A1  |
| National Tribal Air Association (NTAA)   | EPA-HQ-OAR-2014-0827-1316<br>EPA-HQ-OAR-2014-0827-1316-A1<br>EPA-HQ-OAR-2014-0827-1316-A2  |
| National Waste & Recycle Association   | NHTSA-2014-0132-0071<br>NHTSA-2014-0132-0071-A1  |
| National Zephyr Research, NZR Conversions and Equipment Sales, Inc.  | EPA-HQ-OAR-2014-0827-0947<br>EPA-HQ-OAR-2014-0827-0947-A1  |
| Natural Resources Defense Council (NRDC)   | EPA-HQ-OAR-2014-0827-1220<br>EPA-HQ-OAR-2014-0827-1220-A1  |
| Natural Resources Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD) | EPA-HQ-OAR-2014-0827-1305<br>EPA-HQ-OAR-2014-0827-1305-A1  |

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| Navistar, Inc.  | EPA-HQ-OAR-2014-0827-1199<br>EPA-HQ-OAR-2014-0827-1199-A1<br>EPA-HQ-OAR-2014-0827-1218<br>EPA-HQ-OAR-2014-0827-1218-A1<br>NHTSA-2014-0132-0094<br>NHTSA-2014-0132-0094-A1  |
| Navy  | EPA-HQ-OAR-2014-0827-1137<br>EPA-HQ-OAR-2014-0827-1137-A1  |
| Neapco  | EPA-HQ-OAR-2014-0827-1134<br>EPA-HQ-OAR-2014-0827-1134-A1<br>EPA-HQ-OAR-2014-0827-1150<br>EPA-HQ-OAR-2014-0827-1150-A1   |
| New Flyer of America Inc.                                     | EPA-HQ-OAR-2014-0827-1306<br>EPA-HQ-OAR-2014-0827-1306-A1  |
| Newell Coach Corporation                                      | EPA-HQ-OAR-2014-0827-1319<br>EPA-HQ-OAR-2014-0827-1319-A1  |
| NGV America   | EPA-HQ-OAR-2014-0827-1270<br>EPA-HQ-OAR-2014-0827-1270-A1<br>NHTSA-2014-0132-0096<br>NHTSA-2014-0132-0096-A1   |
| Nissan North America, Inc.                                    | EPA-HQ-OAR-2014-0827-1026<br>EPA-HQ-OAR-2014-0827-1026-A1<br>NHTSA-2014-0132-0053<br>NHTSA-2014-0132-0053-A1   |
| North American Die Casting Association (NADCA)                | EPA-HQ-OAR-2014-0827-1283<br>EPA-HQ-OAR-2014-0827-1283-A1  |
| Northeast States for Coordinated Air Use Management (NESCAUM) | EPA-HQ-OAR-2014-0827-1221<br>EPA-HQ-OAR-2014-0827-1221-A1  |
| Nuss Truck & Equipment of Minnesota and Wisconsin             | EPA-HQ-OAR-2014-0827-0918<br>EPA-HQ-OAR-2014-0827-0918-A1<br>EPA-HQ-OAR-2014-0827-0918-A2<br>EPA-HQ-OAR-2014-0827-0922<br>EPA-HQ-OAR-2014-0827-0922-A1<br>NHTSA-2014-0132-0054<br>NHTSA-2014-0132-0054-A1  |
| Odyne Systems LLC   | EPA-HQ-OAR-2014-0827-1239<br>EPA-HQ-OAR-2014-0827-1239-A1<br>EPA-HQ-OAR-2014-0827-1239-A2<br>EPA-HQ-OAR-2014-0827-1239-A3<br>EPA-HQ-OAR-2014-0827-1239-A4<br>EPA-HQ-OAR-2014-0827-1317<br>EPA-HQ-OAR-2014-0827-1317-A1<br>EPA-HQ-OAR-2014-0827-1317-A2 |

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| Ohio Environmental Council (OEC)                          | EPA-HQ-OAR-2014-0827-1174<br>EPA-HQ-OAR-2014-0827-1174-A1  |
| Ohio Sustainable Business Council (SBC)                   | EPA-HQ-OAR-2014-0827-1177<br>EPA-HQ-OAR-2014-0827-1177-A1  |
| Operation Free<br>Optimus Technologies                    | EPA-HQ-OAR-2014-0827-1175<br>EPA-HQ-OAR-2014-0827-1276<br>EPA-HQ-OAR-2014-0827-1276-A1   |
| Orange EV   | EPA-HQ-OAR-2014-0827-1135<br>EPA-HQ-OAR-2014-0827-1135-A1  |
| Oshkosh Corporation                                       | EPA-HQ-OAR-2014-0827-1162<br>EPA-HQ-OAR-2014-0827-1162-A1<br>EPA-HQ-OAR-2014-0827-1162-A2  |
| Owner-Operator Independent Drivers<br>Association (OOIDA) | EPA-HQ-OAR-2014-0827-0738<br>EPA-HQ-OAR-2014-0827-0738-A1<br>EPA-HQ-OAR-2014-0827-0806<br>EPA-HQ-OAR-2014-0827-0806-A1<br>EPA-HQ-OAR-2014-0827-1244<br>EPA-HQ-OAR-2014-0827-1244-A1<br>EPA-HQ-OAR-2014-0827-1244-A2<br>EPA-HQ-OAR-2014-0827-1244-A3<br>EPA-HQ-OAR-2014-0827-1244-A4<br>NHTSA-2014-0132-0016<br>NHTSA-2014-0132-0016-A1 |
| Ozone Transport Commission (OTC)                          | EPA-HQ-OAR-2014-0827-1211<br>EPA-HQ-OAR-2014-0827-1211-A1<br>EPA-HQ-OAR-2014-0827-1211-A2  |
| PACCAR, Inc.  | EPA-HQ-OAR-2014-0827-1204<br>EPA-HQ-OAR-2014-0827-1204-A1  |
| Parker Hannifin   | EPA-HQ-OAR-2014-0827-0725<br>EPA-HQ-OAR-2014-0827-0725-A1  |
| Pew Charitable Trusts                                     | EPA-HQ-OAR-2014-0827-1334<br>EPA-HQ-OAR-2014-0827-1334-A1  |
| Plant Oil Powered Diesel Fuel Systems                     | EPA-HQ-OAR-2014-0827-1125<br>EPA-HQ-OAR-2014-0827-1125-A1<br>EPA-HQ-OAR-2014-0827-1467<br>EPA-HQ-OAR-2014-0827-1467-A1<br>EPA-HQ-OAR-2014-0827-1467-A2   |
| Plastics Industry Trade Association (SPI)                 | EPA-HQ-OAR-2014-0827-1225<br>EPA-HQ-OAR-2014-0827-1225-A1  |
| Power Solutions International (PSI)                       | EPA-HQ-OAR-2014-0827-1161<br>EPA-HQ-OAR-2014-0827-1161-A1  |
| Proterra  | EPA-HQ-OAR-2014-0827-1160<br>EPA-HQ-OAR-2014-0827-1160-A1  |



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| Proventia Emission Control  | EPA-HQ-OAR-2014-0827-0811<br>EPA-HQ-OAR-2014-0827-0811-A1<br>NHTSA-2014-0132-0030<br>NHTSA-2014-0132-0030-A1   |
| Quantum Technologies  | EPA-HQ-OAR-2014-0827-1154<br>EPA-HQ-OAR-2014-0827-1154-A1  |
| Quasar Energy Group   | EPA-HQ-OAR-2014-0827-1335<br>EPA-HQ-OAR-2014-0827-1335-A1  |
| Recreational Vehicle Industry Association (RVIA)                  | EPA-HQ-OAR-2014-0827-1261<br>EPA-HQ-OAR-2014-0827-1261-A1<br>NHTSA-2014-0132-0090<br>NHTSA-2014-0132-0090-A1   |
| Reeves Brothers Trucking, Inc.                                    | EPA-HQ-OAR-2014-0827-1465<br>EPA-HQ-OAR-2014-0827-1465-A1<br>EPA-HQ-OAR-2014-0827-1465-A2  |
| Refrigerated Food Express Inc. et al.<br>Resources for the Future | EPA-HQ-OAR-2014-0827-1155<br>EPA-HQ-OAR-2014-0827-1200<br>EPA-HQ-OAR-2014-0827-1200-A1   |
| Robert Bosch LLC  | EPA-HQ-OAR-2014-0827-1466<br>EPA-HQ-OAR-2014-0827-1466-A1<br>EPA-HQ-OAR-2014-0827-1466-A2  |
| ROUSCH CleanTech  | EPA-HQ-OAR-2014-0827-1007<br>EPA-HQ-OAR-2014-0827-1007-A1<br>NHTSA-2014-0132-0052<br>NHTSA-2014-0132-0052-A1   |
| Rubber Manufacturers Association (RMA)                            | EPA-HQ-OAR-2014-0827-1304<br>EPA-HQ-OAR-2014-0827-1304-A1<br>NHTSA-2014-0132-0112<br>NHTSA-2014-0132-0112-A1   |
| SABIC Innovative Plastics US LLC                                  | EPA-HQ-OAR-2014-0827-1207<br>EPA-HQ-OAR-2014-0827-1207-A1  |
| Sanborn Head  | EPA-HQ-OAR-2014-0827-1257<br>EPA-HQ-OAR-2014-0827-1257-A1<br>EPA-HQ-OAR-2014-0827-1332<br>EPA-HQ-OAR-2014-0827-1332-A1                                 |
| Schneider National Inc  | EPA-HQ-OAR-2014-0827-1201<br>EPA-HQ-OAR-2014-0827-1201-A1<br>EPA-HQ-OAR-2014-0827-1318<br>EPA-HQ-OAR-2014-0827-1318-A1<br>EPA-HQ-OAR-2014-0827-1318-A2 |
| School Bus Manufacturers Technical Council                        | EPA-HQ-OAR-2014-0827-1287<br>EPA-HQ-OAR-2014-0827-1287-A1  |

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| Securing America's Future Energy                     | EPA-HQ-OAR-2014-0827-1282<br>EPA-HQ-OAR-2014-0827-1282-A1<br>EPA-HQ-OAR-2014-0827-1462<br>EPA-HQ-OAR-2014-0827-1462-A1                                    |
| Shahed, SM   | NHTSA-2014-0132-0033<br>NHTSA-2014-0132-0033-A1   |
| Sierra Club  | EPA-HQ-OAR-2014-0827-1277<br>EPA-HQ-OAR-2014-0827-1277-A1   |
| Solar Provider Group                                 | EPA-HQ-OAR-2014-0827-1235<br>EPA-HQ-OAR-2014-0827-1235-A1   |
| South Coast Air Quality Management District (SCAQMD) | EPA-HQ-OAR-2014-0827-1181<br>EPA-HQ-OAR-2014-0827-1181-A1   |
| Specialty Equipment Market Association (SEMA)        | EPA-HQ-OAR-2014-0827-1469<br>EPA-HQ-OAR-2014-0827-1469-A1<br>EPA-HQ-OAR-2014-0827-1469-A2<br>EPA-HQ-OAR-2014-0827-1469-A3<br>EPA-HQ-OAR-2014-0827-1469-A4 |
| Steady State Supply                                  | EPA-HQ-OAR-2014-0827-1333<br>EPA-HQ-OAR-2014-0827-1333-A1   |
| STEMCO   | EPA-HQ-OAR-2014-0827-1259<br>EPA-HQ-OAR-2014-0827-1259-A1   |
| Stoughton Trailers                                   | EPA-HQ-OAR-2014-0827-1212<br>EPA-HQ-OAR-2014-0827-1212-A1<br>EPA-HQ-OAR-2014-0827-1212-A2   |
| Structural Composites, Inc. and Compsys, Inc.        | EPA-HQ-OAR-2014-0827-1205<br>EPA-HQ-OAR-2014-0827-1205-A1   |
| Thermo King  | EPA-HQ-OAR-2014-0827-1196<br>EPA-HQ-OAR-2014-0827-1196-A1   |
| Tiffin Motorhomes, Inc.                              | NHTSA-2014-0132-0099<br>NHTSA-2014-0132-0099-A1   |
| TireStamp, Inc.                                      | EPA-HQ-OAR-2014-0827-1255<br>EPA-HQ-OAR-2014-0827-1255-A1<br>NHTSA-2014-0132-0081<br>NHTSA-2014-0132-0081-A1  |
| Transportation Power                                 | EPA-HQ-OAR-2014-0827-1149<br>EPA-HQ-OAR-2014-0827-1149-A1   |
| Triple Decker Transport Ltd.                         | EPA-HQ-OAR-2014-0827-0908<br>EPA-HQ-OAR-2014-0827-0908-A1   |
| Truck & Engine Manufacturers Association (EMA)       | EPA-HQ-OAR-2014-0827-1269<br>EPA-HQ-OAR-2014-0827-1269-A1   |
| Truck Country of Wisconsin                           | EPA-HQ-OAR-2014-0827-1468<br>EPA-HQ-OAR-2014-0827-1468-A1   |

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| Truck Renting and Leasing Association          | EPA-HQ-OAR-2014-0827-1140<br>EPA-HQ-OAR-2014-0827-1140-A1<br>NHTSA-2014-0132-0062<br>NHTSA-2014-0132-0062-A1  |
| Truck Trailer Manufacturers Association (TTMA) | EPA-HQ-OAR-2014-0827-0727<br>EPA-HQ-OAR-2014-0827-0727-A1<br>EPA-HQ-OAR-2014-0827-0742<br>EPA-HQ-OAR-2014-0827-0747<br>EPA-HQ-OAR-2014-0827-1172<br>EPA-HQ-OAR-2014-0827-1172-A1<br>NHTSA-2014-0132-0012<br>NHTSA-2014-0132-0012-A1 |
| Union of Concerned Scientists (UCS)            | EPA-HQ-OAR-2014-0827-1329<br>EPA-HQ-OAR-2014-0827-1329-A1<br>EPA-HQ-OAR-2014-0827-1329-A2   |
| United Parcel Service (UPS)                    | EPA-HQ-OAR-2014-0827-0917<br>EPA-HQ-OAR-2014-0827-0917-A1<br>EPA-HQ-OAR-2014-0827-1262<br>EPA-HQ-OAR-2014-0827-1262-A1<br>NHTSA-2014-0132-0036<br>NHTSA-2014-0132-0036-A1   |
| Utility Trailer Manufacturing Company          | EPA-HQ-OAR-2014-0827-1183<br>EPA-HQ-OAR-2014-0827-1183-A1<br>EPA-HQ-OAR-2014-0827-1213<br>EPA-HQ-OAR-2014-0827-1213-A1<br>EPA-HQ-OAR-2014-0827-1213-A2<br>NHTSA-2014-0132-0085<br>NHTSA-2014-0132-0085-A1                           |
| VNG  | EPA-HQ-OAR-2014-0827-1208<br>EPA-HQ-OAR-2014-0827-1208-A1   |
| Volvo Group                                    | EPA-HQ-OAR-2014-0827-1290<br>EPA-HQ-OAR-2014-0827-1290-A1   |
| Wabash National Corporation                    | EPA-HQ-OAR-2014-0827-1242<br>EPA-HQ-OAR-2014-0827-1242-A1<br>EPA-HQ-OAR-2014-0827-1242-A2<br>EPA-HQ-OAR-2014-0827-1242-A3<br>EPA-HQ-OAR-2014-0827-1242-A4   |
| Walmart Transportation                         | NHTSA-2014-0132-0117<br>NHTSA-2014-0132-0117-A1   |
| Walsh, Michael and Charlton, Stephen           | NHTSA-2014-0132-0102<br>NHTSA-2014-0132-0102-A1   |

Waste Management (WM)

EPA-HQ-OAR-2014-0827-1214  
EPA-HQ-OAR-2014-0827-1214-A1  
EPA-HQ-OAR-2014-0827-1214-A2  
EPA-HQ-OAR-2014-0827-1256  
EPA-HQ-OAR-2014-0827-1256-A1

Werner Enterprises

EPA-HQ-OAR-2014-0827-1236  
EPA-HQ-OAR-2014-0827-1236-A1

Worldwide Equipment Enterprises, Inc.

EPA-HQ-OAR-2014-0827-0948  
EPA-HQ-OAR-2014-0827-0948-A1  
EPA-HQ-OAR-2014-0827-0948-A2

Zero Truck

EPA-HQ-OAR-2014-0827-1292  
EPA-HQ-OAR-2014-0827-1292-A1

## List of Acronyms

|         |  |
|---------|--|
| µg      | Microgram  |
| µm      | Micrometers  |
| 2002\$  | U.S. Dollars in calendar year 2002                   |
| 2009\$  | U.S. Dollars in calendar year 2009                   |
| A/C     | Air Conditioning                                     |
| ABS     | Antilock Brake Systems                               |
| ABT     | Averaging, Banking and Trading                       |
| AC      | Alternating Current                                  |
| ACES    | Advanced Collaborative Emission Study                |
| ALVW    | Adjusted Loaded Vehicle Weight                       |
| AEO     | Annual Energy Outlook                                |
| AES     | Automatic Engine Shutdown                            |
| AHS     | American Housing Survey                              |
| AMOC    | Atlantic Meridional Overturning Circulation          |
| AMT     | Automated Manual Transmission                        |
| ANL     | Argonne National Laboratory                          |
| APU     | Auxiliary Power Unit                                 |
| AQ      | Air Quality  |
| AQCD    | Air Quality Criteria Document                        |
| AR4     | Fourth Assessment Report                             |
| ARB     | California Air Resources Board                       |
| ASL     | Aggressive Shift Logic                               |
| ASPEN   | Assessment System for Population Exposure Nationwide |
| AT      | Automatic Transmissions                              |
| ATA     | American Trucking Association                        |
| ATIS    | Automated Tire Inflation System                      |
| ATRI    | Alliance for Transportation Research Institute       |
| ATSDR   | Agency for Toxic Substances and Disease Registry     |
| ATUS    | American Time Use Survey                             |
| Avg     | Average  |
| BAC     | Battery Air Conditioning                             |
| BenMAP  | Benefits Mapping and Analysis Program                |
| bhp     | Brake Horsepower                                     |
| bhp-hrs | Brake Horsepower Hours                               |
| BLS     | Bureau of Labor Statistics                           |
| BSFC    | Brake Specific Fuel Consumption                      |
| BTS     | Bureau of Transportation Statistics                  |
| BTU     | British Thermal Unit                                 |
| CAA     | Clean Air Act  |
| CAAA    | Clean Air Act Amendments                             |
| CAD/CAE | Computer Aided Design And Engineering                |

|                    |   |
|--------------------|---|
| CAE                | Computer Aided Engineering                      |
| CAFE               | Corporate Average Fuel Economy                  |
| CARB               | California Air Resources Board                  |
| CBI                | Confidential Business Information               |
| CCP                | Coupled Cam Phasing                             |
| CCSP               | Climate Change Science Program                  |
| Cd                 | Coefficient of Drag                             |
| $C_dA$             | Drag Area                                       |
| CDC                | Centers for Disease Control                     |
| CFD                | Computational Fluid Dynamics                    |
| CFR                | Code of Federal Regulations                     |
| CH <sub>4</sub>    | Methane   |
| CILCC              | Combined International Local and Commuter Cycle |
| CITT               | Chemical Industry Institute of Toxicology       |
| CMAQ               | Community Multiscale Air Quality                |
| CO                 | Carbon Monoxide                                 |
| CO <sub>2</sub>    | Carbon Dioxide                                  |
| CO <sub>2</sub> eq | CO <sub>2</sub> Equivalent                      |
| COFC               | Container-on-Flatcar                            |
| COI                | Cost of Illness                                 |
| COPD               | Chronic Obstructive Pulmonary Disease           |
| CoV                | Coefficient of Variation                        |
| CPS                | Cam Profile Switching                           |
| CRC                | Coordinating Research Council                   |
| CRGNSA             | Columbia River Gorge National Scenic Area       |
| CRR                | Rolling Resistance Coefficient                  |
| CS                 | Climate Sensitivity                             |
| CSI                | Cambridge Systematics Inc.                      |
| CSS                | Coastal Sage Scrub                              |
| CSV                | Comma-separated Values                          |
| CVD                | Cardiovascular Disease                          |
| CVT                | Continuously-Variable Transmission              |
| CW                 | Curb Weight                                     |
| D/UAF              | Downward and Upward Adjustment Factor           |
| DCP                | Dual Cam Phasing                                |
| DCT                | Dual Clutch Transmission                        |
| DE                 | Diesel Exhaust                                  |
| DEAC               | Cylinder Deactivation                           |
| DEER               | Diesel Engine-Efficiency and Emissions Research |
| DEF                | Diesel Exhaust Fluid                            |
| DHHS               | U.S. Department of Health and Human Services    |
| Diesel HAD         | Diesel Health Assessment Document               |
| DMC                | Direct Manufacturing Costs                      |

|            |   |
|------------|---|
| DO         | Dissolved Oxygen  |
| DOC        | Diesel Oxidation Catalyst   |
| DOD        | Department of Defense   |
| DOE        | Department of Energy  |
| DOHC       | Dual Overhead Camshaft Engines  |
| DOT        | Department of Transportation  |
| DPF        | Diesel Particulate Filter   |
| DPM        | Diesel Particulate Matter   |
| DR         | Discount Rate   |
| DRIA       | Draft Regulatory Impact Analysis  |
| DVVL       | Discrete Variable Valve Lift  |
| EC         | European Commission   |
| EC         | Elemental Carbon  |
| ECU        | Electronic Control Unit   |
| ED         | Emergency Department  |
| EERA       | Energy and Environmental Research Associates                              |
| EFR        | Engine Friction Reduction   |
| EGR        | Exhaust Gas Recirculation   |
| EHPS       | Electrohydraulic Power Steering   |
| EIA        | Energy Information Administration (part of the U.S. Department of Energy) |
| EISA       | Energy Independence and Security Act                                      |
| EMS-HAP    | Emissions Modeling System for Hazardous Air Pollution                     |
| EO         | Executive Order   |
| EPA        | Environmental Protection Agency   |
| EPS        | Electric Power Steering   |
| ERG        | Eastern Research Group  |
| ESC        | Electronic Stability Control  |
| EV         | Electric Vehicle  |
| F          | Frequency   |
| FEL        | Family Emission Limit   |
| FET        | Federal Excise Tax  |
| FEV1       | Functional Expiratory Volume  |
| FHWA       | Federal Highway Administration  |
| FIA        | Forest Inventory and Analysis   |
| FMCSA      | Federal Motor Carrier Safety Administration                               |
| FOH        | Fuel Operated Heater  |
| FR         | Federal Register  |
| FTP        | Federal Test Procedure  |
| FVC        | Forced Vital Capacity   |
| g          | Gram  |
| g/s        | Gram-per-second   |
| g/ton-mile | Grams emitted to move one ton (2000 pounds) of freight over one mile      |
| gal        | Gallon  |

|                   |  |
|-------------------|--|
| gal/1000 ton-mile | Gallons of fuel used to move one ton of payload (2,000 pounds) over 1000 miles |
| GCAM              | Global Change Assessment Model   |
| GCW               | Gross Combined Weight  |
| GDP               | Gross Domestic Product   |
| GEM               | Greenhouse gas Emissions Model   |
| GEOS              | Goddard Earth Observing System   |
| GHG               | Greenhouse Gases   |
| GIFT              | Geospatial Intermodal Freight Transportation                                   |
| GREET             | Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation        |
| GSF1              | Generic Speed Form one   |
| GUI               | Graphical User Interface   |
| GVWR              | Gross Vehicle Weight Rating  |
| GWP               | Global Warming Potential   |
| HABs              | Harmful Algal Blooms   |
| HAD               | Diesel Health Assessment Document  |
| HC                | Hydrocarbon  |
| HD                | Heavy-Duty   |
| HDUDDS            | Heavy Duty Urban Dynamometer Driving Cycle                                     |
| HEG               | High Efficiency Gearbox  |
| HEI               | Health Effects Institute   |
| HES               | Health Effects Subcommittee  |
| HEV               | Hybrid Electric Vehicle  |
| HFC               | Hydrofluorocarbon  |
| HFET              | Highway Fuel Economy Dynamometer Procedure                                     |
| HHD               | Heavy Heavy-Duty   |
| HHDDT             | Highway Heavy-Duty Diesel Transient  |
| hp                | Horsepower   |
| hrs               | Hours  |
| HRV               | Heart Rate Variability   |
| HSC               | High Speed Cruise Duty Cycle   |
| HTUF              | Hybrid Truck User Forum  |
| hz                | Hertz  |
| IARC              | International Agency for Research on Cancer                                    |
| IATC              | Improved Automatic Transmission Control  |
| IC                | Indirect Costs   |
| ICCT              | International Council on Clean Transport                                       |
| ICD               | International Classification of Diseases                                       |
| ICF               | ICF International  |
| ICM               | Indirect Cost Multiplier   |
| ICP               | Intake Cam Phasing   |
| IMAC              | Improved Mobile Air Conditioning   |
| IMPROVE           | Interagency Monitoring of Protected Visual Environments                        |



|                |   |
|----------------|---|
| IPCC           | Intergovernmental Panel on Climate Change                         |
| IRFA           | Initial Regulatory Flexibility Analysis                           |
| IRIS           | Integrated Risk Information System                                |
| ISA            | Integrated Science Assessment                                     |
| JAMA           | Journal of the American Medical Association                       |
| k              | Thousand  |
| kg             | Kilogram  |
| KI             | kinetic intensity   |
| km             | Kilometer   |
| km/h           | Kilometers per Hour   |
| kW             | Kilowatt  |
| L              | Liter   |
| lb             | Pound   |
| LD             | Light-Duty  |
| LHD            | Light Heavy-Duty  |
| LLNL           | Lawrence Livermore National Laboratory's                          |
| LRR            | Lower Rolling Resistance  |
| LSC            | Low Speed Cruise Duty Cycle                                       |
| LT             | Light Trucks  |
| LTCCS          | Large Truck Crash Causation Study                                 |
| LUB            | Low Friction Lubes  |
| LUC            | Land Use Change   |
| m <sup>2</sup> | Square Meters   |
| m <sup>3</sup> | Cubic Meters  |
| MAGICC         | Model for the Assessment of Greenhouse-gas Induced Climate Change |
| MCF            | Mixed Conifer Forest  |
| MD             | Medium-Duty   |
| MDPV           | Medium-Duty Passenger Vehicles                                    |
| mg             | Milligram   |
| MHD            | Medium Heavy-Duty   |
| MHEV           | Mild Hybrid   |
| mi             | mile  |
| min            | Minute  |
| MM             | Million   |
| MMBD           | Million Barrels per Day   |
| MMT            | Million Metric Tons   |
| MOVES          | Motor Vehicle Emissions Simulator                                 |
| mpg            | Miles per Gallon  |
| mph            | Miles per Hour  |
| MSAT           | Mobile Source Air Toxic   |
| MRL            | Minimal Risk Level  |
| MT             | Manual Transmission   |
| MY             | Model Year  |

|                  |   |
|------------------|---|
| N <sub>2</sub> O | Nitrous Oxide   |
| NA               | Not Applicable  |
| NAAQS            | National Ambient Air Quality Standards                    |
| NAFA             | National Association of Fleet Administrators              |
| NAICS            | North American Industry Classification System             |
| NAS              | National Academy of Sciences                              |
| NATA             | National Air Toxic Assessment                             |
| NCAR             | National Center for Atmospheric Research                  |
| NCI              | National Cancer Institute                                 |
| NCLAN            | National Crop Loss Assessment Network                     |
| NEC              | Net Energy Change Tolerance                               |
| NEI              | National Emissions Inventory                              |
| NEMS             | National Energy Modeling System                           |
| NEPA             | National Environmental Policy Act                         |
| NESCAUM          | Northeastern States for Coordinated Air Use Management    |
| NESCCAF          | Northeast States Center for a Clean Air Future            |
| NESHAP           | National Emissions Standards for Hazardous Air Pollutants |
| NHS              | National Highway System                                   |
| NHTSA            | National Highway Traffic Safety Administration            |
| NiMH             | Nickel Metal-Hydride                                      |
| NIOSH            | National Institute of Occupational Safety and Health      |
| Nm               | Newton-meters   |
| NMHC             | Nonmethane Hydrocarbons                                   |
| NMMAFS           | National Morbidity, Mortality, and Air Pollution Study    |
| NO <sub>x</sub>  | Nitrogen Oxide  |
| NO <sub>2</sub>  | Nitrogen Dioxide  |
| NOAA             | National Oceanic and Atmospheric Administration           |
| NO <sub>x</sub>  | Oxides of Nitrogen  |
| NPRM             | Notice of Proposed Rulemaking                             |
| NPV              | Net Present Value   |
| NRC              | National Research Council                                 |
| NRC-CAN          | National Research Council of Canada                       |
| NREL             | National Renewable Energy Laboratory                      |
| NTP              | National Toxicology Program                               |
| NVH              | Noise Vibration and Harshness                             |
| O&M              | Operating and maintenance                                 |
| O <sub>3</sub>   | Ozone   |
| OAQPS            | Office of Air Quality Planning and Standards              |
| OC               | Organic Carbon  |
| OE               | Original Equipment  |
| OEHHA            | Office of Environmental Health Hazard Assessment          |
| OEM              | Original Equipment Manufacturer                           |
| OHV              | Overhead Valve  |

|                   |   |
|-------------------|---|
| OMB               | Office of Management and Budget                       |
| OPEC              | Organization of Petroleum Exporting Countries         |
| ORD               | EPA's Office of Research and Development              |
| ORNL              | Oak Ridge National Laboratory                         |
| OTAQ              | Office of Transportation and Air Quality              |
| Pa                | Pascal  |
| PAH               | Polycyclic Aromatic Hydrocarbons                      |
| PEF               | Peak Expiratory Flow                                  |
| PEMS              | Portable Emissions Monitoring System                  |
| PGM               | Platinum Group Metal                                  |
| PHEV              | Plug-in Hybrid Electric Vehicles                      |
| PM                | Particulate Matter                                    |
| PM <sub>10</sub>  | Coarse Particulate Matter (diameter of 10 µm or less) |
| PM <sub>2.5</sub> | Fine Particulate Matter (diameter of 2.5 µm or less)  |
| POM               | Polycyclic Organic Matter                             |
| Ppb               | Parts per Billion                                     |
| Ppm               | Parts per Million                                     |
| Psi               | Pounds per Square Inch                                |
| PTO               | Power Take Off  |
| R&D               | Research and Development                              |
| RBM               | Resisting Bending Moment                              |
| REL               | Reference Exposure Level                              |
| RESS              | Rechargeable Energy Storage System                    |
| RFA               | Regulatory Flexibility Act                            |
| RfC               | Reference Concentration                               |
| RFS2              | Renewable Fuel Standard 2                             |
| RIA               | Regulatory Impact Analysis                            |
| RPE               | Retail Price Equivalent                               |
| Rpm               | Revolutions per Minute                                |
| RSWT              | Reduced-Scale Wind Tunnel                             |
| S                 | Second  |
| SAB               | Science Advisory Board                                |
| SAB-HES           | Science Advisory Board - Health Effects Subcommittee  |
| SAE               | Society of Automotive Engineers                       |
| SAR               | Second Assessment Report                              |
| SAV               | Submerged Aquatic Vegetation                          |
| SBA               | Small Business Administration                         |
| SBAR              | Small Business Advocacy Review                        |
| SBREFA            | Small Business Regulatory Enforcement Fairness Act    |
| SCC               | Social Cost of Carbon                                 |
| SCR               | Selective Catalyst Reduction                          |
| SER               | Small Entity Representation                           |
| SET               | Supplemental Emission Test                            |

|                 |  |
|-----------------|--|
| SGDI            | Stoichiometric Gasoline Direct Injection       |
| SHEV            | Strong Hybrid Vehicles                         |
| SI              | Spark-Ignition                                 |
| SIDI            | Spark Ignition Direct Injection                |
| SO <sub>2</sub> | Sulfur Dioxide                                 |
| SO <sub>x</sub> | Sulfur Oxides                                  |
| SOA             | Secondary Organic Aerosol                      |
| SOC             | State of Charge                                |
| SOHC            | Single Overhead Cam                            |
| SO <sub>x</sub> | Oxides of Sulfur                               |
| SPR             | Strategic Petroleum Reserve                    |
| STB             | Surface Transportation Board                   |
| Std.            | Standard                                       |
| STP             | Scaled Tractive Power                          |
| SUV             | Sport Utility Vehicle                          |
| SVOC            | Semi-Volatile Organic Compound                 |
| SwRI            | Southwest Research Institute                   |
| TAR             | Technical Assessment Report                    |
| TC              | Total Costs                                    |
| TCp             | Total Cost package                             |
| TDS             | Turbocharging And Downsizing                   |
| THC             | Total Hydrocarbon                              |
| TIAX            | TIAX LLC                                       |
| TMC             | Technology & Maintenance Council               |
| TOFC            | Trailer-on-Flatcar                             |
| Ton-mile        | One ton (2000 pounds) of payload over one mile |
| TPM             | Tire Pressure Monitoring                       |
| TRBDS           | Turbocharging and Downsizing                   |
| TRU             | Trailer Refrigeration Unit                     |
| TSD             | Technical Support Document                     |
| TSS             | Thermal Storage                                |
| TTMA            | Truck Trailer Manufacturers Association        |
| TW              | Test Weight                                    |
| U/DAF           | Upward and Downward Adjustment Factor          |
| UCT             | Urban Creep and Transient Duty Cycle           |
| UFP             | Ultra Fine Particles                           |
| URE             | Unit Risk Estimate                             |
| USDA            | United States Department of Agriculture        |
| USGCRP          | United States Global Change Research Program   |
| UV              | Ultraviolet                                    |
| UV-b            | Ultraviolet-b                                  |
| VHHD            | Vocational Heavy Heavy-Duty                    |
| VIN             | Vehicle Identification Number                  |

|       |  |
|-------|--|
| VIUS  | Vehicle Inventory Use Survey                     |
| VLHD  | Vocational Light Heavy-Duty                      |
| VMHD  | Vocational Medium Heavy-Duty                     |
| VMT   | Vehicle Miles Traveled                           |
| VOC   | Volatile Organic Compound                        |
| VSL   | Vehicle Speed Limiter                            |
| VTRIS | Vehicle Travel Information System                |
| VVL   | Variable Valve Lift                              |
| VVT   | Variable Valve Timing                            |
| WACAP | Western Airborne Contaminants Assessment Project |
| WBS   | Wide Base Singles                                |
| WHR   | Waste Heat Recovery                              |
| WHTC  | World Harmonized Transient Cycle                 |
| WHVC  | World Harmonized Vehicle Cycle                   |
| WRF   | Weather Research Forecasting                     |
| WTP   | Willingness-to-Pay                               |
| WTVC  | World Wide Transient Vehicle Cycle               |
| WVU   | West Virginia University                         |

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# 1 General Comments 1

## 1.1 General Comments on the Proposed Phase 2 Program

The following comments relate in general to the Notice of Proposed Rulemaking (NPRM). The comments in this chapter are not on any specific aspect of the proposed rule; rather, they are directed to the general substance of the proposal. Responses to more detailed comments on specific provisions of the proposal can be found in later chapters of this joint Response to Comments (RTC), as well as the FRM Preamble, and the Regulatory Impact Analysis (RIA). For more information on the proposed rule, see the Federal Register at 80 FR 40138, published on July 13, 2015. The public comments submitted on this rule can be viewed online at [www.regulations.gov](http://www.regulations.gov) (the public docket for this rulemaking are docket number EPA-HQ-OAR-2014-0827 and NHTSA-2014-0132).

We received a large number of comments on the Phase 2 NPRM, and even in their general comments many stakeholders expressed concerns with very specific aspects of the program. In responding comments about the general substance of the program below, we have categorized these comments into four broad categories: comments that generally support the Phase 2 program, comments that support the goals of the Phase 2 program but with concerns about specific aspects of the proposal, comments that generally call for stronger standards, and comments that generally call for no regulation or that question the need for Phase 2 GHG/fuel efficiency standards. While some comments are applicable to more than one category, we considered each comment's overall message in associating one commenter per category. Comments made on specific aspects of the Phase 2 program are responded to according to topic in the later chapters of this document.

### **Comments that Generally Support the Phase 2 Program**

American Chemistry Council (ACC)  
Barcode Technology Solutions  
Burger, Mark  
City of Bloomington  
City of Lawrence, Indiana  
City of Carmel, IN  
City of South Bend, Indiana  
Clean Energy  
Clean Fuels Ohio (CFO)  
Cleantech San Diego  
Diaz, Miguel  
Earth Day Coalition (EDC)  
Edison Solar Inc.  
Energy Ohio Network  
Enevo Inc.  
Hoosier Environmental Council  
League of Women Voters of Los Angeles County  
Los Angeles Cleantech Incubator (LACI)  
Mazza & Sons, Inc.  
Midwest Truckers Association  
Momentum Wireless Power  
MPI Solar  
National Tribal Air Association (NTAA)

Ohio Environmental Council (OEC)  
Ohio Sustainable Business Council (SBC)  
PepsiCo  
Pew Charitable Trusts  
Quasar Energy Group  
Refrigerated Food Express Inc. et al.  
Sanborn Head  
Solar Provider Group  
Steady State Supply  
Walmart Transportation  
Zero Truck

**Comments that Generally Support the Goals of the Phase 2 Program but with Detailed Concerns about Specific Aspects of the Proposal**

Alcoa  
Allison Transmissions, Inc.  
American Automotive Policy Council (AAPA)  
Autocar, LLC  
American Council for an Energy-Efficient Economy (ACEEE)  
American Gas Association (AGA) et al.  
BYD Motors  
California Air Resources Board (CARB)  
Convoy Solutions LLC (related to Idle Air)  
CALSTART  
Center for Biological Diversity  
Consumer Federation of America (CFA)  
Cummins, Inc.  
Daimler Trucks North America, LLC, Detroit Diesel Corporation, Mercedes Benz USA  
Dana Holding Corporation  
Electric Drive Transportation Association (EDTA)  
Environmental Defense Fund (EDF)  
FCA US, LLC  
Fire Apparatus Manufacturers' Association (FAMA)  
Ford Motor Company  
GILLIG LLC  
Honeywell Transportation System (HTS)  
Hino Motors, Ltd.  
International Council on Clean Transportation (ICCT)  
Idle Smart  
IdleAIR  
International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)  
Isuzu Motors Limited  
Meritor, Inc  
Oshkosh Corporation  
Lubrizol Corporation  
NAFA Fleet Management Association  
National Association of Clean Air Agencies (NACAA)  
National Association of Manufacturers (NAM)  
Natural Resources Defense Council (NRDC)  
Navistar, Inc.



New Flyer of America Inc.  
NGVAmerica  
Northeast States for Coordinated Air Use Management (NESCAUM)  
Odyne Systems LLC  
Optimus Technologies  
PACCAR, Inc.  
Parker Hannifin  
Rubber Manufacturers Association (RMA)  
ROUSCH CleanTech  
Securing America's Future Energy  
Sierra Club  
SmartTruck  
Thermo King  
Truck & Engine Manufacturers Association (EMA)  
Truck Renting and Leasing Association  
Union of Concerned Scientists (UCS)  
United Parcel Service (UPS)  
Volvo Group  
Wabash National Corporation  
Waste Management (WM)  
Werner Enterprises  
XL Hybrids

**Comments that Generally Call for More Stringent Standards**

Achates Power, et al.  
Advanced Engine System Institute (AESI)  
American Lung Association  
Amy's Kitchen et al.  
Bay Area Air Quality Management District (BAAQMD)  
Business for Innovative Climate & Energy Policy  
California State Senator Ricardo Lara  
California Interfaith Power and Light  
Coalition on the Environment and Jewish Life  
Ceres  
City of West Hollywood  
Clean Air Task Force et al.  
Climate 911  
Climate Resolve  
Coalition for Clean Air/California Cleaner Freight Coalition  
Dignity Health  
Environmental Law and Policy Center  
Fuller, Tony  
Investor Network on Climate Risk  
Environment California Research and Policy Center, Environment America Research and Policy Center  
Fort, Karen  
Gilroy, JD  
Mass Comment Campaign sponsored by anonymous  
Mass Comment Campaign sponsored by anonymous  
Mass Comment Campaign sponsored by Environment America  
Mass Comment Campaign sponsored by KnowWho Auto Mailer  
Mass Comment Campaign sponsored by Sierra Club

Mass Comment Campaign sponsored by the Environmental Defense Fund  
Mass Comment Campaign sponsored by the Pew Charitable Trusts  
Mass Comment Campaign sponsored by Union of Concerned Scientists  
McNicol  
Moms Clean Air Force  
Nelson, Dennis  
Orange EV  
Quealy, Kevin  
Respiratory Health Association  
Siemens  
Stuckey, Richard  
Transportation Power  
US Hybrid Corporation

**Comments that Generally Call for No Regulation or Question the Need for Phase 2 GHG/Fuel Efficiency Standards 4**

National Automobile Dealers Association (NADA)  
North American Die Casting Association (NADCA)  
Owner-Operator Independent Drivers Association (OOIDA)  
Schneider National Inc.

**Response:**

The Phase 2 program builds on our commitment to robust collaboration with stakeholders and the public, following an expansive and thorough outreach effort in which the agencies gathered input, data and views from heavy-duty vehicle and engine manufacturers, technology suppliers, trucking fleets, truck drivers, dealerships, environmental organizations, and state agencies. We appreciate the time and effort taken by the commenters in developing these comments.

Many commenters generally supported the Phase 2 program or the goals of the proposal. The detailed comments on specific aspects of the proposal submitted by many commenters that supported overall program goals covered a range of positions – from support for standards that are less stringent than the proposed alternative (Alternative 3) to support for standards that are stronger than the more stringent alternative considered (Alternative 4). Similarly, we received general comments that call for a stronger program and those that call for no regulation or questions the need for further GHG/fuel efficiency reductions from the heavy-duty vehicle sector.

The agencies have revised the proposed standards and related requirements to address issues raised in these comments, resulting in an improved final program. While fundamentally similar to the proposed rules, the final program will achieve greater GHG and fuel consumption savings. Responding to the President's Climate Action Plan and his February 18, 2014 directive, as well as our statutory obligations, the final Phase 2 program includes technology-advancing standards that will phase in over the long-term (through model year 2027) to result in an ambitious, yet achievable program that will significantly reduce GHG emissions and fuel consumption from new on-road medium- and heavy-duty vehicles. Phase 2 will maintain the underlying regulatory structure developed in the Phase 1 program, such as the general categorization of Heavy-Duty Vehicles HDVs (including vehicles considered Medium-Duty Vehicles or MDVs under NHTSA regulations) and the separate standards for vehicles and engines. The final standards are almost entirely performance based, allowing manufacturers to meet standards through a mix of different technologies at reasonable cost. As described in the Preamble, EPA and NHTSA believe the final standards best fulfill our respective statutory authorities when

considered in the context of available technology, feasible reductions of emissions and fuel consumption, costs, lead time, safety, and other relevant factors.

For responses to specific issues raised these comments, please see the separate chapters of this joint Response to Comment document.

## **1.2 Support for a National Program**

Many commenters expressed support for a single, national set of standards, i.e., a program harmonized between the two agencies and across all 50 states. These commenters include:

American Automotive Policy Council  
American Trucking Associations (ATA)  
California Trucking Association  
Caterpillar, Daimler, Navistar, PACCAR, and the Volvo Group  
Chemours Company FC, LLC  
Cummins, Inc  
Diesel Technology Forum  
Eaton Vehicle Group  
Electric Drive Transportation Association (EDTA)  
FCA US, LLC  
FedEx Corporation  
Ford Motor Company  
General Motors  
International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)  
Motor & Equipment Manufacturers Association (MEMA)  
North American Die Casting Association (NADCA)  
National Association of Manufacturers (NAM)  
Navistar, Inc.  
Nissan  
Truck & Engine Manufacturers Association (EMA)  
Truck Renting and Leasing Association  
Volvo Group  
Isuzu Motors Limited  
United Parcel Service (UPS)  
Walmart Transportation

### **Response:**

Finalizing federal standards that would help manufacturers continue to build a single fleet of vehicles and engines is an important goal of the Phase 2 program. The agencies have made significant efforts to coordinate the Phase 2 standards between EPA and NHTSA and with the California Air Resources Board (CARB). The agencies have consulted frequently with CARB staff during the development of this rule, given California's unique ability among the states to adopt their own GHG standards for on-highway engines and vehicles (assuming criteria of CAA section 209 (b) are satisfied). As discussed in the NPRM, the agencies' technical staffs have shared information on technology cost, technology effectiveness, and feasibility with the CARB staff prior to the proposal. See 80 FR 40150. We also received information from CARB on these same topics. EPA and NHTSA have also shared preliminary results from several of our modeling exercises with CARB as we examined different potential levels of

stringency for the Phase 2 program. In addition, CARB staff and managers have also participated with EPA and NHTSA in meetings with many external stakeholders, in particular with vehicle OEMs and technology suppliers. We have also had additional discussions with CARB, as documented in the agencies' dockets. Through this close coordination, the agencies are finalizing a Phase 2 program that will be fully aligned between EPA and NHTSA, while providing CARB with the opportunity to adopt a Phase 2 program that will allow manufacturers to continue to build a single fleet of vehicles and engines.

### **1.3 EPA and NHTSA Statutory Authorities 6**

**Organization:** California Air Resources Board (CARB)

#### Legal Authority

Alternative 4 is consistent with U.S. EPA's authority to promulgate GHG emission standards under the federal CAA, and with NHTSA's authority to promulgate fuel efficiency standards under the Energy Independence and Security Act (EISA). [EPA-HQ-OAR-2014-0827-1265-A1 p.24]

**Organization:** Center for Biological Diversity

#### **THE PROPOSED STANDARDS DO NOT MEET THE TECHNOLOGY-FORCING REQUIREMENTS OF THE GOVERNING STATUTES**

The applicable statutes require that the Proposed Rule implement fuel efficiency standards that achieve the maximum feasible improvement in HD Vehicle fuel efficiency and are technology-forcing. The Proposed Rule fails to fulfill this mandate. [EPA-HQ-OAR-2014-0827-1460-A1 p.4]

#### **Statutory Overview**

The purposes of the Energy Policy Conversation Act ("EPCA") are to decrease the nation's dependence on foreign imports, to enhance national security and to achieve the efficient utilization of scarce resources.<sup>13</sup> To achieve these goals, EPCA, as amended by the Energy Independence and Security Act of 2007 ("EISA"), expressly demands that NHTSA set maximum feasible fuel economy standards.<sup>14</sup> In the case of HD Vehicles, Section 32902(k) of EPCA requires NHTSA to set standards and implement a HD Vehicle "fuel efficiency improvement program designed to achieve the maximum feasible improvement."<sup>15</sup> The requisite standards shall be "appropriate, cost-effective, and technologically feasible for commercial medium-and heavy-duty on-highway vehicles and work trucks."<sup>16</sup> In fulfilling its duties under Section 32902(a), NHTSA "cannot set fuel economy standards that are contrary to Congress's purpose in enacting the EPCA – energy conservation," it cannot act arbitrarily and capriciously; it cannot advance conclusions unsupported by the evidence; if it conducts cost-benefit analyses, it may not assign values of zero to benefits that can be ascertained within a range; and it cannot bias its cost-benefit analysis.<sup>17</sup> Section 32902(k) imposes the same requirements. In addition, fuel efficiency standards under EPCA and EISA must be technology-forcing.<sup>18</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.4]

While the Agencies may have discretion, as noted in the Proposed Rule, to balance the factors related to maximum feasible improvements and technology-forcing, this discretion is not unlimited. The Agencies may not make arbitrary and capricious determinations that ignore the statutory limits upon that

discretion. As discussed below, the Proposed Rule fails to achieve the statutory mandates of setting maximum feasible fuel efficiency improvements and of forcing technological innovation by purposefully limiting itself to the application of technology that is either commercially available today or mere steps from market-ready, by permitting manufacturers to exclude even some of this technology, and by failing to present an alternative that truly presents the “maximum feasible” emission reductions. The Agencies should revise the Proposed Rule and adopt standards that meet their respective statutory obligations. [EPA-HQ-OAR-2014-0827-1460-A1 p.5]

### **An Additional 30 Percent Fuel Savings and Greenhouse Gas Reduction is Possible Through Reasonable Technology Forcing and an Accelerated Implementation Schedule**

The technologies upon which the Agencies based the proposed standards are largely already in use or else very close to market ready. Yet, as discussed above, by statute the Agencies must consider all innovative technologies as well. Doing so to the maximum reasonable level would bring additional significant benefits and remain feasible in both cost and manufacturing logistics. Furthermore, as the Agencies repeatedly acknowledge, there are substantial benefits to a faster implementation schedule: this is both feasible and necessary to comply with the statutory requirement for maximally feasible reductions. [EPA-HQ-OAR-2014-0827-1460-A1 p.6]

#### 1. Additional Technology Options

In several instances, the Agencies present a “suite” of presently available and feasible technologies, but expressly do not require that each technology within the “suite” be applied.<sup>21</sup> In other words, the Agencies make adoption of some proven, available, feasible and efficient technologies optional. However, in every instance where such “optional” technologies would add to a vehicle’s fuel efficiency, the failure to require their implementation constitutes a violation of the mandates of EISA to produce the “maximum feasible” fuel efficiency improvements. We urge the Agencies instead to adopt efficiency standards that include every one of the technologies now allocated to an optional technology “suite”, excepting only those that provide no additional benefit. [EPA-HQ-OAR-2014-0827-1460-A1 p.6]

The Proposed Rule represents an unreasonable balancing of factors related to technology-forcing. As noted above, the NHTSA may balance cost, appropriateness and technological feasibility when determining maximal feasible reductions under the EISA. Similarly, the EPA may balance a number of factors, also including cost and technological effectiveness. But here, the Phase 2 standards as proposed would result in not only zero net operating costs (in contrast to the Phase 1 rules), but would even result in net benefit to operators in the form of fuel savings. Though this seems laudable, these savings have come at a health and environmental cost that cannot be borne by U.S. citizens. Here, the benefit to truck operators is far greater than the technologically feasible reductions that would benefit public health and the environment, and consequently violate the statutory requirements. [EPA-HQ-OAR-2014-0827-1460-A1 p.6]

The Proposed Rule neglects a wide range of technologies that could significantly reduce fuel use and emissions. For instance, one analysis indicates that up to 30 percent greater reductions in emissions are technologically feasible in the timeframe of the Proposed Rule.<sup>23</sup> The areas of the Proposed Rule that should be strengthened are briefly reviewed below. [EPA-HQ-OAR-2014-0827-1460-A1 p.6]

## **CONCLUSION**

The Proposed Rule must be strengthened to fulfill the technology forcing nature of the Clean Air Act and to meet the requirement of maximal feasible reductions required by EPCA/EISA. Specifically, the Phase 2 standards should: (1) reflect all potential technologies; (2) assume more aggressive penetration rates and reduction potential; and (3) occur over a shorter implementation period. Furthermore, we urge the EPA to revisit the treatment of methane emissions from natural gas engines and vehicles to ensure that the climate benefits of the Phase 2 standards are not compromised. Finally, the Center requests that EPA require adequate after-treatment of APU exhaust to ensure that nationwide particulate matter emissions do not increase as a result of the Phase 2 standards. [EPA-HQ-OAR-2014-0827-1460-A1 p.21]

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13 Center for Biological Diversity v. NHTSA, 538 F.3d 1172, 1182 (9th Cir. 2007).

14 49 U.S.C. § 32902(a).

15 49 U.S.C. § 32902(k)(2) (emphasis added).

16 Id.

17 Center for Biological Diversity v. NHTSA, supra note 13, 538 F.3d at 1197, 1200, and passim.

18 EPCA and EISA are meant to encourage technological innovation in the field, not simply promote the wider adoption of existing technologies. See, e.g., *Center for Auto Safety v. Thomas*, 847 F.2d 843, 870 (D.C. Cir. 1988) (overruled on other grounds) (“[t]he experience of a decade leaves little doubt that the congressional scheme in fact induced manufacturers to achieve major technological breakthroughs as they advanced towards the mandated goal”); *Green Mt. Chrysler Plymouth Dodge Jeep v. Crombie*, 508 F. Supp. 2d 295, 358-359 (D. Vt. 2007) (discussing technology-forcing character of EPCA and the use of increased fuel efficiency to augment performance rather than mileage); *Kennecott Greens Creek Min. Co. v. Mine Safety and Health Admin.*, 476 F.3d 946, 957 (D.C. Cir. 2007) (“when a statute is technology forcing, the agency can impose a standard which only the most technologically advanced plants in an industry have been able to achieve – even if only in some of their operations some of the time”). The Clean Air Act is similarly technology-forcing. Legislative history indicates that the primary purpose of the Act was not “to be limited by what is or appears to be technologically or economically feasible,” which may mean that “industries will be asked to do what seems impossible at the present time.” 116 Cong. Rec. 32901-32902 (1970), *Legislative History of the Clean Air Amendments of 1970* (Committee Print compiled for the Senate Committee on Public Works by the Library of Congress), Ser. No. 93-18, p. 227 (1974); see also *Whitman v. American Trucking Association*, 531 U.S. 457, 491 (2001).

21 See, e.g., *infra* comment letter subsection a. Engine Standards, regarding spark-ignition engine standards and subsection d. Tractor-Trailers, regarding tractor aerodynamics.

23 Sharpe, What is at stake, supra note 1.

**Organization:** National Automobile Dealers Association (NADA)

NON-REGULATORY STRATEGIES

In its 2014 report, the NAS discussed numerous non-regulatory approaches to increasing FE, including comprehensive driver training, the use of higher productivity vehicles (e.g., longer combinations), congestion mitigation, more efficient vehicle deployment and routing, and rigorous maintenance practices. NADA/ATD recognizes the limited authority EPA and NHTSA have to regulate vehicles in-use. Nonetheless, EPA and NHTSA are uniquely situated to partner with key government, industry and other interested stakeholders to promote non-regulatory but effective FE improvement strategies. [EPA-HQ-OAR-2014-0827-1309-A1 p.12]

**Organization:** North American Die Casting Association (NADCA)

***Nationwide Standard as a Ceiling, not Floor***

Regardless of whether regulators move forward with Phase II, manufacturers and consumers need a single nationwide standard. This applies not only to overall efficiency reduction targets but also to types of permissible vehicles and weight loads transported across state lines. Manufacturers and shippers face major hurdles meeting the regulations of various states, often causing transportation delays, rerouting, and confusion. [EPA-HQ-OAR-2014-0827-1283-A1 p.2]

In this instance, we strongly encourage regulators to establish these rules as a ceiling rather than a floor for states to follow. Manufacturers are concerned certain states may take steps to go beyond the federal rule and create more stringent regulations. This not only creates significant confusion throughout the industry, it effectively forces manufacturers to go beyond federal guidelines, particularly in the case of a state as large and economically significant as California. It is simply not feasible to expect manufacturers to invest heavily to meet the federal standard only the have the bar moved again by each state. [EPA-HQ-OAR-2014-0827-1283-A1 p.2]

However, should the Administration move forward with the Phase II standards, we encourage regulators to adopt a nationwide ceiling with achievable standards rejecting Alternative 4. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

**Organization:** Plant Oil Powered Diesel Fuel Systems

The Truck Rule 2 is inconsistent with law: both the Congressional intent underlying the truck fuel efficiency statute, 49 U.S.C. § 32902(k) ('Truck Rule statute'), and the mandate of the Supreme Court to 'take steps to *slow* or *reduce* [global warming].' Massachusetts v. EPA, 549 U.S. 497, 525 (2007) (emphasis supplied) (interpreting Clean Air Act sections 202(a)(1) and (a)(2), 42 U.S.C. §§ 7521(a)(1) and (a)(2)). A way to make them consistent with law, and, if the two agencies so desired, although they are not required to, to harmonize them, would be to define 'fuel' as 'fossil fuel.' The two agencies have not considered this solution, even though it would simply and elegantly address the putative statutory purposes in far more effective manner than does the proposed Truck Rule 2. [EPA-HQ-OAR-2014-0827-1125-A1 p.3]

If the two agencies do not adopt this definitional change, but adhere, instead, to the proposed Truck Rule 2, then this Rule will automatically disqualify a new engine fueled by 100 percent ordinary plant oil from ever winning the two agencies' certification for sale in the United States.' This anomaly is due to the Truck Rule 2's calculation of both GHG emissions and fuel consumption as an incorrect surrogate for 'fuel efficiency' based solely on tailpipe emissions. For the reason stated below, having to do with the composition of plant oil, the proposed Truck Rule 2's utilizing tailpipe emissions as the sole determinant of 'fuel efficiency' and GHG emissions unduly penalizes a plant oil-enabled engine; it

would pass either if the two agencies defined 'fuel' to be 'fossil fuel' or if this Rule were changed to adhere, as POP Diesel points out below, to the lawfully mandated measurement of 'fuel efficiency' as energy input to the engine (instead of fuel consumed) per unit of work performed and greenhouse gas emissions as net life cycle emissions (instead of exclusively tailpipe emissions). [EPA-HQ-OAR-2014-0827-1125-A1 p.3]

Since the two agencies have approved of the Clean Air Act criteria emissions from select, retrofitted plant oil-enabled engines' and EPA has approved of beneficial 100 percent plant oil from the inedible fruit seeds of the jatropha tree's supplying these engines, this prejudice that the Truck Rule 2 wreaks on a new POP Diesel-equipped engine prevents 100 percent plant oil fuel from ever coming on to the market in new engines, without the two agencies' adopting either a waiver or variance from the proposed Standards for such engines. Since the economics of generating a supply of jatropha plant oil do not lend themselves to the high cost of POP Diesel's retrofitting older engines that are not subject to the Truck Rule 2 or its predecessor Truck Rule 1, which took effect in 2011, the viability of this economically and environmentally-beneficial fuel's coming on to the market in more than just esoteric applications depends on introduction, following the two agencies' certification, of new engines equipped from the factory to run on this fuel. [EPA-HQ-OAR-2014-0827-1125-A1 p.4]

A. The Fuel Efficiency Standards are inconsistent with law because they measure fuel consumption, rather than fuel efficiency, and thereby are inconsistent with the plain meaning of the statutory law codified at 49 U.S.C. § 32902(k) and Congressional intent evident therein. [EPA-HQ-OAR-2014-0827-1125-A1 p.4]

B. The GHG Standards are inconsistent with the law laid down by the U.S. Supreme Court in Massachusetts v. EPA that following an endangerment finding, which the courts have upheld, EPA must 'take steps to *slow or reduce* [global warming].' 549 U.S. at 525 (Emphasis supplied). [EPA-HQ-OAR-2014-0827-1125-A1 p.4]

1. They measure emissions only coming from the tailpipe, rather than net, life cycle greenhouse gas emissions, which is the only way to calibrate penalties and rewards so as to bring about effective change in product offerings and consumer choice in the marketplace. [EPA-HQ-OAR-2014-0827-1125-A1 p.4]

C. Although the two agencies are not under any obligation to harmonize the GHG Emissions and Fuel Efficiency Standards, the two agencies have not considered crafting a viable, unified regulation that would be consistent with the Congressional intent underlying both the GHG Emissions and Fuel Efficiency Standards: to define 'fuel' as the quantity of fossil fuel supplying an engine, according to its carbon content, for the purposes of calculating both fuel efficiency and GHG emissions. Since the statutes involved do not define 'fuel,' the two agencies have the discretion to utilize any definition that is 'reasonable.' Chevron, USA, Inc. v. Natural Resources Defense Council, 467 U.S. 837 (1984). Defining 'fuel' as 'fossil fuel' would satisfy Congressional intent by proportionally penalizing those engines that consume more fossil fuel than others, and within the realm of fossil fuels, penalizing a fossil fuel such as petroleum that has a higher mole weight of carbon than does another fossil fuel, such as natural gas. Thus, NHTSA is in error in believing that converting tailpipe carbon emissions into fuel consumption is 'necessarily' the only way to gauge 'fuel efficiency' and equating tailpipe emissions with the sum total of GHG emissions the only way to harmonize the two sets of Standards. Proposed Truck Rule 2, 80 Fed. Reg. 40137, 40159. EPA's taking the additional step of basing the merit determination for an engine under the GHG Emissions Standards fully according to the net life cycle greenhouse gas emissions of the fuel powering the engine would bring these Standards into full compliance with the Supreme Court's mandate. [EPA-HQ-OAR-2014-0827-1125-A1 p.4-5]



## **A. The Fuel Efficiency Standards Are Inconsistent with Law**

### **1. Fuel Efficiency Standards' Fail to Abide by the Plain Meaning of Fuel 'Efficiency'**

The Tailpipe Rule is the Truck Rule 2's moniker for measuring tailpipe carbon emissions as the sum total of engine and vehicle 'greenhouse gas emissions' and converting these carbon emissions into fuel consumed in erroneous satisfaction of Congress's 'fuel efficiency' mandate. The Tailpipe Rule is contrary to the plain meaning of the term 'fuel efficiency' used in statute codified in 42 U.S.C. § 32902(k)(2).<sup>3</sup> [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

Dictionaries customarily define 'efficiency' to mean a measurement of the energy input to, rather than the fuel consumed by, a machine or engine to perform a unit of work or travel a certain distance. For example, efficiency is: [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

*3. Efficient operation as measured by a comparison of actual results with those that could be achieved with the same expenditure of energy: as* [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

*a. the ratio of the useful energy delivered by a dynamic system (as a machine, engine, or motor) to the energy supplied to it over the same period or cycle of operation.* [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

Webster's Third New International Dictionary 725 (Merriam-Webster, 2002). Or: [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

*the ratio of the useful work performed by a machine or in a process to the total energy expended or heat taken in.*

New Oxford American Dictionary 554 (Oxford U. Press, 3d ed. 2010). Or: [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

*3. the ratio of the work done or energy developed by a machine, engine, etc., to the energy supplied to it, usually expressed as a percentage.*

The Random House Dictionary of the English Language 455 (1983). Or: [EPA-HQ-OAR-2014-0827-1125-A1 p.6]

*2b. The ratio of the energy delivered by a machine to the energy supplied for its operation.*

The American Heritage College Dictionary 446 (Houghton Mifflin Co., 4<sup>th</sup> ed. 2002). [EPA-HQ-OAR-2014-0827-1125-A1 p.7]

In sum, all dictionaries define the word 'efficiency' to be energy input to an engine per unit of work performed, not fuel consumed. That the Fuel Efficiency Standards fail to define 'fuel efficiency' by its only common definition defies the plain meaning of the statute. [EPA-HQ-OAR-2014-0827-1125-A1 p.7]

### **2. The Fuel Efficiency Standards Fail to Give Meaning to the Statutory Term 'Fuel Economy'; As a Matter of Truck Statutory Construction, the Only Feasible Meaning with Respect to Trucks Is 'Fuel Efficiency' (i.e., Energy Input to the Engine)**

To consider the two agencies' statutory basis for anchoring the two sets of Standards on tailpipe emissions, because the preamble to the proposed Truck Rule 2 does not go into as much detail, POP Diesel refers to excerpts from the preamble to the Final Rule for these Standards that took effect in 2011 (Final Truck Rule 1'), on which the proposed Truck Rule 2 is based. These excerpts appear as Exhibit 4 [exhibit 4 can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1125-A1]. [EPA-HQ-OAR-2014-0827-1125-A1 p.7]

As a matter of statutory construction, POP Diesel agrees with NHTSA that Congress has expressly defined 'fuel economy' with regards to light duty vehicles to mean 'miles per gallon,' but that this metric is unsuitable for the commercial trucking sector because of the substantial and variable weight that trucks haul over distance. Final Truck Rule 1, 76 Fed. Reg. 57,106, 57,133 / 1-2 (Sept. 15, 2011). See, e.g., 49 U.S.C. § 32912(b) (authorizing penalties on car manufacturers per 0.1 mile-per-gallon excess). [EPA-HQ-OAR-2014-0827-1125-A1 p.7]

However, NHTSA's selection of 'fuel consumption' to govern the Truck Rule 2, instead of the measure of 'fuel efficiency' that accords with its plain, dictionary meaning,' fails to give any meaning in the Truck Rule 2 to the term 'fuel economy' that Congress included in a subsidiary clause in 49 U.S.C. § 32902(k)(2). 49 U.S.C. § 32902(k)(2) ('and [DOT and EPA] shall adopt and implement ... [truck] fuel economy standards'). Since Congress is presumed to have intended to give meaning to every word and phrase it includes in statute, the failure by NHTSA's adoption of a 'fuel consumption' metric to give any meaning to the term 'fuel economy,' as that term is stated in Congress's directive for NHTSA's development of truck 'fuel efficiency' standards,' raises a further question about the validity of the 'fuel consumption' metric itself. [EPA-HQ-OAR-2014-0827-1125-A1 p.7]

POP Diesel agrees with NHTSA's position that there is and must be a difference between 'fuel economy' and 'fuel consumption' with regards to trucks and the Truck Rule 2. As NHTSA stated, 'the [heavy duty] program is built around a fuel consumption metric,' versus a 'fuel economy' metric. 76 Fed. Reg. at 57,133 / 1. [EPA-HQ-OAR-2014-0827-1125-A1 p.8]

Since, as NHTSA stated, 'fuel economy' does not mean 'fuel consumption' with regards to the Truck Rule statute, one must give a different meaning to 'fuel economy' in this context. In conclusion, the plain, dictionary meaning of 'fuel efficiency' set forth above means that Congress must have intended both 'fuel efficiency' and the subsidiary term 'fuel economy' stated in 42 U.S.C. § 32909(k)(2) to mean, with respect to trucks (and not light duty vehicles subject to 42 U.S.C. § 32912(b)), the exact same thing: fuel energy supplied to the engine per unit of work performed by the engine, and not fuel consumed by the engine. [EPA-HQ-OAR-2014-0827-1125-A1 p.8]

### **3. The Legislative History Supports the View That the Fuel Efficiency and Greenhouse Gas Emissions Standards Need Not Both Turn on the Same Measure of Tailpipe Emissions**

Recapping, the Tailpipe Rule's measure of 'fuel efficiency' by the rate of carbon coming out the tailpipe is contrary to the plain meaning of the term 'fuel efficiency' used in Congress's mandate to NHTSA, codified in 49 U.S.C. § 32902(k)(2), to adopt a 'commercial [] truck fuel efficiency program' that 'achieve[s] the maximum feasible improvement.' POP Diesel submits that the term 'fuel efficiency' means the amount of fuel energy going into a truck engine per unit of work performed, not the amount of carbon emissions coming out the tailpipe, which the Fuel Efficiency Standards convert to a measure of fuel consumption. [EPA-HQ-OAR-2014-0827-1125-A1 p.8]

The legislative commentary, from the Senate debate, on adoption of the provision now codified as 49 U.S.C. § 32902(k)(2) is included in the Senate Congressional Record for December 13, 2007, at pages

S15385-S15389 and S15421-S15432, attached hereto as Exhibit 5 [exhibit 5 can be found on p.34 of docket number EPA-HQ-OAR-2014-0827-1125-A1].<sup>6</sup> Senator Diane Feinstein's unopposed comments therein support POP Diesel's position that Congress did not intend that the Fuel Efficiency and the Greenhouse Gas Standards rely on the same measure of tailpipe emissions. [EPA-HQ-OAR-2014-0827-1125-A1 p.8]

While agreeing with Senators Carl Levin and Daniel Inouye that there was no reason why the two sets of standards could not, generally speaking, be 'consistent' with each other, Senator Feinstein stated, at page S15386, 'Congress resisted all efforts to add legislative language requiring 'harmonization' of the[] EPA and NHTSA standards.' Exhibit 5. On information and belief, Sen. Feinstein made this statement to preserve California's life cycle greenhouse gas emissions standards ('the California standards') that were then under development or in effect. These were different from fuel efficiency standards and were more stringent than the tailpipe measurement of GHG emissions included in the subsequent federal Truck Rule 1 adopted in 2011. [EPA-HQ-OAR-2014-0827-1125-A1 p.8-9]

A federal court in California later struck down the California standards as being violative of the Constitution's Commerce Clause because, measuring and comparing the entire life cycle emissions of different fuels, they penalized, for instance, biodiesel made from soy that came all the way from the Midwest, as compared to biodiesel that came from soy grown locally in California. As a result of this decision, California later abandoned its net life cycle greenhouse gas emissions standards and for the sake of nationwide conformity, made them identical to the federal Truck Rule's Tailpipe Rule that forms the heart of the Truck Rule 1 and proposed Truck Rule 2. [EPA-HQ-OAR-2014-0827-1125-A1 p.9]

The point that Sen. Feinstein was making in the Senate floor debate was that federal greenhouse emissions standards need not be identical to federal fuel efficiency standards because Congress resisted including language that would have made them so. Even so, EPA and NHTSA went ahead made them identical by using the measure of tailpipe carbon emissions as an (incorrect) surrogate for 'fuel efficiency' and (incomplete) surrogate for 'greenhouse gas emissions.' POP Diesel suggests in part C below a simple way that the two sets of standards could be harmonized in keeping with the statutory purposes. [EPA-HQ-OAR-2014-0827-1125-A1 p.9]

## **B. The Greenhouse Gas Emissions Standards Are Inconsistent with Law**

### **1. The GHG Standards Are Legally Inadequate for Measuring Only Tailpipe Emissions, and Not Net Life Cycle Emissions**

The U.S. Court of Appeals for the D.C. Circuit determined in Center for Biological Diversity v. EPA, a 2013 decision, that EPA was not exempt from basing its penalty and merits assessments with respect to stationary source GHG emissions on an assessment of full life cycle emissions. Although the Court has not had occasion to extend this holding to 42 U.S.C. §§ 7521(a)(1) and (a)(2)) requiring Greenhouse Gas Emissions Standards for trucks, logically, the Clean Air Act should compel assessment of net life cycle greenhouse gas emissions in every instance, since that is the only way to penalize and reward engine technologies and the fuels they enable so as to cause market players to make effective decisions. [EPA-HQ-OAR-2014-0827-1125-A1 p.9]

For instance, a study conducted by the National Renewable Energy Laboratory and a literature review commissioned by EPA both concluded that 100% plant oil embodies approximately half the energy in its manufacture, including planting the oil-bearing plants, harvesting, extracting the oil, and in transport, as does its biodiesel-processed derivative. Exhibits 6 and 7 [exhibit 6 can be found on p.41 and exhibit 7 can be found on p.44 of docket number EPA-HQ-OAR-2014-0827-1125-A1]. The process to make

HEFA's out of plant oil is similarly energy intensive: hydro-processing plant oil and then running this through a petroleum refinery. Therefore, per unit of fuel used, plant oil has far superior greenhouse gas-mitigating potential than do biodiesel or HEFA's. Yet the Renewable Fuel Standard ('RFS'), as EPA has implemented it, is only concerned with life cycle greenhouse gas emissions insofar as a fuel crosses either the 20% threshold in GHG reduction, compared to the petroleum base, to qualify as a 'renewable fuel' or the 50% threshold GHG reduction to qualify as an 'advanced biofuel.' EPA has not yet factored into the Renewable Fuel Standard any life cycle analysis that would differentiate in the award of tradable credits as between fuels passing either of these thresholds that have markedly different global warming-mitigation value. Since EPA has already determined that biodiesel and HEFA's qualify as 'advanced biofuels,' the RFS, as presently constructed, would not award the use of ordinary plant oil any more tradable credits per gallon than EPA has already awarded biodiesel or HEFA's, were EPA to approve POP Diesel's pending petitions for a pathway for tradable RFS credits for ordinary jatropha plant oil used as fuel. POP Diesel's petitions to EPA to award ordinary plant oil higher or double the tradeable credits of biodiesel have been pending since February 2012, July 2012 and May 2014. [EPA-HQ-OAR-2014-0827-1125-A1 p.9-10]

A POP Diesel-equipped new engine running on 100% plant oil except for the brief startup and shutdown periods on petroleum diesel magnifies the superior global warming-mitigation value of ordinary plant oil fuel because, in comparison, biodiesel and HEFA's ordinarily blend in subordination to petroleum diesel. Nationwide standards adopted by the Petroleum Products Committee of ASTM International and incorporated by law in most states limit biodiesel for most applications, including on-highway use, to at most a 5% to 20% blend, with the remainder being 80% to 95% petroleum diesel. While ASTM Standard Specification D-975 no longer distinguishes between the source of the fuel, whether petroleum hydrocarbons or plant oil hydrocarbons turned into HEFA's, as a practical matter, the 80% to 95% balance of 5% to 20% biodiesel or HEFA's will be petroleum, and not a processed derivative of plant oil.' Therefore, these other diesel engine biofuels, while having inferior greenhouse gas-mitigating value, do not run at close to the 100% concentration that POP Diesel Fuel comprised of 100% jatropha plant oil operates at in a POP Diesel-equipped engine. [EPA-HQ-OAR-2014-0827-1125-A1 p.10]

Once EPA acts on POP Diesel's petitions for a pathway to receive tradable credits under the Renewable Fuel Standard for jatropha plant oil, POP Diesel will be disadvantaged in comparison to these other derivative fuels from plant oil, unless EPA concurrently proposes a level of credits commensurate with plant oil's superior net life cycle emissions value, in comparison to biodiesel's and HEFA's'. Given the need for modest expenditure of an additional \$1,500 to \$3,000 per new semi truck engine specially equipped to run from the factory on this fuel with modified fuel tank, heaters and valve set comprising the patented and EPA- and NHTSA-approved POP Diesel Fuel System, there would not be any governmental incentive for private investment to finance POP Diesel's business, and the broader distribution and sale of its global warming-preferred fuel, unless EPA simultaneously awards tradable credits per gallon of 100% jatropha plant oil worth well more than those for the more highly processed and energy intensive fuels deriving from this oil. Without these correspondingly more valuable tradable credits per volume equivalent of POP Diesel Fuel, private financiers may conclude to eschew POP Diesel's products in favor of the alternatives which are not as beneficial to the cause of fighting global warming. [EPA-HQ-OAR-2014-0827-1125-A1 p.10-11]

While the proposed Truck Rule 2 relies without change on the Truck Rule 1's assessment of different alternative fuels and their corresponding engine technologies, this assessment, on which basis EPA decides to focus on solely tailpipe emissions in measuring GHG emissions, is more deeply flawed, given the passage of time, than it was at the time of the 2011 publication of the Truck Rule 1. Regardless of the fact that the majority of the electricity generated in the United States continues to

derive from the combustion of fossil fuels, battery-powered electric engines are unsuitable for the trucking market because they cannot produce the torque necessary. There are no hydrogen-powered trucks on the market, and none planned, as far as POP Diesel is aware. As set forth in the news release that is Exhibit 8 [exhibit 8 can be found on p.49 of docket number EPA-HQ-OAR-2014-0827-1125-A1], the two semi truck engine manufacturers which had started to develop such new engines to run on natural gas halted this development in 2014. Since the proposed Truck Rule 2 disqualifies an engine from certification running on 100% plant oil, the only kind of engine left for the trucking market is a petroleum diesel engine certified to run on 5% to 20% biodiesel, which will not suffice to satisfy EPA's mandate to 'slow or reduce' global warming from trucks, since these trucks will continue to combust 80% to 95% fossil fuel petroleum. [EPA-HQ-OAR-2014-0827-1125-A1 p.11]

As is set forth in comments submitted to the proposed Truck Rule 1 docket, Exhibit 9 (page 16-155 therein) [exhibit 9 can be found on p.52 of docket number EPA-HQ-OAR-2014-0827-1125-A1], the California Air Resources Board has already done significant work to determine and compare life cycle GI-IG emissions from different engine-enabled fuels. This approach is very feasible. [EPA-HQ-OAR-2014-0827-1125-A1 p.11]

### **C. Nonetheless, the Fuel Efficiency and Greenhouse Gas Emissions Standards Can Be 'Harmonized' by Defining 'Fuel' as 'Fossil Fuel' and Measuring Net, Life Cycle Greenhouse Gas Emissions, Versus Exclusively Tailpipe Emissions**

If they want to, the two agencies can achieve 'harmonization' of the Fuel Efficiency and Greenhouse Gas Emissions Standards in the following way, fully in keeping with the two sets of statutory mandates, as interpreted by the Supreme Court in Massachusetts v. EPA: [EPA-HQ-OAR-2014-0827-1125-A1 p.12]

1. Define 'fuel' as 'fossil fuel.' ('Fuel' is not defined in the statute; therefore, the agencies can use any 'reasonable' definition, according the Supreme Court case Chevron v. Natural Resources Defense Council, 467 U.S. 837 ). [EPA-HQ-OAR-2014-0827-1125-A1 p.13]
2. Measure 'greenhouse gas emissions' as net, life cycle greenhouse gas emissions of the fuel that runs in the engine, not simply and exclusively as tailpipe emissions. [EPA-HQ-OAR-2014-0827-1125-A1 p.13]

Therefore, by definition, those engines that have less fossil fuel going into them will have better 'fuel efficiency' and also lower net, life cycle greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1125-A1 p.13]

Since POP Diesel expects that by the time of publication of the final Truck Rule 2, it will have an agreement with an original diesel engine manufacturer to manufacture POP Diesel-equipped engines for the medium- and heavy-duty market for sale ready from the factory to run on 100% jatropha plant oil, POP Diesel would like to be able to introduce these engines to the diesel engine U.S. market. However, since the existing Truck Rule 1 and Truck Rule 2, as presently written, would not permit such a new engine to win certification for the reasons stated above, there is no point in POP Diesel's even submitting such an engine for certification testing. POP Diesel prays that if the two agencies do not agree in full with POP Diesel's comments and amend the proposed Truck Rule 2 accordingly, they will grant it such relief as will allow its engines fairly to become certification on the merits of their true fuel efficiency and net life cycle GHG emissions performance, so that it will be able to sell its engines in the United States market. [EPA-HQ-OAR-2014-0827-1125-A1 p.14]

[The following comments are from a supplemental comment with a correction to the original comments in docket number EPA-HQ-OAR-2014-0827-1467-A2]

I write on behalf of the above-named corporation, which goes by the short name POP Diesel, to make one correction and amplify one point for your consideration in addition to the comments submitted on September 11, 2015 (“Comments”). These supplemental and amended comments give details on and concern matters that your two agencies have not heretofore considered. Because of the novelty and profundity of its Comments, POP Diesel had been unable to formulate these details by the deadline of its September 11 submission. Therefore, I respectfully request that the agencies give this statement full consideration at this time. [EPA-HQ-OAR-2014-0827-1467-A2 p.1]

The amplification is to Part IV, Section (C), Point (1) of the Comments, as to the details of how POP Diesel proposes that the agencies measure fossil fuel going into a truck engine. The Comments and Exhibit 3 thereto explained that a medium- or heavy-duty compression ignition engine demands a quantity of energy input to it from the fuel according to the throttle position commanded by the operator. The quantity of fuel that the engine consumes at any particular throttle position will vary according to the fuel’s energy or heat content. [EPA-HQ-OAR-2014-0827-1467-A2 p.2-3]

The measurement of “fuel efficiency” by fossil fuel going into an engine for the purpose of final Standards should be determined by the carbon content, or carbon as a fraction of the molecular weight, per unit of energy of the fossil fuel. Fuels such as jatropha plant oil which do not derive from fossilized matter should count as contributing zero energy in the “fuel efficiency” calculation of total energy consumed per unit of work performed under the final Standards for the portion of an emissions test cycle in which the engine runs on the non-fossil fuel. [EPA-HQ-OAR-2014-0827-1467-A2 p.3]

In this way, engines that consume a fossil fuel that has a higher carbon content per unit of the fuel’s energy, such as petroleum, will have worse “fuel efficiency” than fossil fuels with lower carbon content, such as natural gas. In addition, non-fossil fuel jatropha plant oil, run in a POP Diesel-equipped engine, would not contribute any fossil fuel energy consumed towards the calculation of the engine’s “fuel efficiency.” The agencies would have to establish milestone measurements of an engine’s energy efficiency, its efficiency in consuming energy, corresponding to the brake power of the engine, to be able to ratchet down over a period of years the amount of energy consumed per unit of power generated, thereby improving “fuel efficiency” of any particular power-output engine. [EPA-HQ-OAR-2014-0827-1467-A2 p.3]

In the alternative, the agencies may choose to not ratchet down “fuel efficiency” of particular power-output engines, but instead, to calculate and ratchet down the manufacturer’s fleet average of “fuel efficiency” and pursuant to Point (2) of Part IV, Section C of the Comments, net life cycle greenhouse gas emissions, thereby encouraging engine manufacturers to include engines that run on non-fossil fuels within their portfolio of engines certified and sold to the market. The price of the non-fossil fuel may then play a part in determining market adoption of the engine powered in part or all by non-fossil fuel. If EPA changes the proposed Standards to not automatically disqualify a POP Diesel-equipped engine from ever winning certification running on 100 percent jatropha plant oil, POP Diesel will be able to sell 100 percent jatropha plant oil in the United States at a fifty (50) cent per gallon discount below petroleum diesel, even at today’s low petroleum prices and taking into account the engine’s consumption of 10 percent more plant oil to perform the same amount of work as it would running on petroleum diesel fuel. [EPA-HQ-OAR-2014-0827-1467-A2 p.3-4]

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1 Although EPA grants formal certification that emissions are compliant with the Clean Air Act, NHTSA must give its approval as part of the certification process.

2 A POP Diesel-equipped engine's first such approval, which took place in July 2013, is listed in the EPA spreadsheet excerpted as Exhibit 1, which is available at <http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm> (scroll down the page to find the link titled 'Outside Useful Life Clean Alternative Fuel Conversion Systems ') (last checked Sept. 8, 2015); Exhibit 1 can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1125-A1

<sup>3</sup>This mandate is to adopt a 'commercial [ ] truck fuel efficiency program' that 'achieve[s] the maximum feasible improvement.' 49 U.S.C. § 32902(k)(2).

4 Energy input to an engine. rather than fuel consumed by the engine, per unit of work performed.

<sup>5</sup>42 U.S.C. § 32902(k)(2).

<sup>6</sup>As there are not any Committee reports on this legislative provision in either Chamber, this Senate legislative commentary from the Congressional Record constitutes the complete legislative history of the truck fuel efficiency mandate, 42 U.S.C. § 32902(k)(2). Apparently, this provision was never subject to any hearings, but found its way into the final floor version that the Senate, and then passed the House without comment from the House floor.

7 POP Diesel expects to equip, initially, a new semi-truck engine from the factory to run on 100% ordinary plant oil. Such engines will run for almost their entire daily drive cycle on 100% plant oil fuel, with only the first 15 minutes and the last 5 minutes on petroleum diesel.

**Organization:** Union of Concerned Scientists (UCS)

Freight is the one section of the transportation sector in which fuel use is projected to rise over the next 20 years, with increases in truck fuel consumption being the primary cause. EIA projects that fuel use will increase 37 percent, from 2.4 million barrels of oil a day (mbd) to 3.3 mbd from 2010 to 2035. The Phase 1 heavy-duty standards mitigated the growth in fuel use to some extent but do not change the overall trajectory. The long lead-time and duration of the Phase 2 standards offer both the opportunity and responsibility to make real reductions in fuel consumption. We believe that the proposed rule is an important step forward; however, the proposal does not go far enough. It is insufficient to bring oil use down to 2010 levels, let alone put us on a trajectory towards the emissions reductions needed to reach an 80 percent reduction below 1990 levels by mid-century, a level necessary to prevent the worst consequences of climate change. The agencies should strengthen the rule to ensure that they are reducing truck fuel consumption and associated greenhouse gas emissions to the maximum extent that is technically achievable and cost-effective. [EPA-HQ-OAR-2014-0827-1329-A2 p.4]

UCS, in collaboration with researchers, has shown that reducing fuel consumption 40 percent over 2010 levels by 2025 is both technically achievable and cost effective (Khan et al. 2015). We strongly urge the agencies to adopt a level of stringency that is in line with this analysis to maximize the potential reductions in fuel use. The attached analysis shows that this is an achievable goal while relying predominantly on incremental increases in conventional technologies, with advanced technologies only entering the market slowly in the later years of the proposed regulatory period. With the long lead time proposed by the agencies (more than a decade after the rule is slated to be finalized), it is important to take a complete view of the technologies that will be available to reduce fuel use that far into the future. Under the Clean Air Act, EPA has the authority to set “technology-forcing” standards to achieve emissions reductions. NHTSA, under the Energy Independence and Security Act, has an obligation to set “maximum feasible” standards. Thus, it is appropriate for the standard to include promising

technologies that are not yet market-ready but are expected to be available in a decade in setting the stringency of the standard. [EPA-HQ-OAR-2014-0827-1329-A2 p.4]

Our comments touch on many aspects of the proposed rule, but are nearly all directed at ways in which the stringency of the standard can and should be increased. Compared to our target of 40 percent fuel use reduction from new trucks by 2025 compared to 2010, we calculate that this standard achieves a 36% decrease in fuel use and emissions by 2027. Although the benefits cited by the agencies are significant—saving 550,000 barrels of oil a day and reducing greenhouse gas emissions by 120 million metric tons in 2035—they would be significantly higher if the agencies proposal mirrored our analysis. Achieving a 40-percent reduction from new trucks would save an additional 200,000 barrels of oil a day and avoid 40 million metric tons of greenhouse gas emissions in 2035. From our perspective, this proposal leaves too much on the table. [EPA-HQ-OAR-2014-0827-1329-A2 p.4]

There are numerous analyses from independent institutions such as the National Academies of Science and Southwest Research Institute as well as data from industry and the Department of Energy’s SuperTruck program that show that the 40-percent target by 2025 is feasible and cost-effective, indicating that waiting until 2027 to implement the stringency in the preferred alternative (Alternative 3) is unnecessary. Thus, we believe that the timing and stringency of Alternative 4 is more appropriate, as it pulls the 36-percent reduction of Alternative 3 forward to 2024. However, many of the concerns we articulate in these comments also apply to Alternative 4 and is therefore not an approach that we would fully endorse. If the final rule extends to 2027, we urge the agencies to increase the stringency beyond a 40-percent reduction, recognizing the broader array of technologies available with longer lead-time. [EPA-HQ-OAR-2014-0827-1329-A2 p.4]

We appreciate the work that the agencies have done to work with stakeholders and integrate data into their analysis of the issues involved in this rule. We have included detailed analysis on many parts of the rule in these comments and look forward to continued engagement with the agencies. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

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Khan, S., D.W. Cooke, and L. Tonachel. 2015. Fuel savings in new heavy-duty trucks in 2025. Transportation Research Board Paper 15-4977. Presented at the 94<sup>th</sup> annual meeting of the Transportation Research Board, January 11-15, 2015, Washington, DC. Online at <http://docs.trb.org/prp/15-4977.pdf>.

**Response:**

CARB stated that Alternative 4 is consistent with each agencies’ respective statutory authorities to promulgate GHG and fuel efficiency standards. The agencies would not disagree with that assertion if we had determined Alternative 4 to be feasible. However, due to concerns over the risks associated with the rapid pace of technology implementation required under the proposal’s Alternative 4 (in particular, risk of unreliability due to the shorter lead time to bring technologies to market or to apply existing technologies to unfamiliar market segments), and the unquantified costs associated with those risks, we have determined that it is likely that Alternative 4, as set out in the NPRM, is infeasible.

The Center for Biological Diversity argues that the proposed standards are insufficiently stringent and are inconsistent with the “technology-forcing” mandate of the Clean Air Act. CBD is correct that certain CAA provisions are technology forcing (any provision, for example, requiring standards to be based on some type of best performing technology, e.g. CAA section 112 (d)(2) and (3), or 213(a)(3) and (4), but neither section 202 (a) (1) nor (2) is one of those provisions. See 77 FR 62673/1



(explaining why section 202 (a) (1) and (2) allow but do not compel technology forcing standards; see also *id.* column 2 correcting this same commenter’s erroneous characterization). However, the final Phase 2 standards are technology-forcing, in that they are premised in part on performance of technologies not presently commercialized, but which the agencies show can be brought reliably to market in the lead time afforded by the rule. A notable example is waste heat recovery as part of the basis for the tractor engine standards. Certain aerodynamic technologies projected to be available for trailers are another example.

NADA encouraged the agencies to pursue non-regulatory strategies to improve fuel efficiency. However, such non-regulatory strategies would not necessarily fulfill the agencies’ respective statutory obligations.

NADCA encouraged the agencies “to establish these rules as a ceiling rather than a floor for states to follow.” However, it is not within the scope of this rulemaking to establish limits on state actions. In addition, EPA notes that the CAA provisions preempting state actions, explicitly allow more stringent requirements under certain circumstances.

POP Diesel submitted comments which largely reiterate its comments in the Phase 1 rulemaking. With respect to the greenhouse gas standards, POP Diesel maintains that the standards should not be established on a fuel neutral/tailpipe emission basis, but rather should be established on a lifecycle basis. POP Diesel takes this position because the fuel additive it produces actually results in increased CO2 emissions at the tailpipe, so if there is any CO2 benefit, it could only come from some earlier point in the fuel’s lifecycle. EPA has already rejected these comments, and we incorporate that entire response here. See 77 FR 51704-705 (Aug. 27, 2012). In sum, EPA is well within its discretion not to turn a vehicular emission standard into a motor fuel program, particularly when there is an entire separate statutory program (the section 211 renewable fuels program) respecting life-cycle implications of vehicular fuel use.<sup>1</sup> EPA is also well within its discretion in adopting a fuel neutral, tailpipe – based program in order to harmonize the program with fuel consumption rules of NHTSA. POP Diesel cites *Center for Biological Diversity v. EPA*, 722 F. 3d 401 (D.C. Cir. 2013) for the proposition that “EPA was not exempt from basing its penalty and merits assessments with respect to stationary source GHG emissions on an assessment of full life cycle emissions.” The commenter is mistaken. The court quite pointedly did not address the merits of EPA’s action, but found that the agency had failed to provide a reasoned justification, and hence had acted arbitrarily. 722 F. 3d at 412.

POP Diesel’s comments related to EISA are addressed in section I.E.1 of the Preamble to the final rule.

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<sup>1</sup> See in particular: “Even if EPA were to assume that POP Diesel’s claim of lifecycle emissions reductions are valid, and considered setting a vehicle emissions standard that assumed or required use of the POP Diesel technology and fuel, POP Diesel admits this would in fact lead to an increase in the actual GHG emissions from the vehicle. The only decrease in emissions would come from the claimed reduction in lifecycle GHG emissions that POP Diesel says would occur with use of their fuel. That would amount to adopting a vehicle emissions standard to promote a vehicle technology that does not reduce but instead increases the GHG emissions of the vehicle. The vehicle emissions standard would take that approach solely as a mechanism to mandate the use of a certain diesel fuel -based on emissions impacts associated with the fuel, not the vehicle. This would dramatically distort the purpose and structure of the *vehicle* emissions standard program, largely turning it into a de facto fuel program. There is no good reason to consider such a result here, especially where there already is a separate fuel based program, the RFS program, that is directly aimed at achieving the result POP Diesel seeks—a fuel program that achieves a reduction in lifecycle GHG emissions associated with the diesel fuel used by motor vehicles, through a mandate to use certain renewable diesel fuels”

### 1.3.1 EPA Authority 20

**Organization:** California Air Resources Board (CARB)

#### Alternative 4 is Consistent with U.S. EPA's Statutory Authority

U.S. EPA is promulgating the proposed Phase 2 greenhouse gas emission standards pursuant to the statutory authority of Title II of the federal CAA, and specifically sections 202(a)(1) and (2), sections 202(d), 203-209, 216, and 301 (42 U.S.C. 7521 (a)(1) and (2), 7521(d), 7522-7543, 7550, and 7601). [EPA-HQ-OAR-2014-0827-1265-A1 p.24]

Alternative 4 is consistent with the statutory provisions applicable to U.S. EPA's determination of the requisite lead time requirements associated with the proposed greenhouse gas emission standards. CAA section 202(a)(2) [42 U.S.C. § 7521(a)(2)] provides that “[a]ny regulation prescribed under paragraph (1) of this subsection (and any revision thereof) shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.” [EPA-HQ-OAR-2014-0827-1265-A1 p.24]

Courts interpreting section 202(a) of the CAA have recognized that Congress intended U.S. EPA to rely upon projected future developments and advances in pollution control technology in establishing emission standards, and expected U.S. EPA to “press for the development and application of improved technology rather than be limited by that which exists today.” *Natural Resources Defense Council v. U.S. EPA*, 655 F.2d 318, 328 (D.C. Cir. 1981) (*NRDC*). The *NRDC* court noted that a longer lead time “gives the U.S. EPA greater scope for confidence that theoretical solutions will be translated successfully into mechanical realizations”,<sup>11</sup> and further stated that “the presence of substantial lead time for development before manufacturers will have to commit themselves to mass production of a chosen prototype gives the agency greater leeway to modify its standards if the actual future course of technology diverges from expectation.” (*Id.*). The court concluded: [EPA-HQ-OAR-2014-0827-1265-A1 p.24]

“We think that the U.S. EPA will have demonstrated the reasonableness of its basis for prediction if it answers any theoretical objections to the [projected control technology], identifies the major steps necessary in refinement of the [projected control technology], and offers plausible reasons for believing that each of those steps can be completed in the time available.”<sup>12</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.25]

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<sup>11</sup> *Id.* at 329.

<sup>12</sup> *Id.* at 331-32. *Accord, Husqvarna AB v. Environmental Protection Agency*, 254 F.3d 195, 201 (D.C. Cir. 2001) and *National Petrochemical & Refiners Association v. Environmental Protection Agency*, 287 F.3d 1130, 1136 (D.C. Cir. 2002).

**Organization:** Center for Biological Diversity

EPA's authority to regulate greenhouse gas emissions from Heavy Duty (“HD”) Vehicles is codified in section 202(a) of the Clean Air Act (“CAA”).<sup>19</sup> The Act's pollution emission reduction goals are technology-forcing: [EPA-HQ-OAR-2014-0827-1460-A1 p.5]

Case and statutory law support the broad authority of EPA to force substantial change on the status quo on an industry-wide basis. The 'technology-forcing goals' of Subchapter 11, the portion of the Clean Air Act that establishes emissions standards for moving vehicles, are well recognized. *See Whitman v. American Trucking Ass'ns*, 531 U.S. 457, 491-492, 121 S. Ct. 903, 149 L. Ed. 2d 1 (2001) (Breyer, J. dissenting). The technology-forcing authority of the Clean Air Act is embodied in the language of the Act that directs EPA to promulgate standards 'that reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which the standards apply, ....' 42 U.S.C. § 7521(a)(3)(A)(i). EPA is thus empowered to set standards for future model years based on reasonable projections of technology that may not be available currently. *NRDC v. Thomas*, 256 U.S. App. D.C. 310, 805 F.2d 410, 429 (D.C. Cir. 1986). [EPA-HQ-OAR-2014-0827-1460-A1 p.5]

*Cent. Valley Chrysler-Jeep, Inc. v. Goldstene*, 529 F. Supp. 2d 1151, 1178 (E.D. Cal. 2007); *see also Motor Vehicle Mfrs. Ass'n v. New York State DEC*, 17 F.3d 521, 536 (2<sup>nd</sup> Cir. 1994) (noting that the Clean Air Act is 'technology forcing' in the context of California's LEV program). [EPA-HQ-OAR-2014-0827-1460-A1 p.5]

Most importantly, when directly comparing the Proposed Rule 2027 standards and what SuperTruck partners have already achieved, the proposed standards for tractors-trailers would achieve only about three-quarters of the fuel savings that have been demonstrated by SuperTruck partners.<sup>50</sup> The Proposed Rule takes SuperTruck research and development into account when calculating the dynamic baseline, or reference truck, but fails to properly employ the demonstrated improvements from the SuperTruck program when determining what technology is maximally feasible. In fact, the Draft Regulatory Impact Analysis ("RIA") explicitly acknowledges that there are likely to be more advanced aerodynamics options by 2027.<sup>52</sup> Since the Agencies already predict such advances, the technology-forcing nature of the governing statutes requires that they be included in the standards, especially when the proposed time horizon is within the range of tractor redesign cycles.<sup>53</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.11]

Although the Proposed Rule assumes a wide range of technologies, the penetration rates assumed by the Agencies and potential improvements appear to be underestimated.<sup>54</sup> The technology forcing nature of Clean Air Act § 202 and EPCA/EISA requires more aggressive assumptions regarding technology adoption. The Agencies are proposing standards that are either already attained or easily attainable, and then hoping that manufacturers will explore and continue to improve technologies of their free will.<sup>55</sup> This is contrary to the specific language, structure, and intent of the statutes: a clear regulatory signal is necessary and intended to drive innovation, ensuring that technology improvements occur as rapidly as possible. [EPA-HQ-OAR-2014-0827-1460-A1 p.11]

In sum, the total reductions of greenhouse gas emissions and fuel usage could be significantly greater if the Agencies adopt standards that represent true maximum efficiency improvements, even while remaining economically feasible and safe. The NHTSA may not adopt standards that undermine the purpose of the EPCA/EISA – energy conservation. Yet, the proposed fuel use reductions for tractor-trailers would provide only about one-third of the maximal feasible benefits. This constitutes an arbitrary and capricious balancing of factors that significantly impedes the congressional mandate to promote energy conservation. Likewise, these minimal reductions fail the Clean Air Act's technology-forcing requirement. [EPA-HQ-OAR-2014-0827-1460-A1 p.11-12]

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19 42 U.S.C. § 7521(a)(3)(A)(i).

<sup>50</sup> ICCT SuperTruck blog, *supra* note 46.

<sup>52</sup> Draft RIA at 2-18.

<sup>53</sup> *Id.* at 2-16 (“tractor model lifecycle of up to 10 years”).

<sup>54</sup> For example, dual clutch systems are assumed to provide only up to 2% improvement (Proposed Rule at Table III-7), but the stakeholder workshop assigned this technology approximately 5.5 (+ 2) % improvement (ICCT Tractor-Trailer report, *supra*note 44); the Proposed Rule omits weight reduction in setting stringency assigning an improvement of 0.3 % (Proposed Rule at 40223), while the stakeholder workshop found over 3 (+ 1) % improvements from weight reduction (ICCT Tractor-Trailer report,*supra* note 44).

<sup>55</sup> *See, e.g.*, Draft RIA, *supra* note 43 at 2-16 (“we anticipate manufacturers would continue to apply these techniques [sealing gaps] across their models and continue to explore refinements and re-designs in other areas of the tractor”). But note that the Agencies are also fully aware that a regulatory signal is necessary to correct private market failures and “provide regulatory certainty and thus generate important economic benefits in addition to reducing externalities.” *Id.* at 8-5.

**Organization:** Daimler Trucks North America LLC

### **Legal Issues with Glider Provisions**

As DTNA expressed in its comments to the Phase 2 Proposed Rule, DTNA has concerns with EPA's proposed regulation of 'glider kits' and 'glider vehicles,' including EPA's legal authority for regulating them. EPA's Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act ('CAA'), which does not provide EPA authority to regulate the sale of motor vehicle components. The CAA only provides EPA with authority to regulate 'new motor vehicles' and their engines, defined as 'self-propelled' vehicles 'the equitable or legal title to which has never been transferred to the ultimate purchaser'—not non-motorized frames, cabs, and axles. 42 U.S.C. §§ 7522(a), 7550(3). In turn, any regulation of glider kits is beyond the agency's authority. Further, glider vehicles when constructed retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not 'new' under the CAA. Thus, EPA lacks authority to regulate glider vehicles. And even if the EPA had authority to regulate, the CAA requires 4-years' lead-time for new or revised NOx and PM requirements and for regulations governing engine rebuilding practices, which has not been met under the proposed regulations. [EPA-HQ-OAR-2014-0827-1926-A1 p.2]

### **B. EPA Lacks Authority to Regulate 'Glider Kits' and 'Glider Vehicles'**

The distinction between 'glider kits' and 'glider vehicles' is important because EPA lacks authority to regulate vehicle parts, including assemblages of parts (without an engine) such as glider kits. EPA's Phase 2 Proposed Rule is being carried out under the authority of the CAA, and the CAA does not provide EPA authority to regulate the sale of motor vehicle components, which is all that glider kits are. The CAA only authorizes EPA to set emission standards for 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7521(a)(1), and to prohibit the sale of uncertified 'new motor vehicles' and 'new motor vehicle engines,' see 42 U.S.C. § 7522(a)(1). 'New motor vehicles' are defined under the CAA as 'self-propelled' vehicles 'the equitable or legal title to which has never been transferred to an ultimate purchaser'—not non-motorized frames, cabs, and axles. 42 U.S.C. § 7550(2), (3). Because glider kits do not contain engines, transmissions, and drive axles, and have no motive power, the CAA does not authorize EPA to regulate the sale of glider kits. [EPA-HQ-OAR-2014-0827-1926-A1 p.2-3]

EPA's examples of CAA provisions that address certain vehicle components are inapplicable. EPA cites to three CAA provisions granting it authority to regulate evaporative emissions, including from certain components, and concludes from those specific provisions that it has authority to regulate all vehicle components, whether or not they produce emissions in any form. Specifically, EPA cites to 'CAA section 202(a)(6) (standards for onboard vapor recovery systems on 'new light-duty vehicles,' and requiring installation of such systems); section 202(a)(5)(A) (standards to control emissions from refueling motor vehicles, and requiring consideration of, and possible design standards for, fueling system components), 202(k) (standards to control evaporative emissions from gasoline-fueled motor vehicles).' EPA Legal Memo, at 3. From these examples, EPA concludes that it has authority to regulate all vehicle components, a conclusion that is not justified under the language, of the Act. First, the fact that the CAA lists specific components that EPA may regulate suggests that EPA lacks authority to regulate other components that are not specifically listed, particularly given the broader dictate that EPA may set emission standards only for 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7521(a)(1), and may prohibit only the sale of uncertified 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7522(a)(1). Second, all of the examples cited by EPA relate to evaporative emissions. Although EPA might be able to argue that it has authority to regulate evaporative emissions from those specific components, and exhaust emissions from 'new motor vehicles' and 'new motor vehicle engines,' it is a stretch to say that EPA has authority to regulate all motor vehicle components. This is particularly true where, as with glider kits, the components do not produce emissions on their own. EPA itself recognizes that it cannot extend its argument to the smallest vehicle component—"This is not to say that the Act authorizes emission standards for any part of a motor vehicle, however small," EPA Legal Memo, at 3—but nonetheless believes it has the authority to draw the line to include glider kits and trailers. In fact, Congress drew the line in the CAA at 'new motor vehicles' and 'new motor vehicle engines,' and EPA may not extend its authority further than Congress allowed. [EPA-HQ-OAR-2014-0827-1926-A1 p.3]

EPA also lacks authority to regulate glider vehicles. When constructed, glider vehicles retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not 'new' under the CAA and not subject to EPA's regulatory authority. EPA's argument that glider assemblers market their finished products as 'new trucks' is unavailing. A company's marketing materials have no bearing on the statutory definition that governs EPA's authority. Although the CAA may not reference Vehicle Identification Numbers as determinative of new motor vehicle status, the Act does contain an express definition of 'new motor vehicles'—"self-propelled" vehicles 'the equitable or legal title to which has never been transferred to an ultimate purchaser,' 42 U.S.C. § 7550(2), (3)—which EPA is not free to disregard. Glider vehicles incorporate not just a used engine, as EPA suggests, but the engine, transmission, and rear axle—the entire powertrain that comprises a significant portion of a vehicle's cost and identity—from a previously owned vehicle. The glider kit, which may be considered to be 'new' vehicle parts, is not self-propelled. The glider becomes self-propelled only when the powertrain components are added, but cannot be a 'new motor vehicle' because the equitable or legal title of those powertrain components has previously been transferred to an ultimate purchaser. [EPA-HQ-OAR-2014-0827-1926-A1 p.3-4]

• **EPA Lacks Authority to Regulate 'Glider Kits'** - The distinction between “glider kits” and “glider vehicles” is important because EPA lacks authority to regulate vehicle parts, including assemblages of parts (without an engine) such as glider kits. EPA’s Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act (“CAA”), and the CAA does not provide EPA authority to regulate the sale of motor vehicle components, which is all that glider kits are. The CAA only authorizes EPA to prohibit the sale of uncertified “new motor vehicles” and “new motor vehicle engines.” See 42 U.S.C. § 7522(a)(1). “New motor vehicles” are defined under the CAA as “self-propelled” vehicles “the equitable or legal title to which has never been transferred to an ultimate purchaser”—not non-motorized frames, cabs, and axles. 42 U.S.C. § 7550(2), (3). Because glider kits do not contain engines,

and have no motive power, the CAA does not authorize EPA to regulate the sale of glider kits. [EPA-HQ-OAR-2014-0827-1164-A1 p.122-123]

· **Regulation of 'Glider Vehicles' Targets NOx / PM Emissions and Must Meet Statutory Lead Time Requirement** - In addition, the proposed regulation of “glider vehicles” actually targets NOx/PM emissions rather than GHG emissions, as EPA concedes, and is therefore inappropriate for inclusion in a GHG rule. Glider sales actually create the potential to reduce GHG emissions by incorporating used and rebuilt engines in newer, more aerodynamic vehicles. Rebuilt engines used in glider vehicles emit fewer GHGs, and new cabs and low rolling resistance tires are more efficient than what they replace. Because regulation of glider vehicles targets NOx/PM emissions, it should be done only in a separate rulemaking, if at all. [EPA-HQ-OAR-2014-0827-1164-A1 p.123][This comment can also be found in section 14.2 of this comment document]

In addition, this separate rulemaking should be carefully drafted to meet statutory lead-time requirements for NOx and PM regulations as required by statute. NOx and PM emissions standards are subject to an express CAA lead-time requirement under which new or revised NOx and PM requirements cannot take effect sooner than the model year commencing 4 years after new or revised standard is promulgated. 42 U.S.C. § 7521(a)(3)(C). As currently proposed, with an effective date of January 1, 2018, the proposed glider regulations violate the 4- year lead-time requirement under the CAA. Assuming the Phase 2 rule is finalized in early 2016, the earliest that the regulations governing glider vehicles could take effect would be 2020, in compliance with the CAA lead-time requirement. [EPA-HQ-OAR-2014-0827-1164-A1 p.123]

For its proposed glider provisions, EPA purports to rely on its authority to regulate the “practice of rebuilding heavy-duty engines.” 42 U.S.C. § 7521(a)(3)(D). However, EPA is not regulating engine rebuilding practices, as evidenced by the lack of relevant proposed amendments to its engine rebuilding regulations (40 C.F.R. §§ 86.004-40, 1068.120). Instead, EPA is attempting to regulate vehicle rebuilding, which it clearly does not have the authority to do under the CAA. Congress granted EPA authority to regulate “new motor vehicles” and “new motor vehicle engines” only, and while Congress granted EPA authority to regulate engine rebuilding, it did not grant EPA similar authority to regulate vehicle rebuilding. EPA’s reliance on (3)(D) is misplaced with respect to its proposed regulation of glider vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.123]

Even if EPA were properly regulating heavy-duty engine rebuilding practices with its proposed glider provisions, it would be subject to the same four-year statutory lead-time requirement. The four-year lead-time and three-year stability requirements of 42 U.S.C. § 7521(a)(3)(C) are applicable to all of paragraph 3, which includes the engine rebuilding provision contained in (3)(D). It is not enough for EPA to opine that the January 1, 2018 implementation date for the glider provisions allows “sufficient time to ‘permit the development and application of the requisite control measures’” under 42 U.S.C. § 7521(a)(3)(D). The four-year lead-time and three-year stability requirements of (3)(C) provide an absolute minimum, even for engine rebuilding regulations, and then EPA must determine whether additional time is required above and beyond that based on its determination under the standard contained in (3)(D). [EPA- HQ-OAR-2014-0827-1164-A1 p.123]

As currently proposed, EPA is attempting to regulate NOx and PM in the GHG rule in a way it could not undertake in a proper NOx and PM rulemaking. Under the CAA, EPA must allow four years of lead time, at a minimum, before its proposed glider provisions would take effect. [EPA-HQ-OAR-2014-0827-1164-A1 p.124]

• **Delegated Assembly, EPA's lack of authority** - DTNA has a concern about the EPA creating a large paperwork burden, requiring contracts with and instructions to body builders, that creates no benefit to the environment beyond our current business practice of supplying an Incomplete Vehicle Document (IVD) to final stage manufacturers. This concern drives us to comment that the EPA lacks the authority for delegated assembly regulations any more expansive than those in 40 C.F.R. § 1037.620 today. EPA bases its delegated assembly regulations on the authority to regulate the “introduction into commerce” and a claim that the sale of a partially complete vehicle or engine from the primary manufacturer to the secondary manufacturer is within the scope of this “commerce.” 42 U.S.C. §7522(a)(1) (authorizing regulation at the introduction into commerce) and 75 Fed. Reg. 74152 at 74362 (Nov. 30, 2010) (citing EPA authority for Part 1037 delegated assembly regulations). But the EPA incorrectly interprets what “commerce” is. [EPA-HQ-OAR-2014-0827-1164-A1 p.105-106]

Unlike Congress’s authority over commerce, which extends down to matters within a manufacturing plant located entirely within one state (see, e.g., *National Labor Relations Board v. Jones & Laughlin Steel*, 301 U.S. 1 (1937)), Congress defined the scope of the EPA’s “commerce” more narrowly than its own. If Congress intended for the EPA to regulate manufacturing processes or to consider “introduction into commerce” to include the manufacturing process, Congress knew how to specify so. Within the CAA itself, Congress commanded the EPA to regulate the manufacture of consumer or commercial products (prohibiting “the manufacture or introduction into commerce...”), the manufacture of aftermarket motor vehicle components (prohibiting any person to “manufacture or sell...”), and the manufacture of fuel (prohibiting “the manufacture, introduction into commerce, offering for sale, or sale...”). 42 U.S.C. §§ 7511b (e)(3)(A), 7522(a)(3)(B), and 7545(c)(1) (emphases added). Moreover, the text of the Air Quality Act of 1967, the predecessor to the CAA, contained a prohibition against the “manufacture for sale” of noncompliant vehicles and engines, but Congress explicitly struck “manufacture for sale” from the law relating to vehicles during the 1970 amendment process. Air Quality Act, P.L. 90-148 (Nov. 21, 1967), §203(a)(1), formerly 42 U.S.C. §1857f-2(a)(1); CAA, P.L. 91-604, §203(a)(1) (Dec. 31, 1970) (enacting H.R. 17255). Following the canons of statutory interpretation, one might logically presume that Congress intended for manufacture of vehicles and engines not to be regulated from the fact that (1) Congress omitted manufacturing from the regulated activities while including it elsewhere and (2) it actively struck manufacturing from the list of such activities. Stated another way, if Congress considered “introduction into commerce” to include manufacturing, then the “manufacture for sale” is surplusage in the sections of the CAA where it sits alongside mention of sale or introduction into commerce. In summary, Congress’s vehicle and engine regulations provide for regulation at the “introduction into commerce” but not for regulation of manufacture, as do (e.g.) the fuel regulations. [EPA-HQ-OAR-2014-0827-1164-A1 p.106]

So what is “introduction into commerce”? Congress gives an indication through its regulation of vehicles and engines over their “useful life.” 42 U.S.C. §7521(a)(1). Useful life is defined in the CAA and in the EPA’s regulations to be “a period of use” of some number of years or thousands of miles, depending on the type of vehicle. See, e.g., 42 U.S.C. §7521(d)(1) (defining useful life for light-duty vehicles and light-duty trucks as “a period of use of five years or of fifty thousand miles ..., whichever first occurs”) and 40 C.F.R. §86.004-2 (defining the useful life for Class 8 heavy-duty vehicles as “a period of use” of 10 years or 435,000 miles). It strains credulity to argue that the useful life, defined as “a period of use,” also includes periods prior to the engines or vehicles first use. In other words, the most logical inference to draw from both Congress’s and the EPA’s own definition of the useful lives is that the period over which an engine or vehicle can be regulated is only a period beginning with initial use. By contrast, regulation of an engine or vehicle’s emissions prior the first use or prior to completion of manufacturing is beyond the EPA’s authority. In turn, because regulation of an engine or vehicle’s emissions prior to its being used is beyond the EPA’s authority, the most reasonable interpretation of “introduction into commerce,” the point at which the EPA can begin to regulate, is not a sale part way through the manufacturing process (as in a sale from an original-stage manufacturer to a later-stage

manufacturer) but the sale to the ultimate purchaser (at which point the vehicle begins its period of use). [EPA-HQ-OAR-2014-0827-1164-A1 p.106-107]

Even if the EPA could regulate prior to the first use of an engine or vehicle, Congress authorized only test-based standards, not regulations over how vehicles or engines are manufactured. In particular, Congress (first) mandated the EPA to create “standards [that] shall be applicable to such vehicles and engines for their useful life.” 42 U.S.C. §7521(a)(1). Second, “to determine whether [a] vehicle or engine conforms with regulations prescribed under section 202 [§7521] of [the CAA],” the EPA “shall test, or require to be tested in such manner as [the EPA Administrator] deems appropriate,” such vehicles or engines. 42 U.S.C. §7525(a)(1) (emphases added). That is, “testing” of vehicles or engines is the means by which the EPA determines the compliance that is necessary for a vehicle or engine’s introduction into commerce. Prescribing procedures relating to contracts between manufacturers is not “testing.” [EPA-HQ-OAR-2014-0827-1164-A1 p.107]

The CAA’s legislative history bears out the above interpretation of the EPA’s authority. A Senate report shows Congressional intent that “[e]very manufacturer must provide, at the time of delivery, dealers and the ultimate purchaser a certificate that the vessel, vehicle, aircraft, or engine conforms to the regulations.” Sen. Rpt. 91-1196, at 62 (1970) (emphasis added). Similarly, a House report authorized “test[ing] ... any new motor vehicle or motor vehicle engine as it comes off the assembly line in order to determine whether the vehicle or engine conforms with the applicable emission standards” but not a requirement for contracts between manufacturers. H.R. Rpt. 91-1146, at 53585359 (1970) (emphasis added). Further during a discussion between then-Vice President of Ford Motor Company Herbert Misch and Senator Robert Dole, Mr. Misch stated that one act proposed to be prohibited in Section 203 of the CAA goes too far: “the requirement that ‘manufacture for sale’ cease upon revocation of certification. We do not feel that production should cease in order to remedy whatever defects may be found through sampling.” 2 Clean Air Act Amendments of 1970 1015 (U.S. Government Printing Office 1970) (quoting Joint Hearings before the Subcommittee on Air and Water Pollution of the Committee on Public Works and the Committee on Commerce, United States Senate, March 24 and 25, 1970). Senator Dole responded “[A]s long as we prohibit the sale of the defective vehicle it should not be necessary to stop production.” That is, Mr. Misch and Senator Dole spoke in favor of allowing the manufacturing of vehicles and engines whose compliance certificate has been revoked, as long as the manufacturer did not sell them. And, as discussed above, in the final CAA text Congress struck “manufacture for sale” from the list of acts prohibited “unless [a] vehicle or engine is covered by a certificate of conformity.” 42 U.S.C. §7522(a)(1). In short, the legislative history is replete with statements like those above voicing a desire for test-based standards and for end of assembly line testing that will reflect in-use emissions, but not for compliance prior to completion of the vehicle nor formal written requests or other such mandatory documents. [EPA-HQ-OAR-2014-0827-1164-A1 p.107]

In summary, the text and history of the CAA show that regulation of assembly processes and the requirement for delegated assembly contracts are beyond the EPA’s authority under the CAA. DTNA respectfully suggests that the EPA work with us to develop text that we could add to the industry’s current IVD to instruct second stage manufacturers what remains to be completed in order to bring the vehicle into compliance. [EPA-HQ-OAR-2014-0827-1164-A1 p.108]

**Organization:** Environmental Defense Fund (EDF)

### **Legal Authority**

EPA has manifest legal authority to adopt greenhouse gas emission standards for new medium-and heavy-duty vehicles.<sup>85</sup> Below, we discuss two particular features of this authority: the technology-



forcing nature of section 202 of the Clean Air Act (“CAA”) and EPA’s authority to address trailers. [EPA-HQ-OAR-2014-0827-1312-A1 p.19]

#### **A. EPA has clear authority to establish technology--forcing standards**

EPA has clear authority to establish technology-forcing emission standards under section 202(a) of the CAA, which provides that standards established under section 202(a)(1) “shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology.”<sup>86</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.19]

Related provisions of section 202— including those governing heavy-duty vehicle criteria pollutant emissions—are expressly technology forcing, providing that regulations “shall contain standards which reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply . . .”<sup>87</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.19]

As the nation’s highest court has recognized, the legislative history of the CAA underscores that Congress did not intend for EPA to be “‘limited by what is or appears to be technologically or economically feasible,’ but ‘to establish what the public interest requires to protect the health of persons,’ even if that means that ‘industries will be asked to do what seems to be impossible at the present time.’”<sup>88</sup> With respect to section 202(a)(1) and (a)(2), Congress intended that EPA “‘press for the development and application of improved technology rather than be limited by that which exists today.’”<sup>89</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.19-20]

EPA has a long history of establishing technology-forcing emission standards that have driven innovation and secured pollution reductions. For instance, EPA standards under section 202 resulted in the development and proliferation of the catalytic converter in 1975 and the three-way catalyst in 1981.<sup>90</sup> Particulate standards for heavy-duty vehicles also resulted in the development of the diesel particulate filter.<sup>91</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.20]

Courts have consistently affirmed EPA’s authority to establish technology-forcing standards under section 202, in some cases holding that only a technology-forcing standard would be compliant with the statute.<sup>92</sup> In adopting such standards, EPA is empowered to make projections about future technology “subject” only “to the restraints of reasonableness.”<sup>93</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.20]

In 1980, for example, EPA promulgated PM emission standards for light-duty diesel vehicles and trucks, requiring that emissions decrease to 0.20 grams per mile in the 1985 model year. EPA determined that the standard would be achievable in 1985 with the perfection of a particle trapping device, which at the time, had achieved only partial success in a prototype stage.<sup>94</sup> The D.C. Circuit affirmed these standards, holding that EPA “will have demonstrated the reasonableness of its basis for prediction if it answers any theoretical objections to the . . . method, identifies the major steps necessary in refinement of the device, and offers plausible reasons for believing that each of those steps can be completed in the time available.”<sup>95</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.20-21]

Likewise, in 2001, EPA established diesel PM and NOx emissions standards for heavy-duty trucks and buses that required substantial reductions and relied on studies suggesting that technologies currently being tested could collectively overcome then-existing obstacles.<sup>96</sup> The D.C. Circuit upheld these standards, affirming EPA’s technological predictions and noting that “the rule c[ould] stand so long as there was one solution as to which EPA's prediction was not arbitrary.”<sup>97</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.21]

EPA describes its Phase 2 proposal as technology forcing, in line with this long and successful history. As we set forth more fully below, however, certain key aspects of the agency's proposal—including the engine standards—are based almost entirely on today's technologies and conservative assumptions about the development of those technologies. EPA must strengthen these provisions to be consistent with the technology-forcing history of section 202 and the agency's own stated intention in the Phase 2 proposal. [EPA-HQ-OAR-2014-0827-1312-A1 p.21]

## **B. EPA has clear authority to regulate trailers**

EPA and NHTSA have proposed standards for trailers that are used in combination with two different classes of tractors. EPA's authority to adopt these proposed standards rests on firm legal footing, reflects a reasonable interpretation of the relevant Clean Air Act provisions, and is consistent with the agency's past regulatory practice. [EPA-HQ-OAR-2014-0827-1312-A1 p.21]

Section 202(a)(1) of the Act authorizes EPA to regulate “the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines . . .”<sup>100</sup> ‘Motor vehicle,’ as it is used in Section 202(a)(1), is defined under Section 216 as “any self-propelled vehicle designed for transporting persons or property on a street or highway.”<sup>101</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.21]

EPA has interpreted this statutory definition to enable the agency to adopt standards addressing emissions from the Class 7 and 8 combination tractor-trailers, which “consist of a cab and engine (tractor or combination tractor) and a detachable trailer.” The statutory definition of ‘motor vehicle’ in section 216 expressly defines that term in light of the vehicle's intended use: “transporting persons or property on a road or highway.” EPA has reasonably interpreted ‘motor vehicle’ to encompass all of the components of Class 7 and 8 tractor-trailers (including the trailer), which are needed to accomplish that objective. [EPA-HQ-OAR-2014-0827-1312-A1 p.21-22]

In particular, Class 7 and 8 tractor-trailers are designed and used to transport large quantities of goods. To perform this task, the vehicle must have three components: an engine, a tractor, and a trailer. These three components are inextricably linked; no one part can successfully transport goods without the other two. And the trailers addressed in the proposal are designed and engineered to operate in tandem with tractors. [EPA-HQ-OAR-2014-0827-1312-A1 p.22]

As their design features would suggest, these tractors and trailers are operated together almost exclusively.<sup>104</sup> The height of the tractor is designed to correspond to the height of the trailer, achieving optimal aerodynamic performance and minimal air-resistance only when the two are coordinated.<sup>105</sup> Moreover, as the primary load-carrying device, trailers account for a substantial percentage of the engine load and therefore contribute significantly to the vehicle's emissions. Accordingly, the use of improved aerodynamic and tire technologies on the trailer will reduce the vehicle's emissions.<sup>106,107</sup> EPA's interpretation of ‘motor vehicle’ as consisting of the engine, tractor, and trailer in the heavy-duty context is therefore a reasonable interpretation of the statute.<sup>108</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.22]

EPA's interpretation is likewise consistent with other provisions of the CAA and EPA implementing regulations addressing heavy-duty vehicles. Section 202(b), which authorizes EPA to adopt criteria pollutant standards for heavy-duty vehicles, defines a ‘heavy duty vehicle’ as, among other things, having “a gross vehicle weight (as determined under regulations promulgated by the Administrator) in excess of six thousand pounds.”<sup>109</sup> EPA regulations confirm that a vehicle's ‘gross vehicle weight’ can be measured by “the maximum weight of a loaded vehicle and trailer,” or by “the maximum design loaded weight of a single vehicle.”<sup>110</sup> These provisions are both tied to the way in which the vehicles are

operated and contemplate the load carried by the trailer. As EPA notes in the proposal, its determination of its authority as to trailers is also consistent with a prior interpretation of the heavy-duty vehicle as being incomplete unless a trailer is attached.<sup>111</sup> EPA must strengthen these provisions to be consistent with its delegated responsibility to establish technology-forcing standards under section 202 and the Agency's own stated intention in the Phase 2 proposal. [EPA-HQ-OAR-2014-0827-1312-A1 p.23]

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85 See, e.g., *Mass. v. Env'tl. Prot. Agency*, 127 S.Ct. 1438 (2007); see also *Coal. for Responsible Regulation, Inc. v. Env'tl. Prot. Agency*, 684 F.3d 102 (D.C. Cir. 2012).

86 42 U.S.C. § 7521 (emphasis added).

87 *Id.*

88 *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 490-91 (2001)(quoting 116 Cong. Rec. 32901-32902 (1970), 1 Legislative History of the Clean Air Amendments of 1970 (Committee Report compiled for the Senate Committee on Public Works by the Library of Congress), Ser. No. 93-18, p. 227 (1974)(emphasis in original).

89 *Natural Res. Def. Council, Inc. v. Env'tl. Prot. Agency*, 655 F.2d 318, 328 (D.C. Cir. 1981)(citing S. Rep. No.1196, 91st Cong., 2d Sess. 24 (1970), reprinted in 1 Legislative History 424; H.R. Rep. No.294, 95th Cong., 1st Sess. 273 (1977), reprinted in (1977) U.S. Code Cong. & Ad. News 1077, 1352, 4 Legislative History 2740).

90 See, e.g., David Gerard and Lester B. Lave, Implementing technology-forcing policies: The 1970 Clean Air Act Amendments and the introduction of advanced automotive emissions controls in the United States, 72 *Technological Forecasting and Social Change* 761 (2005), available at <http://repository.cmu.edu/tepper/1356/>.

91 See, e.g., Chris Wold, Climate Change, Presidential Power, and Leadership: We Can't Wait, 45 *Case Western Reserve J. of Int'l Law* 303, 346, available at <http://law.case.edu/journals/jil/Documents/45CaseWResJIntlL1&2.15.Article.Wold.pdf>.

92 See *Natural Res. Def. Council v. Env'tl. Prot. Agency*, 655 F.2d at 328 (upholding EPA's technology-forcing standards under Section 202(a)(2)); *Natural Res. Def. Council v. Thomas*, 805 F.2d 410 (D.C. Cir. 1986)(affirming authority under Section 202(a)(3)(A)(iii), which authorized regulations for PM emissions now authorized under (a)(3)(A)(i)); *Natural Res. Def. Council v. Reilly*, 983 F.2d 259 (D.C. Cir. 1993)(holding that Section 202(a)(3)(A)(6) is a technology-forcing provision and mandating issuance of a regulation after consideration of developing technologies); *Nat'l Petrochemicals & Refiners Ass'n v. EPA*, 287 F.3d 1130 (D.C. Cir. 2002)(affirming authority under Section 202(a)(3)(A)(i)); *Sierra Club v. EPA*, 325 F.3d 374 (D.C. Cir. 2003)(affirming authority under Section 202(l)(2)); *Crete Carrier Corp. v. Env'tl. Prot. Agency*, 363 F.3d 490 (D.C. Cir. 2004)(holding that Section 202(a)(3)(A)(i) is a technology-forcing provision).

93 *Natural Res. Def. Council, Inc. v. Env'tl. Prot. Agency*, 655 F.2d at 328 (citing *International Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 629 (D.C.Cir.1973)).

94 *Natural Res. Def. Council, Inc. v. Env'tl. Prot. Agency*, 655 F.2d at 331.

95 Id. at 331-32.

96 Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, 66 Fed. Reg. 5002 (2001).

97 Nat'l Petrochemicals & Refiners Ass'n v. EPA, 287 F.3d 1130 (D.C. Cir. 2002) at 1140.

100 Id.

101 42 U.S.C. § 7550 (emphasis added).

104 Trucking companies do not provide insurance protection for truckers when operating a truck-tractor without an attached trailer; it is considered a non-business activity. Truckers must separately purchase 'bobtail insurance' to be covered between dropping off one trailer load and picking up the next one. See, e.g. Insure My Rig, <http://www.insuremyrig.com/what-is-bobtail-insurance.html> (last visited Sept. 29, 2015); Understanding the Difference Between Bobtail and Non-Trucking Liability Insurance,

105 76 Fed. Reg. 57138-39 (Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 1).

106 EPA notes in the proposed rule that the trailers that are pulled by Class 7 and 8 tractors account for two-thirds of the heavy-duty sector's total CO<sub>2</sub> emissions and fuel consumption. 80 Fed. Reg. 40253.

107 As a result of studies undertaken as part of initiatives such as the Department of Energy's SuperTruck program and EPA's SmartWay program, design and operational practices have already been developed to cost-effectively reduce those emissions.

108 The fact that the trailer does not itself 'emit,' does not exclude it from EPA's regulatory authority. Section 202(a)(1) authorizes EPA to adopt standards "applicable to the emission of any air pollutant" from new motor vehicles and motor vehicle engines. This statutory grant of authority clearly encompasses standards like those EPA has previously adopted for vehicle attributes that effect emissions, including low-rolling-resistance tires, low-drag brakes, and more aerodynamic vehicle shapes. 75 Fed. Reg. 25374 (2010 Light Duty Vehicle Greenhouse Gas Emission Standards). EPA has likewise interpreted this authority to allow the agency to adopt compliance approaches that reflect upstream emissions. See *id.* See also Response to Comments ("[Section 202(a)] does not directly address what the "standards applicable to" the emissions must be, or how those standards are to be measured. It does not specify how or what mechanisms EPA may reasonably use in applying a standard to vehicle emissions. This leaves EPA with discretion to develop both elements of the standards and the means of measuring compliance with them.").

109 42 U.S.C. § 7521.

110 40 CFR 86.1803-01.

111 40 CFR 86.1803–01 defines a 'complete heavy-duty vehicle' as a heavy-duty vehicle "that has the primary load carrying device or container attached," while a heavy-duty truck without a load-carrying device is considered an 'incomplete vehicle.' Because trailers are 'load carrying devices,' they are implicitly part of the vehicle.

**Organization:** Fitzgerald Truck Sales

**EPA Lacks Authority to Regulate “Glider Kits”**

The distinction between “glider kits” and “glider vehicles” is important because EPA lacks authority to regulate vehicle parts, including assemblages of parts (without an engine) such as glider kits. EPA’s Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act (“CAA”), and the CAA does not provide EPA authority to regulate the sale of motor vehicle components, which is all that glider kits are. The CAA only authorizes EPA to prohibit the sale of uncertified “new motor vehicles” and “new motor vehicle engines.” See 42 U.S.C. § 7522(a)(1). Because glider kits do not contain engines, and have no motive power, regulation of the sale of glider kits is not authorized by the CAA. EPA has been aware of the use of glider kits for over 35 years, and has not attempted to regulate them because they are not “new motor vehicles” or “new motor vehicle engines” under the CAA. [EPA-HQ-OAR-2014-0827-1134-A1 p.4]

**Organization:** Navistar, Inc.

Title II of the Clean Air Act (“CAA”) governs regulation of on-highway medium- and heavy-duty engines and vehicles. According to EPA, the Proposed GHG Rule implements Section 202(a) of Title II of the CAA. That section requires the EPA Administrator to “prescribe (and from time to time revise) . . . standards applicable to the emission of any air pollutant from any class of classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipate to endanger public health and welfare.” 42 U.S.C. § 7521(a)(1). [EPA-HQ-OAR-2014-0827-1199-A1 p.3-4]

The agencies acknowledge in the NPRM that the Proposed Rule is technology-forcing.<sup>2</sup> That is, manufacturers must develop new technologies or significantly improve existing technologies to meet the standards. In that case, the agencies must demonstrate that their predictions are reasonable, that they have answered any theoretical objection to the identified technologies, identified the steps needed for the technology to be completed in the available time and offer reasons that those steps can be completed.<sup>3</sup> Thus EPA bears the burden of laying out the pathway to the predicted technology in order to make its demonstration that a Proposed Rule is feasible. [EPA-HQ-OAR-2014-0827-1199-A1 p.4]

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2 NPRM at 80 Fed. Reg. 40154.

3 Natural Resources Defense Council, Inc. v. US EPA, 655 F.2d 317 (DC Cir 1981).

**Organization:** Neapco

**EPA Lacks Authority to Regulate “Glider Kits”**

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engines, and have no motive power, regulation of the sale of glider kits is not authorized by the CAA. EPA has been aware of the use of glider kits for over 35 years, and has not attempted to regulate them because they are not “new motor vehicles” or “new motor vehicle engines” under the CAA. [EPA-HQ-OAR-2014-0827-1134-A1 p.4]

**Organization:** Recreational Vehicle Industry Association (RVIA)

b. Consistency can be achieved by exempting motorhomes from the Phase 2 Regulation

Under Phase 1, NHTSA and EPA plainly differed on their regulation of motorhomes. While NHTSA exempted such vehicles from fuel efficiency standards for the reasons discussed above, EPA exercised regulatory authority over these vehicles under the Clean Air Act. Such divergent treatment may not be ideal from the regulator's perspective, but harmonization can be worse for the regulated entity where fuel efficiency standards may impose undue costs or require impractical reduction with little fuel savings as they would here. [EPA-HQ-OAR-2014-0827-1261-A1 p.12]

We recognize the importance of regulatory consistency. Executive Order (EO) 13563 requires agencies to 'tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.' The EO seeks to 'promote such coordination, simplification, and harmonization' as will reduce redundancy, inconsistency, and costs of multiple regulatory requirements. [EPA-HQ-OAR-2014-0827-1261-A1 p.12]

The only fair and lawful way to ensure consistency, harmony and cost-effective regulation is for EPA to exclude motorhomes from its regulations as NHTSA is required to do by EISA. The goal of harmonization cannot be used to create legal authority where there is none. NHTSA's authority under EISA is limited to commercial vehicles. EPA should exercise its discretion to follow NHTSA's congressionally mandated course and exclude motorhomes from its Phase 2 regulations. This approach takes into account both legal authority and disproportionate costs on the motorhome sector. [EPA-HQ-OAR-2014-0827-1261-A1 p.12-13]

In order to maintain regulatory consistency, harmony and cost-effectiveness, EPA should also exempt motorhomes entirely from its Phase 2 standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

**Organization:** Truck Renting and Leasing Association

The context for these comments is President Obama's January 18, 2011 executive order on regulatory review, which states that “[w]here relevant, feasible, and consistent with regulatory objectives, and to the extent permitted by law, each agency ... shall consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public” (Executive Order, “Improving Regulation and Regulatory Review,” § 4 (White House, Jan. 18, 2011)). [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

EPA lacks statutory authority.

In our “Authority Objections” section (3), we will discuss the legal rationale the agencies are putting forward for regulating trailers, why that rationale is flawed, and that the agencies should focus their

efforts on end users, which they actually do have authority to regulate. [EPA-HQ-OAR-2014-0827-1172-A1 p.2]

EPA and NHTSA do not have statutory authority to adopt GHG emission and fuel efficiency standards applicable to trailers. [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

Trailers themselves fail to meet the definition of a “motor vehicle” which states: [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

(2) The term “motor vehicle” means any self-propelled vehicle designed for transporting persons or property on a street or highway. [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

Trailers are not self-propelled, do not burn fuel or exhaust “Greenhouse Gasses.” A vehicle is defined as something used for conveyance having a frame, a suspension, and a braking system. A motorized vehicle is a vehicle (such as a car, truck, or motorcycle) that is powered by a motor. A trailer is a *vehicle* that is not motorized and therefore does not fall under the jurisdiction of the Clean Air Act. [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

EPA acknowledges this in its claim to authority and then attempts to dismiss it by claiming that the tractor, when combined with the trailer, together creates the motor vehicle that they are allowed to regulate under the CAA. “Connected together, a tractor and trailer constitute “a self-propelled vehicle designed for transporting . . . property on a street or highway,” and thus meets the definition of “motor vehicle” under Section 216(2) of the CAA.” [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

Trucks and trailers are legally recognized by the U.S. federal and state governments as two different vehicles, each possessing its own DOT vehicle identification number (VIN), state license plate, registration, regulations, and ownership. The EPA cannot legally declare one vehicle part of the other or the two vehicles to be the same or treated as the same vehicle to enable a new regulation. If they do, then it is not the trailer manufacturer who is creating a new motor vehicle. The CAA directs the EPA Administrator to regulate “new motor vehicles.” The trailer is not a motor vehicle under CAA statute until it is “connected” making it possibly subject to EPA authority not at the time the trailer was constructed, but at the time an operator connects it to a tractor and completes the “Self-propelled motor vehicle” that EPA is claiming meets the definition provided under 216(2) of the CAA. At connection, the combination could then be said to meet the definition for “new motor vehicle” in 216(3) since the combination has not yet had its title transferred to the ultimate purchaser, defined in 216(5) as “the first person who in good faith purchases such new motor vehicle.” [EPA-HQ-OAR-2014-0827-1172-A1 p.3-4]

Any given trailer is not intended to be permanently connected to any truck by the trailer OEM for the useful life of the trailer. This is the distinction that makes the trailer different from any other part or component of the truck. The truck has a device that engages the trailer’s king pin and traps it within the truck’s fifth wheel. It is a third party that engages and disengages this truck device, not the trailer, and not the trailer OEM. Specifically, trailer manufacturers do not sell new “tractor-trailers.” As such, the tractor and trailer cannot be considered a single motor vehicle (indeed, a single trailer is likely to be hauled by multiple tractors during its lifetime, and, conversely, a single tractor is likely to haul multiple trailers). [EPA-HQ-OAR-2014-0827-1172-A1 p.4]

Therefore, if the Agency wants to claim, for practical reasons, that the trailer and tractor are a regulated motor vehicle, it can only regulate the party that joined the trailer to the tractor. EPA has been claiming that they cannot regulate end users of trailers, and so must aim their regulations at trailer manufactures,

but this exposes EPA's lack of authority to regulate, for these trailer manufacturers do not create the vehicles that EPA claims authority to regulate. Under the laws given in the CAA and the usual industry practice of creating new combinations of tractors and trailers to be used briefly and then separating the tractor from the trailer to create a new combination, all without transferring the titles of the combination or even of any of the individual components of the combination, it is those end users who are routinely manufacturing motor vehicles and are thus possibly subject to regulation under the laws of the CAA. It is these very end users who could and possibly should be directed to select certain trailer-based GHG-Reduction/Fuel-Economy devices based on how they ultimately use the vehicle they alone assemble. [EPA-HQ-OAR-2014-0827-1172-A1 p.4]

Since a trailer is built for customer specifications and not an intended truck, trailer OEMs cannot be regulated by the EPA GHG-2 regulations. At the time of trailer manufacture, there is no defined or intended truck and the trailer is still a non-motor vehicle. Upon completion and the trailer title is passed from the trailer OEM to the trailer dealer, or end user, there is still no motorized truck that can be associated with the trailer. The trailer can be pulled by a gas, diesel, natural gas, or electric truck in the future with unknown, varying aerodynamic characteristics. When title of the trailer passes, the trailer OEM has no legal ownership of the trailer vehicle and the trailer is not a part of any truck or other motorized vehicle. The trailer at this point is a separate product yet to be put into commerce. The EPA's definition of a trailer being a part of a motorized vehicle has not been met and the OEM no longer has a legal basis to alter the vehicle. [EPA-HQ-OAR-2014-0827-1172-A1 p.4]

The language and structure of the Clean Air Act requirements and prohibitions for new motor vehicles and engines also contradict EPA's interpretation. Those provisions contemplate a single manufacturer of each new motor vehicle or each new motor vehicle engine. For example, Section 206(a)(1) requires EPA to require testing of "any new motor vehicle . . . submitted by a manufacturer" to determine whether the vehicle may be certified as conforming to emissions regulations. Section 206(b) authorizes EPA to conduct emissions testing to determine whether new motor vehicles "manufactured by a manufacturer do in fact conform" after being certified. Section 207 requires "the manufacturer of each new motor vehicle" to provide an emissions warranty to the ultimate purchaser to certify that the vehicle conforms to the emissions regulations and is free of defects for its useful life. And Section 203(a) prohibits "a manufacturer of new motor vehicles or new motor vehicle engines" from selling or importing such vehicles or engines unless covered by a certificate of conformity. The language of these provisions plainly contemplates a single manufacturer that is responsible for each motor vehicle, not multiple manufacturers of "two detachable parts" that together constitute the single motor vehicle, and are mixed and matched in different pairs throughout their lifetime. Moreover, these provisions on their face do not work as applied to "two detachable parts" of a single motor vehicle that are mixed and matched. In the case of separate manufacturers of the tractor and various trailers that might be hauled by that tractor, the requirements to test, certify, and warrant "the motor vehicle" cannot on their face apply as written, since there is no single manufacturer of "the motor vehicle." And responsibility for violations, such as by selling an uncertified new motor vehicle, is unspecified. [EPA-HQ-OAR-2014-0827-1172-A1 p.4-5]

EPA also contends that the tractor minus the engine constitutes a "motor vehicle," even though such a chassis cannot move without the engine. We are skeptical of this assertion. We are aware of no instance in which EPA has sought to regulate a "motor vehicle" that does not contain an engine, for the obvious reason that such a "vehicle" is not self-propelled and thus does not fall within EPA's jurisdiction. In short, Congress authorized EPA to regulate both engines and complete motor vehicles (containing engines), but did not authorize EPA to regulate a trailer, which is not self-propelled, even if that trailer might be regarded as essential to the purpose of a tractor to transport property. [EPA-HQ-OAR-2014-0827-1172-A1 p.5]



Therefore, as the legal basis of the proposal from the EPA perspective is flawed, all parts of the proposal suggesting expansion of regulation of EPA to trailers should be struck. NHTSA regulation should remove requirements that, by extension, require trailer manufacturers to be regulated by EPA by directing compliance with regulations in 40CFR. [EPA-HQ-OAR-2014-0827-1172-A1 p.5]

The legal basis for including trailers in this rulemaking is flawed and as such it should remove trailers from consideration. If the agencies are set on working to reduce greenhouse gas emissions and fuel consumption as a result of trailer use, they would be better served by regulating that use directly. Drivers and fleets are the ones in control of trailer use, from specification thru disposal; they create new tractor-trailer combinations every day and are the ones who purchase fuel and emit greenhouse gas as a result. [EPA-HQ-OAR-2014-0827-1172-A1 p.18]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

### **EPA's Clean Air Act Authority**

#### *Reducing Emissions through Trailer Improvements*

We support EPA's interpretation of its authority to regulate trailer manufacturers, namely, that the trailer manufacturer is a motor vehicle manufacturer subject to compliance with emission standards under section 202 of the Clean Air Act. EPA's prior regulations affecting the manufacturers of major components of the motor vehicle demonstrate the agency's tradition of addressing mobile sources as systems of components that contribute to vehicle emissions. The trailer manufacturer is the entity with control over the design of the trailer -the load-carrying component of the heavy-duty vehicle, and thus a major contributor to that vehicle's emissions. As such, it is eminently reasonable for EPA to devise standards that harness the emissions-reducing opportunities inherent in trailer design. [EPA-HQ-OAR-2014-0827-1896-A1 p.7]

**Organization:** Environmental Defense Fund (EDF)

Along with the NODA, EPA has provided a legal memorandum responding to certain claims made by TTMA that further explicates its legal authority to establish standards for trailers.<sup>16</sup> We support EPA's reasonable interpretation that a combined tractor-trailer is a motor vehicle within the meaning of section 202(a) and agree that EPA has permissibly required trailer manufactures to demonstrate compliance with these requirements. We also support NHTSA's separate statutory authority to adopt standards for trailers. [EPA-HQ-OAR-2014-0827-1886-A1 p.6-7]

a. EPA reasonably determined the combined tractor-trailer constitutes a "new motor vehicle" within the meaning of section 202(a) and has permissibly established standards for trailers on that basis.

Section 202(a)(1) of the Act directs the Administrator to:

by regulation prescribe . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.<sup>17</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.7]

The Act further defines "motor vehicle" to mean "any self-propelled vehicle designed for transporting persons or property on a street or highway."<sup>18</sup> EPA reasonably explained that a combined tractor-trailer

meets the statutory definition for motor vehicle, noting “Class 7/8 heavy-duty vehicles are composed of three major components:—The engine, the cab-chassis (i.e. the tractor), and the trailer,” and “[c]onnected together, a tractor and trailer constitute ‘a self-propelled vehicle designed for transporting . . . property on a street or highway,’ and thus meet the definition of ‘motor vehicle’ under Section 216(2) of the CAA.”<sup>19</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.7]

TTMA argues that, for purposes of regulating trailer manufacturers, the agency must separately consider the tractor and trailer, but later, once physically connected, TTMA seems to concede that the combined tractor-trailer would meet the statutory definition of “motor vehicle.”<sup>20</sup> That conclusion certainly does not flow inextricably from the statute; nor is it reasonable. Indeed, TTMA’s preferred interpretation—which creates artificial limitations on the agency’s ability to establish standards for a “new motor vehicle”—ignores the realities of how these vehicles are designed and used, and would frustrate EPA’s statutory mandate to regulate “the emission of any air pollutant from any class or classes of new motor vehicles.”<sup>21</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.7-8]

In any event, EPA is tasked with interpreting ambiguous statutory provisions and has done so reasonably here, concluding that a trailer is a vehicle “when it has a frame with axles attached.”<sup>22</sup> That interpretation is reasonable, it enables the agency to address a significant source of emissions from new motor vehicles consistent with section 202’s mandate and the underlying purposes of the Act, and should be accorded deference. [EPA-HQ-OAR-2014-0827-1886-A1 p.8]

EPA’s regulation of trailers is likewise consistent with and supported by the agency’s long-standing, holistic approach to addressing pollution from mobile sources. EPA identifies numerous examples, both of section 202 provisions that authorize regulation of specific components, as well as past agency regulations that address specific vehicle components, including by requiring testing of components and incomplete vehicles to certify compliance with emission standards.<sup>23</sup> In addition to these provisions, EPA has, in other instances, reasonably established and assessed compliance with emissions standards based on the ability of the integrated vehicle system to secure reductions. [EPA-HQ-OAR-2014-0827-1886-A1 p.8]

Engine and Vehicle Standards. EPA and NHTSA’s joint Heavy Duty and Light Duty National Programs recognize the reality that reducing emissions from a class of vehicle requires a holistic approach. In the Phase 1 heavy-duty rule, for instance, EPA and NHTSA affirmed “the importance of addressing the entire vehicle in reducing fuel consumption and GHG emissions,”<sup>24</sup> setting separate standards for the tractor cab and the engine installed in the tractor,<sup>25</sup> including “improvements in the tractor (such as aerodynamics), tires, and other vehicle systems.”<sup>26</sup> Similarly, in setting the Phase 1 standards for light-duty vehicles, EPA and NHTSA considered reductions that could be achieved by deploying advanced technologies and optimizing vehicle systems.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.8]

Compliance Assessment. EPA’s Greenhouse Gas Emissions Model (GEM) for medium- and heavy-duty vehicles, supporting Phase 1 and 2, likewise reflects an integrated, holistic approach. GEM allows various vehicle characteristics to be evaluated for compliance with standards, including for Class 7 and 8 tractor manufacturers, inputs like aerodynamic drag, tire rolling resistance, vehicle speed limiter, vehicle weight reduction, and extended idle reduction.<sup>28</sup> These inputs implicate numerous components of the vehicle including the tires, wheels, body, and transmission.<sup>29</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.9]

Similarly, the OMEGA model for light-duty vehicles allows manufacturers to “choose from a myriad of CO<sub>2</sub> reducing technologies,” so that “for a variety of levels of CO<sub>2</sub> emission control, there are an

almost infinite number of technology combinations which produce the desired CO2 reduction.”<sup>30</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.9]

EPA’s past practice reflects a holistic approach to both establishing and assessing compliance with vehicle emission standards, which allows emission standards to be met through improvements to many portions of the integrated vehicle. In keeping with this longstanding approach, EPA has reasonably interpreted its authority to include establishing emission standards for trailers, a major source of emissions from the integrated heavy-duty vehicle. [EPA-HQ-OAR-2014-0827-1886-A1 p.9]

b. EPA has Reasonably Required Trailer Manufacturers to Demonstrate Compliance with Trailer Standards.

TTMA likewise objects that each motor vehicle can have only one manufacturer, that the trailer manufacturer is not ‘the’ manufacturer for the combined tractor-trailer, and thus, that trailer manufacturers cannot be regulated.<sup>31</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.9]

As a threshold matter, section 202(a)(1)—the provision under which EPA has adopted these standards—requires that the agency adopt standards “applicable to . . . new motor vehicles” but does not describe whether one or more entities may be responsible for meeting these standards. In the absence of such a limitation, EPA reasonably determined that standards could apply to trailer manufacturers as well as tractor manufacturers, given that “[t]he trailer manufacturer sets the design specifications that affect the GHG emissions attributable to pulling the trailer.”<sup>32</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.9-10]

Even so, EPA reasonably determined that trailer manufacturers fall within statutory definition of manufacturer in section 216, which is defined as: [EPA-HQ-OAR-2014-0827-1886-A1 p.10]

any person engaged in the manufacturing or assembling of new motor vehicles, new motor vehicle engines, new nonroad vehicles or new nonroad engines, or importing such vehicles or engines for resale, or who acts for and is under the control of any such person in connection with the distribution of new motor vehicles, new motor vehicle engines, new nonroad vehicles or new nonroad engines.<sup>33</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.10]

This definition is capacious and in no way suggests a new motor vehicle must have a single manufacturer. EPA has determined that “[i]t is reasonable to view the trailer manufacturer as ‘engaged in’ (section 216 (1)) the manufacturing or assembling of the tractor-trailer,”<sup>34</sup> and that its responsibility under section 202 of the CAA to “prescribe (and from time to time revise) . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles . . . which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare” includes the authority to regulate the manufacturer of the trailer component of the combined tractor-trailer.<sup>35</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.10]

TTMA points to several provisions in Title II to support its alternative construction, but these provisions do not compel its single-manufacturer interpretation. Moreover, as EPA notes, the single-manufacturer interpretation would result in an unworkable system where entities without design or manufacturing authority would face compliance obligations.<sup>36</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.10]

Accordingly, the agency’s determination to set standards applicable to trailer manufacturers—given that the trailer is a major contributor to the emissions of the heavy duty vehicle—is a reasonable interpretation of the statutory scheme it is entrusted to administer. As such, the decision warrants deference.<sup>37</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.10]

c. NHTSA has Clear Authority to Regulate Trailers

TTMA likewise challenges NHTSA's authority to adopt trailer standards, but those challenges are equally without merit. The Energy Independence and Security Act (EISA) requires NHTSA to create a medium- and heavy-duty fuel efficiency program "designed to achieve the maximum feasible improvement" in fuel efficiency.<sup>38</sup> Inclusion of trailers in NHTSA's program is reasonable, consistent with the statute, and crucial to satisfying NHTSA's mandate to improve fuel efficiency. Moreover, inclusion of trailers in the program reasonably harmonizes EISA with NHTSA's authority under the Motor Vehicle Safety Act (MVSA) and with EPA authority. [EPA-HQ-OAR-2014-0827-1886-A1 p.11]

EISA's fuel economy standards for medium- and heavy-duty on-highway vehicles and work trucks amends 49 U.S.C. 32902, by adding a subsection (k). EISA also amends the defined terms contained in section 32901 by adding the terms, 'automobile,' 'commercial medium- and heavy-duty on-highway vehicle,' 'non-passenger automobile,' and 'work truck,' each of which is defined as a 'vehicle' of a particular type.<sup>39</sup> For example, a commercial medium- and heavy-duty on-highway vehicle is "an on-highway vehicle with a gross vehicle weight rating of 10,000 pounds or more."<sup>40</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.11]

As NHTSA notes in the rule proposal,<sup>41</sup> EISA does not define 'vehicle,' a term that appears repeatedly in the provisions creating the fuel efficiency program for commercial medium- and heavy-duty on-highway vehicles and work trucks, as well as in the definitions of the added terms. Nor is 'vehicle' an otherwise defined term under section 32901. In light of this silence, NHTSA reasonably looked to its organic statute, the MVSA, contained at the same subtitle, which defines motor vehicle as "a vehicle driven or drawn by mechanical power and manufactured primarily for use on public streets, roads, and highways, but does not include a vehicle operated only on a rail line."<sup>42</sup> Relying both on the terms of the MVSA and EISA, NHTSA reasonably determined that trailers be included within the fuel efficiency program. [EPA-HQ-OAR-2014-0827-1886-A1 p.11]

TTMA asserts that the statutory reference to "gross vehicle weight rating" (GVWR) combined with the distinction that EPA drew in a previous rulemaking between GVWR and 'gross combined weight rating' (GCWR) somehow expressly forecloses NHTSA's regulation of trailers.<sup>43</sup> However, at most this reference helps to elucidate the types of tractors contemplated by the regulation and does not expressly (or otherwise) foreclose regulation of trailers. Moreover, contrary to TTMA's assertion, EPA's definition of GVWR considers the "loaded weight" of the vehicle, "in operational status with all standard equipment."<sup>44</sup> Indeed, the term, 'gross combined weight rating,' does not appear in any provision under Title 42 or Title 49. [EPA-HQ-OAR-2014-0827-1886-A1 p.11-12]

Accordingly, NHTSA reasonably concluded that trailers fall within the definition of commercial medium- and heavy-duty on highway vehicle. Doing so is consistent with the statutory text; and reasonably furthers NHTSA's mandate to secure "maximum feasible" improvements in fuel efficiency from medium- and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1886-A1 p.12]

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16 EPA, Legal Memorandum Discussing Issues Pertaining to Trailers, Glider Vehicles, and Glider Kits under the Clean Air Act, Docket ID. No. EPA-HQ-OAR-2014-0827-1627.

17 42 U.S.C. § 7521(a)(1).

18 42 U.S.C. § 7550(2).

19 80 Fed. Reg. 40170.

20 Comment submitted by John Freiler, Engineering Manager, Truck Trailer Manufacturers Association (TTMA) to EPA Proposed Rule: Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2, at 3, Docket ID No. EPA-HQ-OAR-2014-0827-1172 (September 30, 2015).

21 42 U.S.C. § 7521(a)(1).

22 80 Fed. Reg. 40170.

23 EPA, Legal Memorandum Discussing Issues Pertaining to Trailers, Glider Vehicles, and Glider Kits under the Clean Air Act, at 3 (citing examples including section 202 (a)(6) (standards for onboard vapor recovery systems on light-duty vehicles, requiring installation of such systems); section 202 (a)(5)(A) (standards to control emissions from refueling motor vehicles, requiring consideration of, and possible design standards for, fueling system components); 202 (k) (standards to control evaporative emissions from gasoline-fueled motor vehicles); and 40 C.F.R. 86.146-96 and 86.150-98 (refueling spitback and refueling test procedures)).

24 76 Fed. Reg. 57115.

25 76 Fed. Reg. 57134.

26 76 Fed. Reg. 57135.

27 EPA and NHTSA reviewed a wide range of technologies available to manufacturers, including gasoline direct injection, downsized engines that use turbochargers, advanced transmissions, start-stop technology, improved tire rolling resistance, reductions in vehicle weight, and improvements in vehicle air conditioners, including low leak systems. 75 Fed. Reg. 25332.

28 76 Fed. Reg. 57147.

29 In fact, a number of commenters on the proposal requested “that cab doors, cab sides and backs, cab underbodies, frame rails, cross members, clutch housings, transmission cases, axle differential carrier cases, brake drums, and other components be allowed to be replaced with light-weight versions” to meet the tractor fuel consumption and CO<sub>2</sub> emissions standards.” 76 Fed. Reg. 57151.

30 75 Fed. Reg. 25452. Inputs to the OMEGA model include low rolling resistance tires, low friction lubricants, engine friction reduction, aggressive shift logic, early torque converter lock-up, improved electrical accessories, low drag brakes, and advanced gasoline engine and transmission technologies such as turbo/downsizing, gasoline direct injection, and dual-clutch transmission. 75 Fed. Reg. 25449-50.

31 Comment submitted by John Freiler, Engineering Manager, Truck Trailer Manufacturers Association (TTMA), at 5.

32 EPA, Legal Memorandum, at 5.

33 42 U.S.C. § 7550(1) (CAA § 216(1)).

34 EPA, Legal Memorandum at 5.

35 42 U.S.C. § 7521(a)(1).

36 EPA, Legal Memorandum, at 6.

37 See *Chevron, U.S.A. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837, 844 (1984) (Courts “have long recognized that considerable weight should be accorded to an executive department's construction of a statutory scheme it is entrusted to administer.” When an agency’s authority “on a particular question is implicit rather than explicit . . . a court may not substitute its own construction of a statutory provision for a reasonable interpretation made by the administrator of an agency.”).

38 49 U.S.C. 32902(k).

39 The EISA defines both the ‘commercial medium- and heavy-duty on-highway vehicle’ and the ‘work truck’ under section 32901 as a ‘vehicle’ of a particular gross vehicle weight rating. 49 U.S.C. § 32901(a)(7), (19).

40 49 U.S.C. § 32901(a)(7).

41 80 Fed. Reg. 40171.

42 49 U.S.C. § 30102(a)(7).

43 Comment submitted by John Freiler, Engineering Manager, Truck Trailer Manufacturers Association (TTMA), at 6 (“EISA’s definition of “commercial medium- and heavy-duty on-highway vehicle” excludes trailers. GVWR is distinct from the gross combined weight rating (“GCWR”), which includes both the weight of a loaded trailer and the weight of the tractor.”).

44 40 CFR 86.1803-01. GVWR is defined as “the value specified by the manufacturer as the maximum design loaded weight of a single vehicle, consistent with good engineering judgment.” ‘Loaded weight’ is defined as “the vehicle's curb weight plus 300 pounds.” ‘Curb weight’ is defined as “the actual or the manufacturer's estimated weight of the vehicle in operational status with all standard equipment, and weight of fuel at nominal tank capacity, and the weight of optional equipment computed in accordance with § 86.1832-01.”

**Organization:** National Association of Clean Air Agencies (NACAA)

2. February 2016 draft EPA *Legal Memorandum Discussing Issues Pertaining to Trailers, Glider Vehicles, and Glider Kits under the Clean Air Act*

NACAA is a strong proponent of regulating greenhouse gas emissions associated with trailers. In our September 29, 2015 comments, we commended the agency for proposing such regulations for the first time at the national level. In fact, we noted our belief that EPA’s proposed trailer provisions missed several opportunities to maximize fuel efficiency technologies in the heavy-duty trailer sector and urged the agency to consider our recommendations for additional provisions in the final rule. NACAA has also expressed support for the agency’s proposal to close the existing loophole for glider kits and glider vehicles, under which pre-2013 engines – with no limit on age – may be installed into new glider kits without meeting applicable standards. We believe EPA has the environmental obligation to regulate

trailers, glider vehicles and glider kits, as well as the legal authority to do so in the way it proposes and, in fact, could go further. NACAA, therefore, welcomes the agency's draft legal memorandum on this issue that provides clarification of the firm legal basis for its proposed actions. [EPA-HQ-OAR-2014-0827-1890-A1 p.2]

**Organization:** Stoughton Trailers

Non-Vehicle

A trailer is not powered for self-transportation and does not directly produce CO<sub>2</sub>; therefore, is not under the authority of EPA with regard to the area of focus. [EPA-HQ-OAR-2014-0827-1212-A2 p.2]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

**Regarding Section (g) of the Memo: Alternative Provisions for Trailer Manufacturers.**

We would first like to comment on Section (g) of the Memo, which states that EPA is considering an alternative rule that would simply require trailer manufacturers to label and/or provide some test data to show that the trailer is capable of being assembled into a compliant tractor-trailer, and then impose the responsibility of combining compliant trailers with compliant tractors on the motor carriers. While we would want to see the specifics of such a regulation and carefully consider the statutory authority and practical implications, in general we find this approach be superior to the approach taken in the original proposal, for again, as we understand this proposal, the agency would be placing the compliance obligation on the motor carrier in matching tractors to trailers in daily use so as to achieve the regulatory goals. [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

Presuming that the Agencies can regulate the combination of tractors to trailers under the CAA, we could, in principal, agree with the idea that marketing a trailer constructed in such a way that it could not be used to meet those requirements or willfully mislabeled so as to nullify the regulations on the combination of tractors and trailers could be viewed as a defeat-device under the regulation. We would caution that there would undoubtedly be designs of trailers that could be legitimately used in accordance with these regulations the Agency is considering, or be misused by an end user, and the possibility of such misuse must not constitute "causing" the use of a defeat device. [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

**Regarding the remainder of Memo as it pertains to Trailer Manufacturers:**

Section 3 of our previous comment on the proposed rulemaking, submitted on September 30, 2015, contained, set forth our objections to the Agencies' assertion of legal authority to regulate manufacturers of non-motorized trailers, and we again incorporate that discussion here and add the following summary comments: [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

EPA Authority: Congress, in enacting the Clean Air Act, did not authorize EPA to regulate trailers: [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

A trailer is not a "motor vehicle" as that term is defined in the Clean Air Act (i.e. it is not "self-propelled"). [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

Tractors and trailers are manufactured and sold separately by different sets of manufacturers to customer populations that are not the same. As such, the tractor and the trailer cannot be considered a single motor vehicle. [EPA-HQ-OAR-2014-0827-1873-A2 p.2]

The language and structure of the Clean Air Act requirements and prohibitions contemplate a single manufacturer of each new motor vehicle or each new motor vehicle engine. In the case of separate manufacturers of the tractor and various trailers that might be hauled by that tractor, the requirements to test, certify, and warrant “the motor vehicle” cannot on their face apply as written, since there is no single manufacturer of “the motor vehicle.” It also is unclear which of the manufacturers would be responsible for selling an uncertified motor vehicle. [EPA-HQ-OAR-2014-0827-1873-A2 p.2-3]

That the Clean Air Act authorizes EPA to establish standards for certain types of emission-related vehicle components (e.g., onboard vapor recovery systems) does not grant EPA an open-ended license to regulate any vehicle component. To the contrary, that Congress authorized EPA to regulate certain types of components establishes that EPA is not authorized to regulate those components not specifically enumerated in the Act. EPA’s position is limitless and suggests that EPA has authority to regulate the design characteristics of any component or portion of the vehicle, which thereby renders more specific provisions in the Act superfluous, contrary to well-established rules of statutory interpretation. [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

In short, Congress authorized EPA to regulate both engines and complete motor vehicles (containing engines), but Congress did not authorize EPA to regulate a trailer, which is not self-propelled, even if that trailer might be regarded as essential to the purpose of a tractor to transport property. [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

NHTSA Authority: Congress, in enacting the Energy Independence and Security Act (“EISA”), did not authorize NHTSA to regulate trailers. [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

The EISA defines “commercial medium- and heavy-duty on-highway vehicle” to mean “an on-highway vehicle with a gross vehicle weight rating [GVWR] of 10,000 pounds or more.” This definition excludes trailers. In particular, GVWR is widely understood, including by EPA and NHTSA in prior rulemakings, to include only the loaded weight of the tractor, and specifically to exclude the weight of the trailer. [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

GVWR is distinct from the gross combined weight rating (“GCWR”), which includes both the weight of a loaded trailer and the weight of the tractor itself. And indeed, EPA and NHTSA recognized this important distinction in promulgating GHG emission standards and fuel efficiency standards for medium and heavy-duty engines and vehicles in 2011, stating: “GVWR describes the maximum load that can be carried by a vehicle, including the weight of the vehicle itself. Heavy-duty vehicles also have a gross combined weight rating (GCWR), which describes the maximum load that the vehicle can haul, including the weight of a loaded trailer and the vehicle itself.” See 76 Fed. Reg. 57,106, 57,114 (Sept. 15, 2011). [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

In other words, the EISA definition is tethered to GVWR. If Congress intended the definition of “commercial medium- and heavy-duty on-highway vehicle” to include trailers, it could have done so either explicitly or by defining the category of vehicles by reference to GCWR instead of GVWR. [EPA-HQ-OAR-2014-0827-1873-A2 p.3]

The statutory directive for the agency to regulate the fuel economy of commercial medium- and heavy duty on-highway vehicles and work trucks indicates that Congress did not intend to encompass trailers.



Specifically, Section 32902(k) directs the Secretary of Transportation to examine “the fuel efficiency of commercial and medium- and heavy-duty on-highway vehicles,” to determine procedures and methods “for measuring the fuel efficiency of such vehicles,” to take into consideration the “work performed by such on-highway vehicles” and to implement “fuel economy standards.” But trailers do not actually have any source of power, do not consume fuel, and do not do any work by themselves. As discussed above in relation to EPA authority, trailers may be hauled by multiple different tractors, resulting in different fuel economy for the various tractor-trailer combinations. Even if trailers might have aerodynamic characteristics that affect the fuel economy of the tractor that actually uses fuel, the trailer does not itself have “fuel efficiency,” and Congress did not authorize the Secretary to establish aerodynamic requirements. [EPA-HQ-OAR-2014-0827-1873-A2 p.3-4]

## **Conclusion**

While direct regulation of trailer manufacturers remains outside the statutory authority granted under the Clean Air Act or the Energy Independence and Security Act, there is a method suggested in Section (g) of the Memo and laid out in our comments to the proposed rulemaking to accomplish the Agencies’ goals that may be fall within the bounds of statutory authority. While we stand by our contention that EPA’s SmartWay program provides the optimal solution to reducing greenhouse gas emissions and fuel consumption in the heavy duty freight sector, we hope that if the Agencies feel that additional regulation is needed, they will pursue the “Alternative Provisions” approach and work with the trucking industry to create a set of reasonable and effective regulations. [EPA-HQ-OAR-2014-0827-1873-A2 p.4]

Once again, we appreciate the Agencies’ outreach to the trailer manufacturers and pledge to continue our cooperation in efforts to develop the most effective regulations possible within the existing legal framework. [EPA-HQ-OAR-2014-0827-1873-A2 p.4]

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22 E.g. 80FR40612 Table 1 of §1037.107 – Phase 2 CO<sub>2</sub> Standards for Trailers.

23 For Long Dry Vans, the proposal goes from a baseline of 87.6 to 77 g/ton-mile of CO<sub>2</sub> or a 12% reduction. Fuel required roughly scales with the cube of speed, so a reduction of 4% to speed limits, or reducing 65 to 62 would do that.

29 As pointed out in the text, member companies cannot share specifics through the Truck Trailer Manufacturers Association. We will be encouraging individual members to cite this footnote and supply supporting materials as confidential business information.

**Organization:** Utility Trailer Manufacturing Company

Along with its persistent commitment to building the industry’s strongest, lightest, and safest trailers, Utility is an excellent steward of the environment. Utility Trailer therefore appreciates the Agencies’ overall goal of reducing greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1183-A1 p.1]

Unfortunately, by extending its Proposed Rule to semi-trailers, the EPA has adopted an unprecedented interpretation of its authority that exceeds its Congressional authorization. Additionally, the Agencies have based its analysis on assumptions that are completely untethered from the real world, resulting in proposed regulations that will yield minimal, if any, net greenhouse-gas reduction while imposing crippling administrative burdens on the semi-trailer industry. Utility Trailer respectfully requests that the Agencies reconsider the wisdom of pursuing its foray into regulating the aerodynamic performance

of trailers, and – if they nonetheless are committed to this path – to reform their rules to minimize unnecessary burdens on the industry. [EPA-HQ-OAR-2014-0827-1183-A1 p.1]

**Organization:** Volvo Group

Also included in the NoDA were arguments related to the Agencies' authority to regulate glider vehicles and trailers. The Volvo Group fully supports EPA's and NHTSA's efforts to achieve efficiency gains and criteria emissions reductions as related to gliders and trailers, and offer our comments that follow accordingly. [EPA-HQ-OAR-2014-0827-1928-A1 p.3]

### **Comments on Legal Memorandum Pertaining to Trailers, Glider Vehicles, and Glider Kits under the CAA - EPA-HQ-OAR-2014-0827-1627**

Volvo further supports EPA's proposal to regulate trailers, although we have no comment with respect to the Agency's position on its legal authority to do so. The regulation of trailers is integral to the success of EPA's Phase II GHG regulation. As EPA's Proposed Rule notes, the Agency predicts that between 3 percent and 8 percent of anticipated fuel consumption and CO<sub>2</sub> improvements from the Phase II regulations are expected to come from proposed trailer requirements.<sup>8</sup> While it may be possible, with significant investment, research and development, to design tractors to meet these limits using advanced aerodynamic trailers, and while it may be possible to certify tractors using such trailers, these efforts will be significantly undermined in the absence of regulations requiring the development of aerodynamic trailers. The imposition of stringent new GHG standards on tractors is unreasonable in the absence of similar standards for trailers given the relatively low benefits derived from what will require a very substantial investment for vehicle manufacturers. [EPA-HQ-OAR-2014-0827-1928-A1 p.25]

**Organization:** Wabash National Corporation

### **B. Granting "Small" Manufacturers Exemptions Appears Legally Problematic**

EPA's legal basis for temporarily exempting small trailer manufacturers is questionable. While EPA relied on the Regulatory Flexibility Act to create special provisions for small trailer manufacturers, "[t]he Regulatory Flexibility Act's requirements are purely procedural and only require the agency to describe the required topics."<sup>54</sup> The Regulatory Flexibility Act therefore "does not alter the substantive mission of the agencies under their own statutes; rather, the Act creates procedural obligations to assure that the special concerns of small entities are given attention in the comment and analysis process. . . ."<sup>55</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.22]

Here, Section 202 of the CAA sets "the substantive mission" of EPA, authorizing the agency to set emissions standards for on-road vehicles and engines.<sup>56</sup> But the text of Section 202 says nothing about authorizing EPA to grant special exemptions for small manufacturers. In contrast, several other sections of the CAA contain small business exemptions.<sup>57</sup> Reading a similar small business exception into Section 202 is dubious because "[w]here Congress explicitly enumerates certain exceptions to a general prohibition, additional exceptions are not to be implied, in the absence of evidence of a contrary legislative intent."<sup>58</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.22]

The legislative history of Section 202 suggests that Congress did not intend to grant EPA authority for a small manufacturer exemption. In the 1977 CAA amendments, Congress amended Section 202 to create a small manufacturer exemption for certain model years of motor vehicles. That exemption, however,

expired in the 1982 model year and was then repealed as part of the 1990 amendments of the CAA.<sup>59</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.22]

Section 317 of the CAA bolsters the view that Congress never intended EPA to alter or adjust Section 202 emissions standards for small manufacturers. Consistent with the Regulatory Flexibility Act, Section 317 of the CAA requires EPA to prepare a procedural analysis of the “effects” of CAA rulemakings “with respect to small business.”<sup>60</sup> However, Section 317 further provides that “[n]othing” in Section 317 “shall be construed” to “alter the basis on which a standard or regulation is promulgated under this chapter,” including Section 202.<sup>61</sup> Congress, moreover, stripped courts of jurisdiction to consider any claims arising from EPA’s procedural analysis of small business impacts under Section 317.<sup>62</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.23]

None of these elaborate references to small businesses in the CAA would make much sense if EPA could rely on implied authority to craft small business exemptions.<sup>63</sup> Wabash respectfully submits that all trailer manufacturers, including the remaining 80% of the industry that EPA deems small businesses, comply with the proposed Phase 2 standards. [EPA-HQ-OAR-2014-0827-1242-A2 p.23]

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50 *See id.* at 40,285, 40,544–46. In addition to proposing that small manufacturers receive a one-year delay in complying with the 2018 deadline, EPA requested comment on whether a similar one-year delay maybe warranted when the trailer standards become more stringent in 2021 and 2024. *Id.* at 40,285. EPA also requested comment on whether compliance might be delayed in the future where LRR tires and ATIS might be unavailable for small manufacturers. *Id.* Wabash opposes these vague proposals for future delays because they are speculative, unjustified, and unlawful. Generalized fears about the ability to comply years down the road are no basis to grant additional delays now. If concrete problems arise during the implementation of the rule, small manufacturers may petition EPA for relief, which could then be handled pursuant to the agency’s ordinary procedures.

<sup>51</sup> *See id.* at 40,616 (proposed 40 C.F.R. § 1037.150) (“Standards apply on a delayed schedule for manufacturers meeting the small business criteria specified in 13 CFR 121.201.”).

<sup>52</sup> *See, e.g.,* EPA & NHTSA, *Draft Regulatory Impact Analysis: Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2*, at 1–4 (June 2015) [hereinafter “Draft RIA”] (“Trailers are far less mechanically complex than the tractors that haul them, and much of trailer manufacturing is done by hand.”).

<sup>53</sup> Draft RIA at 1-5. *See also* ICR Supporting Statement, at 25 (“Of the 114 trailer manufacturers, 95 are considered small businesses.”).

<sup>54</sup> *Associated Dog Clubs of New York State, Inc. v. Vilsack*, 75 F. Supp.3d 83, 95 (D.D.C. 2014) (citing *Nat’l Tel. Coop. Ass’n v. FCC*, 563 F.3d 536, 540 (D.C. Cir. 2009) and *U.S. Cellular Corp. v. FCC*, 254 F.3d 78, 88 (D.C. Cir. 2001)

<sup>55</sup> *N.C. Fisheries Ass’n, Inc. v. Gutierrez*, 518 F.Supp.2d 62, 72 (D.D.C. 2007) (quoting *Little Bay Lobster Co., Inc. v. Evans*, 352 F.3d 462, 470 (1st Cir. 2003)).

<sup>56</sup> 42 U.S.C. § 7521(a).

<sup>57</sup> See, e.g., 42 U.S.C. § 7511a(b)(3)(A) (exempting certain small gas stations from gasoline vapor recovery); *id.* § 7545(e)(3) (authorizing EPA to exempt, defer, or modify fuel and additive testing for small businesses); *id.* § 7545(o) (granting small refineries certain exemptions from the Renewable Fuels Standard); *id.* § 7625 (vapor recovery for small business marketers of petroleum products); *id.* § 7651(h) (allowance provisions for small diesel refineries); *id.* § 7661f (small business stationary source technical and environmental compliance assistance program).

<sup>58</sup> *TRW Inc. v. Andrews*, 534 U.S. 19, 28 (2001); see also *NRDC v. EPA*, 489 F.3d 1250, 1259 (D.C. Cir. 2007) (“When the Congress wanted to exempt a particular kind of solid waste combustor from [CAA] section 129’s coverage—based on the desirability of resource recovery or any other interest—it knew how to accomplish this through an express statutory exception and in fact did so for four specific classes of combustion units.... Had the Congress intended to exempt all units that combust waste for the purpose of recovering thermal energy, it could likewise have expressly provided for their exemption in the statute.”).

<sup>59</sup> See CAA Amendments of 1977, PL 95-95, 91 Stat. 685, § 201 (formerly codified at CAA § 202(b)(1)(B)), 42 U.S.C. § 7521(b)(1)); *Am. Motors Corp. v. Blum*, 603 F.2d 978 (D.C. Cir. 1979) (vacating EPA action because it violated the small manufacturer exemption formerly found in CAA Section 202(b)(1)(B)).

<sup>60</sup> 42 U.S.C. § 7617(a)(5) (providing that Section 317 applies to rulemakings under Section 202), § 7617(c)(3) (requiring an analysis of small business impacts for rulemakings covered under Section 317).

<sup>61</sup> 42 U.S.C. § 7617(e)(1); see also *id.* § 7617(c) (“Nothing in this section shall be construed to provide that the analysis of the factors specified in this subsection affects or alters the factors which the Administrator is required to consider in taking any action referred to in subsection (a) of this section.”).

<sup>62</sup> 42 U.S.C. § 7617(e)(3) (“Nothing in this section shall be construed. . . to authorize or require any judicial review of any such standard or regulation, or any stay or injunction of the proposal, promulgation, or effectiveness of such standard or regulation on the basis of failure to comply with this section.”); see also *Motor & Equip. Mfrs. Ass’n v. Nichols*, 142 F.3d 449, 467 (D.C. Cir. 1998) (holding that Section 317(e)(3) deprived the court of subject matter jurisdiction to review auto suppliers claims that EPA failed to analyze the small business impacts of a Section 202 rule).

<sup>63</sup> See *Michigan v. EPA*, 268 F.3d 1075, 1084 (D.C. Cir. 2001) (“EPA cannot rely on its general authority [under the CAA] to make rules necessary to carry out its functions when a specific statutory directive defines the relevant functions of EPA in a particular area.”).

**Organization:** Rubber Manufacturers Association (RMA)

#### **IV. EPA Should Not Add Regulatory Text Giving the Agency Authority to Recall Trailer Tires**

In its October 1, 2015 comments, RMA provided several legal and policy reasons why EPA should not give itself recall authority over tires. RMA’s comments seem to be in line with an EPA legal memorandum<sup>4</sup> recently added to the docket and mentioned in the NODA. Specifically, RMA supports EPA’s acknowledgement in the legal memorandum that tire manufacturers are not vehicle manufacturers under the Clean Air Act, meaning that the agency would not have recall authority over tire manufacturers. [EPA-HQ-OAR-2014-0827-1933-A1 p.5]

In the legal memorandum, EPA distinguished tire manufacturers from trailer manufacturers in such a way to make clear that tire manufacturers should not be considered vehicle manufacturers.<sup>5</sup> First, EPA pointed out that GHG emissions attributable to the trailer are a substantial portion of the total GHG emissions from the tractor trailer. Next, the agency noted that the trailer is a significant, integral part of the finished motor vehicle. Then, because of those reasons, EPA asserted that a trailer manufacturer is not analogous to a part or component manufacturer such as a tire manufacturer or a manufacturer of a side skirt. By making these arguments, EPA acknowledged that a tire's impact on a trailer's overall GHG emissions is more attenuated, recognized that tires alone are not a significant portion of a finished motor vehicle, and correctly identified tire manufacturers as part manufacturers. [EPA-HQ-OAR-2014-0827-1933-A1 p.5]

Therefore, by EPA characterizing tire manufacturers as part manufacturers, not vehicle manufacturers, the agency is essentially acknowledging that it would not have recall authority over tire manufacturers. RMA supports this determination for several legal and policy reasons discussed below and in prior comments. [EPA-HQ-OAR-2014-0827-1933-A1 p.6]

In the Preamble to the proposed rule, EPA requested comment on whether it should add regulatory text that would essentially give the agency authority to recall trailer tires that do not conform to the regulations.<sup>6</sup> As support for this idea, EPA pointed to section 207(c)(1) of the Clean Air Act, the Act's recall provision.<sup>7</sup> Section 207(c)(1) notes that: [EPA-HQ-OAR-2014-0827-1933-A1 p.6]

If the Administrator determines that a substantial number of any class or category of vehicles or engines, although properly maintained and used, do not conform to the regulations ... of this title, when in actual use throughout their useful life ... [the Administrator] shall require the manufacturer to submit a plan for remedying the nonconformity of the vehicles or engines...<sup>8</sup> [EPA-HQ-OAR-2014-0827-1933-A1 p.6]

Section 216 of the Clean Air Act defines manufacturer as "any person engaged in the manufacturing or assembling of new motor vehicles ... or [any person] who acts for and is under control of any such person."<sup>9</sup> As noted in past comments, the plain language of these provisions seems to provide EPA with recall authority over manufacturers of vehicles and engines only, not over other part manufacturers. [EPA-HQ-OAR-2014-0827-1933-A1 p.6]

The legislative history provides additional evidence that Congress did not intend to give EPA recall authority over other part manufacturers. The portions of the U.S. House Committee Report and the Conference Report that covered section 207 only mention vehicles and engines as the products that could be recalled under that section of the Clean Air Act.<sup>10</sup> The House Committee also envisioned testing of vehicles and engines to be quick, easy, and uniform, which seems incongruous to the testing process for tires.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1933-A1 p.6]

Additionally, tires are a consumable item, not a durable component of the trailer and EPA has historically focused on durable components of vehicles for recall purposes. In addition, unlike many other emissions-related vehicle components, a tire's efficiency improves (tire rolling resistance decreases) as a tire wears, thus improving the tire's contribution to fuel economy. In the most recent and publicly available guidance document on recalls, EPA tracked vehicle and engine recalls by problem category and none of the categories seem comparable to tires. For example, EPA recalls have primarily been related to the catalytic system, the fuel delivery system, or the computer system based on their direct impact on emissions.<sup>12</sup> A tire's impact on emissions is more attenuated. [EPA-HQ-OAR-2014-0827-1933-A1 p.7]

If EPA's recall regulations were applied to tires, it is unclear how they would be enforced. The agency has acknowledged that insignificant defects do not warrant recalls.<sup>13</sup> But in the proposal EPA does not discuss tolerances or other policies to account for manufacturing or testing variability. Similar issues have been addressed in Europe, where regulations setting rolling resistance performance thresholds set a regulatory allowance of 0.3 kg/t to accommodate sources of variability.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1933-A1 p.7]

Other global regions that have adopted the allowance of +0.3 kg/t allowance for conformity of production testing include: [EPA-HQ-OAR-2014-0827-1933-A1 p.7]

- The Brazilian Regulation # R544 "Conformity Assessment Requirements For New Tires"
- South Korea "Regulations for Measurement of Energy Efficiency of Tires for Motor Vehicles, and Its Rating and Identification"

Without an alignment procedure that addresses sources of testing variability (machine alignment, machine drift, production variation, etc.), demonstrating non-compliance would be very difficult. [EPA-HQ-OAR-2014-0827-1933-A1 p.7]

## **Response: General EPA Authority Issues**

### *Levels of the Standards and Alternative 4*

As described in the FRM preamble and in Chapter 2 of the RIA, the agencies have adopted technology-forcing standards that are fully consistent with the agencies' respective statutory authorities. However, the agencies have determined that the so-called Alternative 4 pull ahead vehicle standards would not provide sufficient lead time (raising, among other things, issues of technical reliability, as noted by a number of commenters), and thus would not be appropriate under either agency's authority.

### *Authority to Exempt Small Businesses*

Wabash Corp. argues that section 202 (a)(1) and (2) do not provide authority for EPA to create exemptions for small businesses. (The comment does not address NHTSA's parallel authority under EISA). The gist of the argument is that section 202 (a)(1) and (2) do not explicitly mention exemption authority or small business impacts, that section 202 previously contained such a provision which was removed in the 1990 amendments, and that other provisions of the Act (notably section 317) do address small business impacts showing that Congress was explicit when desiring EPA to consider such impacts, at least in an exemption context. The comment is perplexing. EPA is required to consider "cost of compliance" in establishing standards under section 202 (a)(2). An aspect of considering costs is (or, at the very least, can be) to consider impacts on small entities. Regulatory costs can impact small businesses disproportionately, and also result in standards which are less cost effective due to the smaller volumes of pollutant emitted. These are all factors EPA at the very least may consider in determining an appropriate regulatory regime. Any exemptions EPA chooses to create as part of this consideration must have a reasoned factual basis, but are certainly not outside EPA's delegated authority. The commenter's reference to the former section 202 (b) (1), which was removed by the 1990 amendments, is misplaced. That provision required EPA to consider a different NOx standard and lead time for vehicles manufactured in the 1981 and 1982 model years by smaller volume producers who did not produce their own catalytic converters and lacked the resources to do so. See *American Motors Corp. v. Boyd*, 603 F.2d 978 (D.C. Cir.1979). The provision was undoubtedly removed in the 1990 amendments because it was moot. Certainly, there is nothing about that former provision

suggesting that EPA cannot consider whether regulation is warranted under section 202 (a)(2) as part of consideration of costs. Cf. *U.S. Sugar Corp. v. EPA*, No. 11-1108 (D.C. Cir. July 29, 2016) slip op. at 52 (“Under the CAA, the EPA may sometimes act with a soft touch, rather than a firm hand”).

#### *Authority to Establish Delegated Assembly Provisions*

Daimler Truck maintains that EPA lacks authority to establish delegated assembly provisions, largely based on a convoluted argument that Congress intended a more restrictive definition of “commerce” in the Clean Air Act (or perhaps in Title II), and that pre-sale vehicles aren’t introduced into commerce under that restricted definition. At the beginning of this argument, Daimler states that EPA bases its delegated assembly regulations on the authority to regulate the “introduction into commerce”. However, this is incomplete and misleading. The relevant statutory prohibition in section 203(a)(1) prohibits not only the “introduction into commerce” of uncertified vehicles, but also the “distribution in commerce” or “sale” of uncertified vehicles (among others). Daimler does not dispute that, without the exemption provided by the delegated assembly regulations, selling and/or distributing vehicles that are not in a certified configuration is prohibited because such vehicles are not actually covered by a valid certificate of conformity. However, because Daimler’s comment focuses on “introduction into commerce”, the remainder of this response addresses that aspect of their comment.

Delegated assembly provisions are, of course, not unique to this rule and have been in place for many years. See, e.g. 73 FR 59034, 59137-38 (Oct. 8, 2008). Daimler has operated under these provisions (as it acknowledges), and so may be raising its comment far out of time. In this regard, EPA has already addressed the issue of the relationship between the “introduced into commerce” provision of section 203 (a)(1) and the need for delegated assembly allowances in light of that provision, and so has already addressed the scope of the delegated assembly allowance. See 70 FR 40424-25 (July 13, 2005). EPA did not reopen, reconsider, or otherwise seek comment on this longstanding interpretation. However, in the event this seemingly untimely comment requires response, EPA believes that Daimler is mistaken for the reasons set out below.

Daimler’s comment presents the following questions:

1. Does EPA have authority to promulgate pre-sale regulations? More specifically, are pre-sale regulations authorized as regulation of vehicles’ “introduction to commerce” under Sec. 202(a)(1)?
2. Assuming EPA’s ability to regulate pre-sale matters, is EPA authorized to regulate contracts between the primary manufacturer and any secondary manufacturers for the installation of emissions-related components?

These questions can be answered simply:

1. Yes. Pre-sale regulations fall within the scope of EPA’s general Title II authority. In addition, “introduction into commerce” includes pre-sale activities, as “commerce” is not narrowly defined in the Clean Air Act.
2. Yes. EPA may condition the granting of certificates of conformity on a wide range of factors, especially when the primary manufacturer is relying on a secondary manufacturer for partial assembly of the vehicle.

We explain these answers below.

### **I. Pre-sale regulation clearly falls within the scope of EPA’s general Title II authority.**

For most of Title II, no line is drawn for the point at which EPA may begin to regulate. In fact, much of Title II specifically contemplates pre-sale regulation. For example, Sec. 203(a)(3)(A) forbids removal or tampering with devices installed “in compliance with regulations under this subchapter prior to its sale...” and Sec. 203 (a)(3)(B) expressly prohibits “any person to manufacture or sell, or offer to sell, or install, any part or component...where a principle effect of the part is to” render such devices inoperative. Certification under section 206 necessarily addresses pre-sale vehicles.

### **II. The Clean Air Act does not create a narrow definition of “commerce.”**

The commenter relies on context clues to argue that the definition of “commerce” under the Clean Air Act (or at least Title II) is narrower than Congress’s authority over commerce. There is no direct evidence of Congressional intent to shrink the definition of commerce in the Clean Air Act, however. In fact, Sec. 216(6) defines “commerce” as “(A) commerce between any place in any State and any place outside thereof; and (B) commerce wholly within the District of Columbia.” (The commenter, surprisingly, does not even cite this provision). If Congress had meant to define commerce differently from its well-accepted and heavily litigated legal definition, which, as the commenter point out, extends to manufacturing activities, it would have done so expressly in Sec. 216.

### **III. “Introduction into commerce” includes pre-sale activities.**

Congress also meant “introduction into commerce” to include manufacturing and other pre-sale activities. The commenter argues that “if Congress considered ‘introduction into commerce’ to include manufacturing, then the ‘manufacture for sale’ is surplusage in the sections of the CAA where it sits alongside mention of sale or introduction into commerce.” However, it is clear that the lists of activities outlined in various parts of the Clean Air Act and quoted in part by the commenter are repetitive by design—otherwise, the same surplusage logic applies with equal force to the term “introduction to commerce” itself. The use of “introduction to commerce” in these lists across the Clean Air Act is instructive:

- Sec. 183(e)(3)(A) (42 U.S.C. Sec. 7511b(e)(3)(A)): “In order to carry out this section, the Administrator may, by regulation, control or prohibit any activity, including the manufacture or introduction into commerce, offering for sale, or sale of any consumer or commercial product...”
- Sec. 187(b)(3) (42 U.S.C. Sec. 7512a(b)(3)): “The State shall submit a revision to require that gasoline sold, supplied, offered for sale or supply, dispensed, transported or introduced into commerce...be blended...”
- Sec. 203(a)(1) (42 U.S.C. Sec. 7522(a)(1)) (the provision at issue here): “In the case of a manufacturer...the sale, or the offering for sale, or the introduction, or delivery for introduction, into commerce [is prohibited]...”
- Sec. 211(a) (42 U.S.C. Sec. 7545(a)): “No manufacturer or processor of any such fuel or additive may sell, offer for sale, or introduce into commerce such fuel or additive...”
- Sec. 211(c)(1) (42 U.S.C. Sec. 7545(c)(1)): “The Administrator may...by regulation, control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle...”



- Sec. 211(f)(2) (42 U.S.C. Sec. 7545(f)(2)): “It shall be unlawful for any manufacturer of any fuel to introduce into commerce any gasoline which contains a concentration of manganese in excess of .0625...”
- Sec. 211(h)(1) (42 U.S.C. Sec. 7545(h)(1)): “The Administrator shall promulgate regulations making it unlawful for any person during the high ozone season...to sell, offer for sale, dispense, supply, offer for supply, transport, or introduce into commerce gasoline...”

It is unclear from many of these lists what independent work “introduce into commerce” is doing. What does it mean, if not “sale, offer for sale, dispense, supply, offer for supply, [or] transport”? It seems to have been designed by Congress as a catch-all term that allows EPA to regulate commerce-related activities, manufacturing included.

Furthermore, those sections of the Clean Air Act either specifically apply to manufacturers (Secs. 203(a)(1), 211(a), and 211(f)(2)), specifically include manufacturing (Secs. 183(e)(3)(A) and 211(c)(1)), or regulate a product in which manufacturing restrictions would be absurd (Sec. 187(b)(3)), which requires gasoline to be blended with oxygen-rich fuels in certain areas and during certain times of the year to provide for attainment of carbon monoxide NAAQS, and Sec. 211(h)(1), which has a similar time- and place-specific requirement to provide for attainment of the ozone NAAQS).

If a manufacturer is being regulated for what it can “introduce into commerce,” that regulation naturally extends to the manufacturing itself. Congress only needed to include “manufacture” in the list of activities that could be regulated for provisions that applied to a broader set of actors than manufacturers themselves.

The commenter also attempts to draw a parallel between “introduction into commerce” and the “useful life” provisions of Title II. That parallel does not seem to exist in any statutory language or legislative history of which EPA is aware. “Useful life” and “introduction into commerce” are used in very different ways in distinct sections of the Clean Air Act, and thus do not inform each other’s definitions.

#### **IV. Legislative history supports the view that Sec. 203 allows for regulation of pre-sale activities.**

The commenter draws attention to changes in the language of Sec. 203 during the passage of the 1970 Clean Air Act Amendments, but brings up no evidence that these changes actually restrict EPA authority to regulate pre-sale activities. Throughout the debates and eventual passage of the 1970 amendments, Congress made sure to characterize all of the changes made to Sec. 203 as either the status quo (“Sections 203, 204, and 205 would be, for practicable purposes, repetition of existing law.” S. Rep. No. 91-1196, at 28) or as expansions of EPA’s authority (“This revised section [203] extends the prohibitions now in the Act” in numerous areas. S. Rep. No. 91-1196, at 61).

Statements made during the House debate of the bill support this interpretation. In regards to Sections 203 and 206, “the bill provides for tighter automotive emission control standards and for new testing and certification procedures to insure that new motor vehicle engines comply with the regulations.” 116 Cong. Rec. 19,220 (1970) (statement of Rep. Monagan). The same is true for hearings in the Senate. “We wrote the law with the intention of giving the Secretary every authority he could conceivably need” in regards to certificates of conformity. *Air Pollution – 1970: Hearing on S. 2466 Before the Subcomm. on Air and Water Pollution of the S. Comm. on Public Works*, 91st Cong. (1970) (Statement of Sen. Muskie).

**V. EPA’s testing and inspection authority extends to creation of the “delegated assembly” regulatory provisions.**

Under Sec. 206(a)(1), EPA is authorized to issue certificates of conformity to manufacturers whose products pass testing requirements laid down by EPA (“tested in such a manner as [the Administrator] deems appropriate”). Part of that testing regime is being able to understand how individual components of the vehicle contribute to emissions or emissions reductions. Sec. 206(a)(3) explains that such a certificate may only be issued if “any emissions control device, system, or element of design” abides by applicable regulations in Sec. 202(a)(4), which allows for the Administrator to consider a number of factors.

As noted above, delegated assembly provisions were created by EPA years ago to handle the realities of the manufacturing process, especially for heavy duty vehicles, in accord with the structure of the Clean Air Act. If most of a vehicle is built by a primary manufacturer, and then emissions control devices or any other part are installed by a secondary manufacturer, EPA must inquire into the communications and contracts between those manufacturers to verify that the correct parts are going on the correct vehicles consistently, and the installation process is occurring according to the regulations. Certificates of conformity are how Congress empowered EPA to verify the consistency of the manufacturing and recordkeeping processes taken by manufacturers so that the agency didn’t have to require extensive testing of every vehicle that came off the line. Delegated assembly provisions, including certain requirements for contracts between primary and secondary manufacturers, allow EPA to continue to issue certificates of conformity for manufacturers who do not assemble the entire vehicle on their own. Without those provisions, EPA would be unable to verify that Sec. 206(a)(3)’s statutory mandate was fulfilled.

The commenter argues that even if EPA can regulate prior to first sale of a vehicle, it still can only adopt “test-based” provisions, and concludes that “prescribing procedures relating to contracts between manufacturers is not ‘testing’”. This argument fails for the reasons just given. The delegated assembly provisions are a necessary adjunct to the certification (i.e. testing) requirements which are the heart of Title II’s compliance regime. This is not regulating the means of manufacture, as the commenter would have it, but rather part of the process of assuring that the vehicle will be assembled in its certified condition.

Finally, Daimler omits mention of several additional relevant points. First, delegated assembly is an option provided as a flexibility in multi-manufacturer situations, but Daimler is free to be the sole manufacturer of the motor vehicle. Second, even if (against our view) one were to accept the commenter’s argument of a restrictive definition of commerce, “the offering for sale” and the “delivery for introduction, into commerce” of vehicles without a certificate would still be prohibited. See section 203 (a)(1) of the Act. (As noted above, these additional prohibitions also indicate on their face that pre-sale activities are within EPA’s authority under Title II.) Thus, a vehicle must evidently be in certified condition pre-sale by some means. The delegated assembly provisions provide flexibility in multi-manufacturer situations but they are voluntary. Daimler remains free to act as a sole manufacturer should it not wish to utilize the delegated assembly flexibility.

*Recall Authority over Tires*

The Rubber Manufacturers Association maintain that recall authority exists only with respect to vehicles and engines, and because tires are a part, and not a vehicle or an engine, tire manufacturers cannot be compelled to recall tires. The commenter also points to EPA’s discussion in the context of trailers and glider kits which it believes illustrates that, unlike trailers and glider kits, tires are parts, not vehicles.

CAA section 207(c)(1) requires “the manufacturer” to remedy certain in-use problems. The remedy process is generally called recall, and the regulations for this process are in 40 CFR part 1068, subpart F. EPA requested comment on whether to apply these requirements to tire manufacturers in the case of in-use problems with trailer tires. EPA is not adopting this suggestion in the Phase 2 rules, and so we are not requiring that component manufacturers conduct recalls independent of the certificate holder. The Rubber Manufacturers Association indicates correctly that tires are not incomplete vehicles and hence that the recall authority does not apply. However, EPA remains of the view that in the event that trailers do not conform to the standards in-use due to nonconforming tires, tire manufacturers would have a role to play in remedying the problem. In this (hypothetical) situation, a tire manufacturer would not only have produced the part in question, but would have significantly more resources and knowledge regarding how to address (and redress) the problem. Accordingly, EPA would likely require that a component manufacturer responsible for the nonconformity assist in the recall to an extent and in a manner consistent with the provisions of CAA 208 (a). This section specifies that component and part manufacturers “shall establish and maintain records, perform tests where such testing is not otherwise reasonably available under this part and part C of this subchapter (including fees for testing), make reports and provide information the Administrator may reasonably require to determine whether the manufacturer or other person has acted or is acting in compliance with this part and part C of this subchapter and regulations thereunder, or to otherwise carry out the provision of this part and part C of this subchapter...”. Any such action would be considered on a case-by-case basis, adapted to the particular circumstances at the time.

### **Response: EPA Authority for Gliders and Trailers**

In this final rule, EPA is establishing first-time CO<sub>2</sub> emission standards for trailers hauled by tractors. 80 FR 40170. Certain commenters, notably the Truck Trailer Manufacturers Association (TTMA), maintained that EPA lacks authority to adopt requirements for trailer manufacturers, and that emission standards for trailers could be implemented, if at all, by requirements applicable to the entity assembling a tractor-trailer combination. The argument is that trailers by themselves are not “motor vehicles” as defined in section 216 (2) of the Act, that trailer manufacturers therefore do not manufacture motor vehicles, and that standards for trailers can be imposed, if at all, only on “the party that joined the trailer to the tractor.” Comments of TTMA, p. 4; Comments of TTMA (March 31, 2016) p. 2.

EPA also proposed a number of changes and clarifications for rules respecting glider kits and glider vehicles. 80 FR 40527-40530. As shown in **Error! Reference source not found.**, a glider kit is a tractor chassis with frame, front axle, interior and exterior cab, and brakes. It is intended for self-propelled highway use, and becomes a glider vehicle when an engine, transmission, and rear axle are added. Engines are often salvaged from earlier model year vehicles, remanufactured, and installed in the glider kit. The final manufacturer of the glider vehicle, i.e. the entity that installs an engine, is typically a different manufacturer than the original manufacturer of the glider kit. The final rule contains emission standards for engines used in glider vehicles and for greenhouse gas emissions from glider vehicles, but does not contain separate standards for glider kits.<sup>2</sup>

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<sup>2</sup> As discussed below, however, manufacturers of glider kits can, and typically are, responsible for obtaining a certificate of conformity before shipping a glider kit. This is because they are manufacturers of motor vehicles, in this case, an incomplete vehicle. Note that Daimler, in its comments, essentially indicates (in the context of comments related to delegated assembly provisions) that EPA may adopt “test-based” provisions for manufacturers of incomplete vehicles (“even if the EPA could regulate prior to the first use of an engine or



**Figure 1 - Typical Glider Kit Configuration**

Many commenters to both the proposed rule and the NODA supported EPA's interpretation. However, a number of commenters, including Daimler, argued that glider kits are not motor vehicles and so EPA lacks the authority to impose any rules respecting their sale or configuration. Comments of Daimler, pp.

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vehicle, Congress authorized only test-based standards ...testing of vehicles or engines is the means by which the EPA determines the compliance that is necessary for a vehicle or engine's introduction into commerce") The provisions applicable to glider kits are just this type of testing provision, examples being testing of tires and aerodynamic components to generate inputs used in the certification process. (The commenter's arguments that other aspects of the delegated assembly provisions are impermissible are addressed earlier in this same Response).

122-23; Comments of Daimler Trucks (April 1, 2016) pp. 2-3. We respond to these comments below, with additional discussion in RTC Section 14.2.

Under the Act, “motor vehicle” is defined as “any self-propelled vehicle designed for transporting persons or property on a street or highway.” CAA section 216 (2). At proposal, EPA maintained that tractor-trailers are motor vehicles and that EPA therefore has the authority to promulgate emission standards for complete and incomplete vehicles – both the tractor and the trailer. 80 FR 40170. The same proposition holds for glider kits and glider vehicles. *Id.* at 80 FR 40528. The argument that a trailer, or a glider kit, standing alone, is not self-propelled, and therefore is not a motor vehicle, misses the key issues of authority under the Clean Air Act to promulgate emission standards for motor vehicles produced in discrete segments, and the further issue of the entities – namely “manufacturers” – to which standards and certification requirements apply. Simply put, EPA is authorized to set emission standards for complete and incomplete motor vehicles, manufacturers of complete and incomplete motor vehicles can be required to certify to those emission standards, and there can be multiple manufacturers of a motor vehicle, each of which can be required to certify.

#### *Standards for Complete Vehicles – Tractor-Trailers and Glider Vehicles*

Section 202 (a)(1) authorizes EPA to set standards “applicable to the emission of any air pollutant from any ... new motor vehicles.” There is no question that EPA is authorized to establish emission standards under this provision for complete new motor vehicles, and thus can promulgate emission standards for air pollutants emitted by tractor-trailers and by glider vehicles.

Daimler maintained in its comments that although a glider vehicle is a motor vehicle, it is not a “new” motor vehicle because “glider vehicles, when constructed retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not ‘new’ under the CAA.” Daimler Comments p. 121; see also the similar argument in Daimler Truck Comments (April 1, 2016), p. 4. Daimler maintains that because title to the powertrain from the donor vehicle has already been transferred, the glider vehicle to which the powertrain is added cannot be “new.” Comments of April 1, 2016 p. 4. Daimler also notes that NHTSA considers a truck to be “newly manufactured” and subject to Federal Motor Vehicle Safety Standards when a new cab is used in its assembly, “unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle.” 49 CFR 571.7(e). Daimler urges EPA to adopt a parallel provision here.

First, this argument appears to be untimely. In Phase 1, EPA already indicated that glider vehicles are new motor vehicles, at least implicitly, by adopting an interim exemption for them. See 76 FR 57407 (adopting 40 CFR 1037.150(j) indicating that the general prohibition against introducing a vehicle not subject to current model year standards does not apply to MY 2013 or earlier engines). Assuming the argument that glider vehicles are not new can be raised in this rulemaking, EPA notes that the Clean Air Act defines “new motor vehicle” as “a motor vehicle the equitable or legal title to which has never been transferred to an ultimate purchaser” (section 216(3)). Glider vehicles are typically marketed and sold as “brand new” trucks. Indeed, one prominent assembler of glider kits and glider vehicles advertises that “Fitzgerald Glider Kits offers customers the option to purchase a *brand new 2016 tractor*, in any configuration offered by the manufacturer... Fitzgerald Glider Kits has mastered the process of taking the ‘Glider Kit’ and installing the components to work seamlessly *with the new truck.*”<sup>3</sup> The purchaser

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<sup>3</sup> Advertisement for Fitzgerald Glider kits in Overdrive magazine (December 2015)(emphasis added).

of a “new truck” necessarily takes initial title to that truck.<sup>4</sup> Daimler would have it that this ‘new truck’ terminology is a mere marketing ploy, but it obviously reflects reality. As shown in **Error! Reference source not found.** above, the glider kit constitutes the major parts of the vehicle, lacking only the engine, transmission, and rear axle. The EPA sees nothing in the Act that compels the result that adding a used component to an otherwise new motor vehicle necessarily vitiates classification of the motor vehicle as “new.” See 80 FR 40528. Certainly, there is no language in the definition of “new motor vehicle” which directly addresses this issue. Indeed, as noted in Preamble section I.E.1, the definition of “new motor vehicle engine” encompasses engines of any vintage. At the least, this shows that the model year of the engine is not determinative of whether the motor vehicle is “new”. Put another way, a “new motor vehicle” can contain an earlier model year engine. See CAA section 216 (3).<sup>5</sup> Many commenters agreed. See, e.g. Comments of MECA (“Glider vehicles are classified as “new motor vehicles” because they use a new chassis, although they can continue to use engines that are 10-15 years old and emit 20-40 times more pollution than vehicles equipped with a new engine”). Thus, EPA is reasonably interpreting the Act to indicate that adding the engine and transmission to the otherwise-complete vehicle does not prevent the glider vehicle from being “new” – as marketed. As to the suggestion to adopt a provision parallel to the NHTSA definition, EPA notes that the NHTSA definition was developed for different purposes using statutory authority which differs from the Clean Air Act in language and intent. There consequently is no basis for requiring EPA to adopt such a definition, and doing so would impede meaningful control of both GHG emissions and criteria pollutant emissions from glider vehicles, the latter being an imperative, immediate public health concern (see RTC 14.2).

#### *Standards for Incomplete Vehicles*

Section 202 (a)(1) not only authorizes EPA to set standards “applicable to the emission of any air pollutant from any ... new motor vehicles,” but states further that these standards are applicable “whether such vehicles ... are designed as complete systems or incorporate devices to prevent or control such pollution.” The Act in fact thus not only contemplates, but in some instances, directly commands that EPA establish standards for incomplete vehicles and vehicle components. See CAA section 202 (a)(6) (standards for onboard vapor recovery systems on “new light-duty vehicles,” and requiring installation of such systems); section 202 (a)(5)(A) (standards to control emissions from refueling motor vehicles, and requiring consideration of, and possible design standards for, fueling system components); 202 (k) (standards to control evaporative emissions from gasoline-fueled motor vehicles). Both TTMA and Daimler argued, in effect, that these provisions are the exceptions that prove the rule and that without this type of enumerated exception, only entire, complete vehicles can be considered to be “motor vehicles.” This argument is not persuasive. Congress did not indicate that these incomplete vehicle provisions were exceptions to the definition of motor vehicle. Just the opposite. Without amending the new motor vehicle definition, or otherwise indicating that these provisions were not already encompassed within Title II authority over “new motor vehicles”, Congress required EPA to set standards for evaporative emissions from a portion of a motor vehicle. Congress thus indicated in these provisions: 1) that standards should apply to “vehicles” whether or not the “vehicles” were designed as complete systems; 2) that some standards should explicitly apply only to certain components of a

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<sup>4</sup> Fitzgerald states “All Fitzgerald glider kits will be titled in the state of Tennessee and you will receive a title to transfer to your state.” <https://www.fitzgeraldgliderkits.com/frequently-asked-questions>. Last accessed July 9, 2016.

<sup>5</sup> EPA has also previously addressed the issue of used components in new engines and vehicles explicitly in regulations in the context of locomotives and locomotive engines in 40 CFR part 1033. There we defined remanufactured locomotives and locomotive engines to be “new” locomotives and locomotive engines. See 63 FR 18980; see also Summary and Analysis of Comments on Notice of Proposed Rulemaking for Emission Standards for Locomotives and Locomotive Engines (EPA-420-R-97-101 (December 1997)) at pp. 10-14.

vehicle that are plainly not self-propelled. Congress thus necessarily was of the view that incomplete vehicles can be motor vehicles.

Emission standards EPA sets pursuant to this authority thus can be, and often are focused on emissions from the new motor vehicle, and from portions, systems, parts, or components of the vehicle. Standards thus apply not just to exhaust emissions, but to emissions from non-exhaust portions of a vehicle, or from specific vehicle components or parts. See the various evaporative emission standards for light duty vehicles in 40 CFR part 86, subpart B (e.g., 40 CFR 86.146-96 and 86.150-98 (refueling spitback and refueling test procedures); 40 CFR 1060.101-103 and 73 FR 59114-59115 (various evaporative emission standards for small spark ignition equipment); 40 CFR 86.1813-17(a)(2)(iii) (canister bleed evaporative emission test procedure, where testing is solely of fuel tank and evaporative canister); see also 79 FR 23507 (April 28, 2014) (incomplete heavy duty gasoline vehicles could be subject to, and required to certify compliance with, evaporative emission standards)). These standards are implemented by testing the particular vehicle component, not by whole vehicle testing, notwithstanding that the component may not be self-propelled until it is installed in the vehicle or (in the case of non-road equipment), propelled by an engine.<sup>6</sup>

EPA thus can set standards for all or just a portion of the motor vehicle notwithstanding that an incomplete motor vehicle may not yet be self-propelled. This is not to say that the Act authorizes emission standards for any part of a motor vehicle, however insignificant. Under the Act it is reasonable to consider both the significance of the components in comparison to the entire vehicle and the significance of the components for achieving emissions reductions. A vehicle that is complete except for an ignition switch can be subject to standards even though it is not self-propelled. Likewise, as just noted, vehicle components that are significant for controlling evaporative emissions can be subject to standards even though in isolation the components are not self-propelled. However, not every individual component of a complete vehicle can be subjected to standards as an incomplete vehicle. To reflect these considerations, EPA is adopting provisions stating that a trailer is a vehicle “when it has a frame with one or more axles attached,” and a glider kit becomes a vehicle when “it includes a passenger compartment attached to a frame with one or more axles.” Section 1037.801 definition of “vehicle,” paragraphs (1)(ii) and (iii); see also Section XIII.B of the FRM Preamble.

TTMA and Daimler each maintained that this claim of authority is open-ended, and can be extended to the least significant vehicle part. As noted above, EPA acknowledges that lines need to be drawn, but whether looking at the relation between the incomplete vehicle and the complete vehicle, or looking at the relation between the incomplete vehicle and the emissions control requirements, it is evident that trailers and glider kits should properly be treated as vehicles, albeit incomplete ones.<sup>7</sup> They properly fall on the vehicle side of the line. When one finishes assembling a whole aggregation of parts to make a finished section of the vehicle (e.g. the trailer), that is sufficient. You have an entire, complete section made up of assembled parts. Everything needed to be a trailer is complete. This is not an engine block, a wheel, or a headlight. Similarly, glider kits comprise the largely assembled tractor chassis with front axles, frame, interior and exterior cab, and brakes. This is not a few assembled components; rather, it is an assembled truck with a few components missing. See CAA section 216 (9) of the Act, which defines

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<sup>6</sup> “Non-road vehicles” are defined differently than “motor vehicles” under the Act, but the difference does not appear relevant here. Non-road vehicles, like motor vehicles, must be propelled by an engine. See CAA section 216 (11) (“nonroad vehicle” means a vehicle that is powered by a nonroad engine”). Pursuant to this authority, EPA has promulgated many emission standards applicable to components of engineless non-road equipment, for which the equipment manufacturer must certify.

<sup>7</sup> Cf. *Marine Shale Processors v. EPA*, 81 F. 3d 1371, 1383 (5th Cir. 1996) (“[w]e make no comment on this argument: this is simply not a thimbleful case”).

“motor vehicle or engine part manufacturer” as “any person engaged in the manufacturing, assembling or rebuilding of any device, system, part, component or element of design which is installed in or on motor vehicles or motor vehicle engines.” Trailers and glider kits are not “installed in or on” a motor vehicle. A trailer is half of the tractor-trailer, not some component installed on the tractor. And one would more naturally refer to the donor drivetrain being installed on the glider kit than vice versa. See Figure 1 above. Furthermore, as discussed below, the trailer and the glider kit are significant for purposes of controlling emissions from the completed vehicle.

Incomplete vehicle standards must, of course, be reasonably designed to control emissions caused by that particular vehicle segment. The standards for trailers would do so and account for the tractor-trailer combination by using a reference tractor in the trailer test procedure (and, conversely, by use of a reference trailer in the tractor test procedure). The Phase 2 rule contains no emission standards for glider kits in isolation, but the standards for engines installed in glider vehicles, and the greenhouse gas standards for the glider vehicles, necessarily reflect the contribution of the glider kit.

#### *Application of Emission Standards to Manufacturers*

In some ways, the critical issue is to whom do these emission standards apply.<sup>8</sup> As explained in this section, the emission standards apply to manufacturers of motor vehicles, and manufacturers thus are required to certify compliance to test and to certify compliance to those standards. Moreover, the Act contemplates that a motor vehicle can have multiple manufacturers. With respect to the further question of which manufacturer certifies and tests in multiple manufacturer situations, EPA rules have long contained provisions establishing responsibilities where a vehicle has multiple manufacturers. We are again applying the principles already established in these rules in the Phase 2 provisions. The overarching and common sense principle is that the entity with most control over the particular vehicle segment due to producing it is usually the most appropriate entity to test and certify.<sup>9</sup> EPA is implementing the trailer and glider vehicle emission standards in accord with this principle, so that the entities required to test and certify are the trailer manufacturer and, for glider kits and glider vehicles, either the manufacturer of the glider kit or glider vehicle, depending on which is more appropriate in individual circumstances.

#### *Definition of Manufacturer*

Emission standards are implemented through regulation of the manufacturer of the new motor vehicle. See, e.g. section 206 (a)(1) (certification testing of motor vehicle submitted by “a manufacturer”); 203 (a)(1) (manufacturer of new motor vehicle prohibited from introducing uncertified motor vehicles into commerce); 207 (a)(1) (manufacturer of motor vehicle to provide warranty to ultimate purchaser of

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<sup>8</sup> This issue is independent of the discussion above, and thus is not dependent on whether trailers are motor vehicles. Under any theory, EPA may issue emission standards for new motor vehicles and engines. Manufacturers of these vehicles and engines can be required to comply with these standards by testing and certification, and the Act contemplates multiple manufacturers to whom these obligations can attach.

<sup>9</sup> See discussion of standards applicable to small SI equipment fuel systems, implemented by standards for the manufacturers of that equipment at 73 FR 59115 (“In most cases, nonroad standards apply to the manufacturer of the engine or the manufacturer of the nonroad equipment. Here, the products subject to the standards (fuel lines and fuel tanks) are typically manufactured by a different manufacturer. In most cases the engine manufacturers do not produce complete fuel systems and therefore are not in a position to do all the testing and certification work necessary to cover the whole range of products that will be used. We are therefore providing an arrangement in which manufacturers of fuel-system components are in most cases subject to the standards and are subject to certification and other compliance requirements associated with the applicable standards.”).



compliance with applicable emission standards); 207 (c) (recall authority); 208 (a) (recordkeeping and testing can be required of every manufacturer of new motor vehicle).

The Act further distinguishes between manufacturers of motor vehicles and manufacturers of motor vehicle parts. See, e.g. section 206 (a)(2) (voluntary emission control system verification testing); 203 (a)(3)(B) (prohibition on parts manufacturers and other persons relating to defeat devices); 207 (a)(2) (parts manufacturer may provide warranty certification regarding use of parts); 208 (a) (recordkeeping and testing requirements for manufacturers of vehicle and engine “parts or components”).

Thus, the question here is whether a trailer manufacturer or glider kit manufacturer can be a manufacturer of a new motor vehicle and thereby become subject to the certification and related requirements for manufacturers, or must necessarily be classified as a manufacturer of a motor vehicle part or component. EPA may reasonably classify trailer manufacturers and glider kit manufacturers as motor vehicle manufacturers.

Section 216 (1) defines a “manufacturer” as:

“any person engaged in the manufacturing or assembling of new motor vehicles, new motor vehicle engines, new nonroad vehicles or new nonroad engines, or importing such vehicles or engines for resale, or who acts for and is under the control of any such person in connection with the distribution of new motor vehicles, new motor vehicle engines, new nonroad vehicles or new nonroad engines, but shall not include any dealer with respect to new motor vehicles, new motor vehicle engines, new nonroad vehicles or new nonroad engines received by him in commerce”

It appears plain that this definition was not intended to restrict the definition of “manufacturer” to a single person per vehicle. The use of the conjunctive, specifying that a manufacturer is “*any* person engaged in the manufacturing or assembling of new motor vehicles . . . *or* who acts for and is under the control of any such person...” (emphasis added) indicates that Congress anticipated that motor vehicles could have more than one manufacturer, since in at least some cases those will plainly be different people. The capacious reference to “any person engaged in the manufacturing of motor vehicles” likewise allows the natural inference that it could apply to multiple entities engaged in manufacturing.<sup>10</sup>

The provision also applies both to entities that manufacture and entities that assemble, and does so in such a way as to encompass multiple parties: manufacturers “or” (rather than ‘and’) assemblers are included. Nor is there any obvious reason that only one person can be engaged in vehicle manufacture or vehicle assembling.

Reading the Act to provide for multiple motor vehicle manufacturers reasonably reflects industry realities, and achieves important goals of the CAA. Since title II requirements are generally imposed on “manufacturers” it is important that the appropriate parties be included within the definition of manufacturer --“any person engaged in the manufacturing or assembling of new motor vehicles.” Indeed, as set out in Chapter 1 of the RIA, most heavy-duty vehicles are manufactured or assembled by multiple entities; see also Comments of Daimler (October 1, 2015) p. 103.<sup>11</sup> One entity produces a

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<sup>10</sup> See *United States v. Gonzales*, 520 U.S. 1, 5, (1997) (“Read naturally the word ‘any’ has an expansive meaning, that is, ‘one or some indiscriminately of whatever kind’”); *New York v. EPA*, 443 F.3d 880, 884-87 (DC Cir. 2006).

<sup>11</sup> “The EPA should understand that vehicle manufacturing is a multi-stage process (regardless of the technologies on the vehicles) and that each stage of manufacturer has the incentive to properly complete manufacturing ...[T]he

chassis; a different entity manufactures the engine; specialized components (e.g. garbage compactors, cement mixers) are produced by still different entities. For tractor-trailers, one person manufactures the tractor, another the trailer, a third the engine, and another typically assembles the trailer to the tractor. Installation of various vehicle components occurs at different and varied points and by different entities, depending on ultimate desired configurations. See, e.g. Comments of Navistar (October 1, 2015), pp. 12-13. The heavy-duty sector thus differs markedly from the light-duty sector (and from manufacturing of light duty pickups and vans), where a single company designs the vehicle and engine (and many of the parts), and does all assembling of components into the finished motor vehicle.

### *Controls on Manufacturers of Trailers*

It is reasonable to view the trailer manufacturer as “engaged in” (section 216 (1)) the manufacturing or assembling of the tractor-trailer. The trailer manufacturer designs, builds, and assembles a complete and finished portion of the tractor-trailer. All components of the trailer – the tires, axles, flat bed, outsider cover, aerodynamics – are within its control and are part of its assembling process. The trailer manufacturer sets the design specifications that affect the GHG emissions attributable to pulling the trailer. It commences all work on the trailer, and when that work is complete, nothing more is to be done. The trailer is a finished product. With respect to the trailer, the trailer manufacturer is analogous to the manufacturer of the light duty vehicle, specifying, controlling, and assembling all aspects of the product from inception to completion. GHG emissions attributable to the trailer are a substantial portion of the total GHG emissions from the tractor-trailer.<sup>12</sup> Moreover, the trailer manufacturer is not analogous to the manufacturer of a vehicle part or component, like a tire manufacturer, or to the manufacturer of a side skirt. The trailer is a significant, integral part of the finished motor vehicle, and is essential for the tractor-trailer to carry out its commercial purpose. See 80 FR 40170; see also the comment of EDF at n. 104, explaining that trucking companies do not provide insurance protection for truckers when operating a truck-tractor without an attached trailer; it is considered to be a non-business activity).<sup>13</sup> Although it is true that another person may ultimately hitch the trailer to a tractor (which might be viewed as completing assembly of the tractor-trailer), as noted above, EPA does not believe that the fact that one person might qualify as a manufacturer, due to “assembling” the motor vehicle, precludes another person from qualifying as a manufacturer, due to “manufacturing” the motor vehicle. Given that section 216(1) does not restrict motor vehicle manufacturers to a single entity, it appears to be consistent with the facts and the Act to consider trailer manufacturers as persons engaged in the manufacture of a motor vehicle.

This interpretation of section 216(1) is also reasonable in light of the various provisions noted above relating to implementation of the emissions standards – certification under section 206, prohibitions on entry into commerce under section 203, warranty and recall under section 207, and recall under section 208. All of these provisions are naturally applied to the entity responsible for manufacturing the trailer, which manufacturer is likewise responsible for its GHG emissions.

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EPA should continue the longstanding industry practice of allowing primary manufacturers to pass incomplete vehicles with incomplete vehicle documents to secondary manufacturers who complete the installation.”

<sup>12</sup> The relative contribution of trailer controls depends on the types of tractors and trailers, as well as the tier of standards applicable; however, it can be approximately one-third of the total reduction achievable for the tractor-trailer.

<sup>13</sup> Truckers must separately purchase ‘bobtail insurance’ to be covered between dropping off one trailer load and picking up the next one. See, e.g. Insure My Rig, <http://www.insuremyrig.com/what-is-bobtail-insurance.html> (last visited Sept. 29, 2015); Understanding the Difference Between Bobtail and Non-Trucking Liability Insurance.

TTMA maintains that if a tractor-trailer is a motor vehicle, then only the entity connecting the trailer to the tractor could be subject to regulation.<sup>14</sup> This is not a necessary interpretation of section 216 (1), as explained above. TTMA does not discuss that provision, but notes that other provisions refer to “a” manufacturer (or, in one instance, “the” manufacturer), and maintains that this shows that only a single entity can be a manufacturer. See TTMA Comment pp. 4-5, citing to sections 206 (a)(1), 206 (b), 207, and 203 (a). This reading is not compelled by the statutory text. First, the term “manufacturer” in all of these provisions necessarily reflects the underlying definition in section 216(1), and therefore is not limited to a single entity, as just discussed. Second, the interpretation makes no practical sense. An end assembler of a tractor-trailer is not in a position to certify and warrant performance of the trailer, given that the end-assembler has no control over how trailers are designed, constructed, or even which trailers are attached to the tractor. It makes little sense for the entity least able to control the outcome to be responsible for that outcome. The EPA doubts that Congress compelled such an ungainly implementation mechanism, especially given that it is well known that vehicle manufacture responsibility in the heavy-duty vehicle sector is divided. Moreover, the reference to “a” rather than “the” manufacturer in the provisions of section 206(a)(1) and 203(a)(1) – the provisions on vehicle certification and prohibited acts which are the most critical to Title II’s implementation -- is ambiguous as to whether there can be multiple manufacturers. See Webster’s New Collegiate Dictionary (1979) (definition of “a” includes “any”, the same capacious term used in the section 216 definition of “manufacturer”).

TTMA further maintains that the various requirements and prohibitions in Title “on their face do not work as applied to ‘two detachable parts’ of a single motor vehicle that are mixed and matched. In the case of separate manufacturers of the tractor and various trailers that might be hauled by that tractor, the requirements to test, certify, and warrant ‘the motor vehicle’ cannot on their face apply as written, since there is no single manufacturer of ‘the motor vehicle.’ And responsibility for violations, such as by selling an uncertified new motor vehicle, is unspecified.”

EPA disagrees. As just explained, the definition of “manufacturer” plainly contemplates that more than one entity can be the manufacturer of a motor vehicle (as do the references to “a manufacturer”). The fact that portions of the CAA refer to “a manufacturer” does not amend the explicit definition of “manufacturer” to limit it to a single entity per motor vehicle—it merely indicates the responsibilities that can attach to any entity that manufactures motor vehicles. EPA has long interpreted and applied these provisions in a manner that comports with Congressional intent and industry practice to place the responsibilities for certification with the most appropriate of those entities. This can be done by explicitly assigning certification responsibility, or by having multiple manufacturers determine among themselves which are the most appropriate to certify given their particular division of responsibilities. Thus, in the case of tractor-trailers, the entity that has control over design and emissions performance of the tractor is responsible for testing and certifying that the tractor will comply with applicable standards, while the entity that has control over design and emissions performance of the trailer is responsible for testing and certifying that the trailer will comply with applicable standards. The long-standing provisions on delegated assembly and secondary manufacturing are examples of the second situation where manufacturers determine among themselves testing, documentation, and certification responsibilities. See 40 CFR 1037.620, 1037.621, 1037.622, and Preamble Section I.F.2.e.

EPA is therefore reasonably interpreting the definition of “manufacturer” and the various implementation provisions using that term to reflect the realities of the heavy duty vehicle industry whereby multiple manufacturers are responsible for assembling the motor vehicle.

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<sup>14</sup> Consequently, the essential issue here is not whether EPA can issue and implement emission standards for trailers, but at what point in the implementation process those standards apply.

### *Controls on Manufacturers of Glider Kits*

Application of these same principles indicate that a glider kit manufacturer is a manufacturer of a motor vehicle and, as an entity responsible for assuring that glider vehicles meet the Phase 2 vehicle emission standards, can be a party in the certification process as either the certificate holder or the entity which provides essential test information to the glider vehicle manufacturer. As noted above, glider kits include the entire tractor chassis, cab, tires, body, and brakes. Glider kit manufacturers thus control critical elements of the ultimate vehicle's greenhouse gas emissions, in particular, all aerodynamic features and all emissions related to steer tire type. Glider kit manufacturers would therefore be the entity generating critical GEM inputs – at the least, those for aerodynamics and tires. Glider kit manufacturers also often know the final configuration of the glider vehicle, i.e. the type of engine and transmission which the final assembler will add to the glider kit.<sup>15</sup> This is because the typical glider kit contains all necessary wiring, and it is necessary, in turn, for the glider kit manufacturer to know the end configuration in order to wire the kit properly. Thus, a manufacturer of a glider kit can reasonably be viewed as a manufacturer of a motor vehicle under the same logic as above: there can be multiple manufacturers of a motor vehicle; the glider kit manufacturer designs, builds, and assembles a substantial, complete and finished portion of the motor vehicle; and that portion contributes substantially to the GHG emissions from the ultimate glider vehicle. A glider kit is not a vehicle part; rather, it is an assembled truck with a few components missing. The ultimate point here is that both of these entities are manufacturers of the glider motor vehicle and therefore both are within the Act's requirements for certification and testing

EPA rules have long provided provisions establishing responsibilities where there are multiple manufacturers of motor vehicles. See 40 CFR 1037.620 (responsibilities for multiple manufacturers), 40 CFR 1037.621 (delegated assembly), and 40 CFR 1037.622 (shipment of incomplete vehicles to secondary vehicle manufacturers). These provisions, in essence, allow manufacturers to determine among themselves as to which should be the certificate holder, and then assign respective responsibilities depending on that decision. The end result is that incomplete vehicles cannot be introduced into commerce without one of the manufacturers being the certificate holder.

Under the Phase 1 rules, glider kits are considered to be incomplete vehicles which may be introduced into commerce to a secondary manufacturer for final assembly. See 40 CFR 1037.622(b)(1)(i) and 1037.801 (definition of “vehicle” and “incomplete vehicle”) of the Phase 1 regulations (76 FR 57421). Note that 40 CFR 1037.622(b)(1)(i) was originally codified as 40 CFR 1037.620(b)(1)(i). EPA is expanding somewhat on these provisions, but in essence, as under Phase 1, glider kit and glider vehicle manufacturers could operate under delegated assembly provisions whereby the glider kit manufacturer would be the certificate holder. See 40 CFR 1037.621 of the final regulations. Glider kit manufacturers would also continue to be able to ship uncertified kits to secondary manufacturers, and the secondary manufacturer must assemble the vehicle into certifiable condition. 40 CFR 1037.622.<sup>16</sup>

### *Additional Authorities Supporting EPA's Actions*

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<sup>15</sup> PACCAR indicated in its comments that manufacturers of glider kits may not know all details of final assembly. Provisions on delegated assembly, shipment of incomplete vehicles to secondary manufacturers, and assembly instructions for secondary vehicle manufacturers allow manufacturers of glider kits and glider vehicles to apportion responsibilities, as appropriate, including responsibility as to which entity shall be the certificate holder. See 40 CFR 1037.130, 1037.621, and 1037.622.

<sup>16</sup> Under this provision in the Phase 2 regulations, the glider kit manufacturer would still have some responsibility to ensure that products they introduce into U.S. commerce will conform with the regulations when delivered to the ultimate purchasers.

Even if, against our view, trailers and glider kits are not considered to be “motor vehicles,” and the entities engaged in assembling trailers and glider kits are not considered to be manufacturers of motor vehicles, the Clean Air Act still provides authority for the testing requirements adopted here. Section 208 (a) of the Act authorizes EPA to require “every manufacturer of new motor vehicle or engine parts or components” to “perform tests where such testing is not otherwise reasonably available.” This testing can be required to “provide information the Administrator may reasonably require to determine whether the manufacturer ... has acted or is acting in compliance with this part,” which includes showing whether or not the parts manufacturer is engaged in conduct which can cause a prohibited act. Testing would be required to show that the trailer will conform to the vehicle emission standards. In addition, testing for trailer manufacturers would be necessary here to show that the trailer manufacturer is not causing a violation of the combined tractor-trailer GHG emission standard either by manufacturing a trailer which fails to comply with the trailer emission standards, or by furnishing a trailer to the entity assembling tractor-trailers inconsistent with tractor-trailer certified condition. Testing for glider kit manufacturers is necessary to prevent a glider kit manufacturer furnishing a glider kit inconsistent with the tractor’s certified condition. In this regard, we note that section 203 (a)(1) of the Act not only prohibits certain acts, but also prohibits “the causing” of those acts. Furnishing a trailer not meeting the trailer standard would cause a violation of that standard, and the trailer manufacturer would be liable under section 203 (a)(1) for causing the prohibited act to occur. Similarly, a glider kit supplied in a condition inconsistent with the tractor standard would cause the manufacturer of the glider vehicle to violate the GHG emission standard, so the glider kit manufacturer would be similarly liable under section 203 (a)(1) for causing that prohibited act to occur.

In addition, section 203 (a)(3)(B) prohibits use of ‘defeat devices’ – which include “any part or component intended for use with, or as part of, any motor vehicle ... where a principal effect of the part or component is to ... defeat ... any ... element of design installed ... in a motor vehicle” otherwise in compliance with emission standards. Manufacturing or installing a trailer not meeting the trailer emission standard could thus be a defeat device causing a violation of the emission standard. Similarly, a glider kit manufacturer furnishing a glider kit in a configuration that would not meet the tractor standard when the specified engine, transmission, and axle are installed would likewise cause a violation of the tractor emission standard. For example, providing a tractor with a coefficient of drag or tire rolling resistance level inconsistent with tractor certified condition would be a violation of the Act because it would cause the glider vehicle assembler to introduce into commerce a new tractor that is not covered by a *valid* certificate of conformity. Daimler argued in its comments that a glider kit would not be a defeat device because glider vehicles use older engines which are more fuel efficient since they are not meeting the more rigorous standards for criteria pollutant emissions. (Daimler Truck Comment, April 1, 2016, p. 5). However, the glider kit would be a defeat device with respect to the tractor *vehicle* standard, not the separate engine standard. A non-conforming glider kit would adversely affect compliance with the vehicle standard, as just explained. Furthermore, as explained in RTC 14.2, Daimler is incorrect that glider vehicles are more fuel efficient than Phase 1 2017 and later vehicles, much less Phase 2 vehicles.

In the memorandum accompanying the Notice of Data Availability, EPA solicited comment on adopting additional regulations based on these principles. EPA has decided not to adopt those provisions, but again notes that the authorities in CAA sections 208 and 203 support the actions EPA is taking here with respect to trailer and glider kit testing.

#### *Standards for Glider Vehicles and Lead Time for Those Standards*

At proposal, EPA indicated that engines used in glider vehicles are to be certified to standards for the model year in which these vehicles are assembled. 80 FR 40528. This action is well within the

agency's legal authority. As noted above, the Act's definition of "new motor vehicle engine," includes any "engine in a new motor vehicle" without regard to whether or not the engine was previously used. Given the Act's purpose of controlling emissions of air pollutants from motor vehicle engines, with special concern for pollutant emissions from heavy-duty engines, it is reasonable to require engines placed in newly-assembled vehicles to meet the same standards as all other engines in new motor vehicles. Put another way, it is both consistent with the plain language of the Act and reasonable and equitable for the engines in "new trucks" (see Section I.E.(1)(a) of the FRM Preamble) to meet the emission standards for all other engines installed in new trucks.

Daimler challenged this aspect of EPA's proposal, maintaining that it amounted to regulation of vehicle rebuilding, which (according to the commenter) is beyond EPA's authority. Comments of Daimler, p. 123; Comments of Daimler Trucks (April 1, 2016) p. 3. This comment is misplaced. The EPA has authority to regulate emissions of pollutants from engines installed in new motor vehicles. As explained above, glider vehicles are new motor vehicles. As also explained above, the Act's definition of "new motor vehicle engine" includes any "engine in a new motor vehicle" without regard to whether or not the engine was previously used. CAA section 216(3). Consequently, a previously used engine installed in a glider vehicle is within EPA's multiple authorities. See CAA sections 202 (a) (1) (GHGs), and 202 (a)(3)(D) (pollutants from rebuilt heavy duty engines).<sup>17</sup>

As explained in more detail in Section XIII.B of the FRM Preamble, the final rule requires that as of January 1, 2017, glider kit and glider vehicle production involving engines not meeting criteria pollutant standards corresponding to the year of glider vehicle assembly be allowed at the highest annual production for any year from 2010 to 2014. See section 1037.150 (t)(3). (Certain exceptions to this are explained in Section XIII.B. of the FRM Preamble). The rule further requires that as of January 1, 2018, engines in glider vehicles meet criteria pollutant standards and GHG standards corresponding to the year of the glider vehicle assembly, but allowing introduction into commerce of engines meeting criteria pollutant standards corresponding to the year of the engine for up to 300 vehicles per year, or up to the highest annual production volume for calendar years 2010 to 2014, whichever is less. Section 1037.150 (t)(1)(ii) (again subject to various exceptions explained in Section XIII.B. of the FRM Preamble). Glider vehicles using these exempted engines will not be subject to the Phase 1 GHG *vehicle* standards, but will be subject to the Phase 2 vehicle standards beginning with MY 2021.

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<sup>17</sup> Comments from, e.g. Mondial and MEMA made clear that all of the donor engines installed in glider vehicles are rebuilt. See also <http://www.truckinginfo.com/article/story/2013/04/the-return-of-the-glider.aspx> ("1999 to 2002-model diesels were known for reliability, longevity and good fuel mileage. Fitzgerald favors Detroit's 12.7-liter Series 60 from that era, but also installs pre-EGR 14-liter Cummins and 15-liter Caterpillar diesels. All are rebuilt .....").

There are compelling environmental reasons for taking these actions in this time frame. As shown in a separate Sensitivity Analysis of Glider Impacts (Appendix A to Section 14 of this RTC), the restriction on 2017 production is projected to prevent the use of high polluting pre 2002-engines in 5,000 to 10,000 glider vehicles, and would prevent the emission of 207,500-415,000 tons of NO<sub>x</sub> and 3,400-6,800 tons of PM over the lifetime of those vehicles and engines. This is estimated to prevent *350 to 1,600* premature mortalities. If these restrictions were delayed until MY 2021, as commenters argued, this could mean the production of 30,000 to 40,000 additional glider vehicles using the older high polluting engines. Using the same assumptions as above, these three additional model years of production are estimated to result in an additional *2,100 to 6,400* premature mortalities.

These estimates are conservative. They do not account for diesel exhaust PM being a likely human carcinogen (see Preamble section VIII.A.6), and so do not assess potential additional cancers caused by exposure to diesel PM exhaust from these glider vehicles. Nor do these estimates evaluate premature mortality attributable to increased generation of, and exposure to ozone resulting from the increased NO<sub>x</sub> emissions.

With regard to the issue of lead time, EPA indicated at proposal that the agency has long since justified the criteria pollutant standards for engines installed in glider kits. 80 FR 40528. EPA further proposed that engines installed in glider vehicles meet the emission standard for the year of glider vehicle assembly, as of January 1, 2018 and solicited comment on an earlier effective date. Id. at 40529. The agency noted that CAA section 202 (a)(3)(D)<sup>18</sup> requires that standards for rebuilt heavy-duty engines take effect “after a period ... necessary to permit the development and application of the requisite control measures.” Here, no time is needed to develop and apply requisite control measures for criteria pollutants because compliant engines are immediately available.<sup>19</sup> In fact, manufacturers of compliant engines, and dealers of trucks containing those compliant engines, commented that they are disadvantaged by manufacturing more costly compliant engines while glider vehicles avoid using those engines. Not only are compliant engines immediately available, but, as commenters warned, there can be risk of massive pre-buys. Moreover, EPA does not envision that glider manufacturers will actually modify the older engines to meet the applicable standards. Rather, they will either choose from the many compliant engines available today, or they will seek to qualify under other flexibilities provided in the final rule. See Section XIII.B of the FRM Preamble. Given that compliant engines are immediately available, the flexibilities provided in the final rule for continued use of donor engines for traditional glider vehicle functions and by small businesses, and the need to expeditiously prevent further perpetuation of use of heavily polluting engines, EPA sees a need to begin constraining this practice on January 1, 2017. However, the final rule is merely capping glider production using higher-polluting engines in 2017 at 2010-2014 production levels, which would allow for the production of thousands of glider vehicles using these higher polluting engines in 2017, and unlimited production of glider vehicles using less polluting engines.

Various commenters, however, argued that the EPA must provide four years lead-time and three-year stability pursuant to section 202 (a) (3)(C) of the Act, which applies to regulations for criteria pollutant emissions from heavy duty vehicles or engines. For criteria pollutant standards, CAA section

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<sup>18</sup> The engine rebuilding authority of section 202 (a)(3)(D) includes removal of an engine from the donor vehicle. See 40 CFR section 86.004-40 and 62 FR 54702 (Oct. 21, 1997). EPA interprets this language as including installation of the removed engine into a glider kit, thereby assembling a glider vehicle. Daimler, in its comments, questioned whether engine rebuilding authorities were at issue here when EPA did not propose to amend the specific regulations relating to engine rebuilding. EPA has added a conforming cross-reference to the final rule. See section 1068.120 (f).

<sup>19</sup> Memo to Docket, “Availability of Rebuilt Engines that Comply with 2010 Emission Standards”, August 2016.

202(a)(3)(C) establishes lead time and stability requirements for “[a]ny standard promulgated or revised under this paragraph and applicable to classes or categories of heavy duty vehicles or engines.” In this rule, EPA is generally requiring large manufacturers of glider vehicles to use engines that meet the standards for the model year in which a vehicle is manufactured. EPA is not promulgating new criteria pollutant standards. The NO<sub>x</sub> and PM standards that apply to heavy duty engines were promulgated in 2001.

We are not amending these provisions or promulgating new criteria pollutant standards for heavy duty engines here. EPA interprets the phrase “classes or categories of heavy duty vehicles or engines” in CAA 202(a)(3)(C) to refer to categories of vehicles established according to features such as their weight, functional type, (e.g. tractor, vocational vehicle, or pickup truck) or engine cycle (spark-ignition or compression-ignition), or weight class of the vehicle into which an engine is installed (LHD, MHD, or HHD). EPA has established several different categories of heavy duty vehicles (distinguished by gross vehicle weight, engine-cycle, and other criteria related to the vehicles’ intended purpose) and is establishing in this rule GHG standards applicable to each category.<sup>20</sup> By contrast, a “glider vehicle” is defined not by its weight or function but by its method of manufacture. A Class 8 tractor glider vehicle serves exactly the same function and market as a Class 8 tractor manufactured by another manufacturer. Similarly, rebuilt engines installed in glider vehicles (i.e. donor engines) are not distinguished by engine cycle, but rather serve the same function and market as any other HHD or MHD engine. Thus, EPA considers “glider vehicles” and engines installed in glider vehicles to be a description of a method of manufacturing new motor vehicles, not a description of a separate “class or category” of heavy duty vehicles or engines. Consequently, EPA is not adopting new standards for a class or category of heavy duty engines within the meaning of section 202 (a)(3)(C) of the Act.

EPA believes this approach is most consistent with the statutory language and the goals of the Clean Air Act. The date of promulgation of the criteria pollutant standards was 2001. There has been plenty of lead time for the criteria pollutant standards and as a result, manufacturers of glider vehicles have many options for compliant engines that are available on the market today—just as manufacturers of other new heavy-duty vehicles do. We are even providing additional compliance flexibilities to glider manufacturers in recognition of the historic practice of salvaging a small number of engines from vehicles involved in crashes. See Section XIII.B of the FRM Preamble. We do not believe that Congress intended to allow changes in how motor vehicles are manufactured to be a means of avoiding existing, applicable engine standards. Obviously, any industry attempts to avoid or circumvent standards will not become apparent until the standards begin to apply. The unreasonableness of the commenters’ interpretation becomes apparent when one realizes that it would effectively preclude EPA from curbing many types of avoidance, however dangerous, until at least four years from detection. As noted above, EPA estimates conservatively that thousands of premature mortalities are at issue here, emphasizing the need to take expeditious action.

As to Daimler’s further argument that the lead time provisions in section 202 (3)(C) not only apply but also must trump those specifically applicable to heavy duty engine rebuilding, the usual rule of construction is that the more specific provision controls. See, e.g. *HCSC-Laundry v. U.S.*, 450 U.S.1, 6 (1981). EPA also does not accept Daimler’s further argument that section 202 (a)(3)(C) lead time provisions also apply to engine rebuilding because those provisions fall within the same paragraph. First, as explained above, section 202 (a)(3)(C) applies to categories of vehicles and engines established according to features such as their weight, functional type, or engine cycle, or weight class of the vehicle into which an engine is installed. Rebuilt engines are not distinguished by engine cycle, but

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<sup>20</sup> Note, however, the Phase 2 GHG standards for tractors and vocational vehicles do not apply until MY 2021.



rather serve the same function and market as any other engine. Consequently, EPA does not believe that section 202 (a)(3)(C) is applicable here. Moreover, the interpretation advocated by the commenters would render the separate lead time provisions for engine rebuilding a virtual nullity.<sup>21</sup> The sense of the provision is that Congress intended there to be independent lead time consideration for the distinct practice of engine rebuilding. For example, section 202 (a)(3)(C) specifies three “model years” of needed lead time. The concept of model years is a virtual non-sequitur as applied to engine rebuilding, when there is no specific model year (or year-by-year) production involved. Rather, individual engines from any year are being rebuilt. More generally, the purpose of long lead time, to accommodate manufacturers’ necessarily long design and redesign cycles and to allow time for research and development plus field testing, again do not apply to engine rebuilding. Engines can be rebuilt at any time, and rebuilding is not tied to design cycles or R&D decisions. It involves an engine-by-engine, ad hoc decision. Under these circumstances, it is at least ambiguous as to whether the reference to “paragraph” in section 202 (a)(3)(C) (assuming, against our view that the provision applies at all) encompasses the separate lead time provision for rebuilt engines in section 202 (a)(3)(D). Cf. *Desert Citizens Against Pollution v. EPA*, 699 F. 3d 524, 527-28 (D.C. Cir. 2013) (reference to “section” held to be ambiguous where applying provisions of that section leads to results at odds with the overall statutory scheme).

### **1.3.2 NHTSA Authority67**

**Organization:** *Allison Transmission, Inc.*

#### **EPA and NHTSA Face Statutory Constraints in Requiring New Technology; Alternative 4 is Not Supported in The Record**

The Proposed Rule states that several steps have been taken in the rulemaking to address concerns about disrupting the market, including providing considerable lead time, phasing-in of the standards, preserving technology choices, allowing emission averaging, banking and trading and economic savings over time through reduced fuel costs.<sup>12</sup> But these steps only can go so far in a market which is driven by customer demands for vehicles that accomplish specific tasks. EPA and NHTSA cannot conflate necessary flexibility in implementation of new standards with a statutory ability to increase the stringency of emission and fuel efficiency standards beyond a reasonable projection of future technology specific to MD/HD vehicles and the lead time necessary for market adoption. Both Clean Air Act (“CAA”) section 202 and NHTSA’s statutory authority in 49 U.S.C. §32902(k) are not unbounded, but must be read in context of the MD/HD market, including such periods as are necessary to “permit the development and application of requisite technology.”<sup>13</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.11-12]

In this regard, EPA indicates that it has “significant discretion in assessing, weighing, and balancing the relevant statutory criteria.” As discussed above, this discretion to the extent it exists must be based on solid record evidence regarding the ability of the MD/HD market to develop and deploy additional technologies that will, in fact, be purchased by end users. This record is lacking in this rulemaking and EPA is thereby constrained in its legal ability to adopt Alternative 4. Indeed, unlike the most recent

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<sup>21</sup> The argument that the lead time provision for rebuilt engines means that standards for rebuilt engines can take effect only after three model years but can be even longer makes no practical sense. As discussed in the text above, the concept of model year has no basis for rebuilt engines. Even more basically, it does not make sense for Congress to have allowed more lead time for rebuilt engines when less time is needed due to engine rebuilding being an engine-by-engine decision which can be made at any time unconstrained by engine design cycles.

LDV rule, EPA and NHTSA have not proposed to include a regulatory “mid-term evaluation” period that would allow for future adjustment of standards if projections contained in this Proposed Rule prove to be erroneous during the early and mid-2020s. Given this lack of a correcting mechanism, EPA (and by implication NHTSA) must be correspondingly cautious to provide such necessary period of time for the development and application of new technology to this sector. [EPA-HQ-OAR-2014-0827-1284-A1 p.12]

NHTSA indicates that it has “broad discretion to weigh and balance” various statutory factors contained in the Energy Independence and Security Act (“EISA”). The Proposed Rule, however, does not discuss in detail possible constraints on this authority. First, NHTSA authority under EISA references a National Academy of Sciences study as a predicate for a rulemaking to establish a fuel efficiency program. That study has been completed and the statute does not reference any additional studies. Second, NHTSA’s authority is described with regard to “a rulemaking proceeding” to occur “[n]ot later than 24 months after completion of the [NAS] study.” This statutory structure indicates that a singular rulemaking was directed and, indeed, subsection (k)(2) references only “a rulemaking proceeding . . .” (Emphasis added). Third, provisions mandating that adequate lead time be allowed for new fuel efficiency regulations again reference only a “commercial medium- and heavy-duty on-highway vehicle and work truck fuel economy standard . . .” (Emphasis added). Thus, under the plain terms of the statute, only a singular NAS study was required and a singular rulemaking proceeding was to occur, both of which have now happened. This raises the issue of NHTSA’s authority to adopt standards that incorporate increasingly stringent requirements departing from those employed in Phase 1. [EPA-HQ-OAR-2014-0827-1284-A1 p.12]

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12 Id. at 40,155

13 CAA section 202(a)(2). (Emphasis added). In addition, while in its discussion of legal authority for this rulemaking EPA cites the endangerment finding for the Phase 1 LDV rule, that finding is related to the ability to regulate GHGs as air pollutants under the CAA; it does not directly determine the stringency of standards in this rulemaking. Further, EPA also relies on *Utility Air Regulatory Group v. EPA*, 134 S. Ct. 2427 (2104) as authority, yet that case cautioned the Agency that it also may not adopt “unreasonable interpretations of statutory provisions and then edit other statutory provisions to mitigate the unreasonableness.” Id. at 2446. While the decision related specifically to stationary source permitting, the court expressed an unwillingness to allow the Agency to engage in a “multiyear voyage of discovery” when interpreting CAA permitting provisions and their application to small sources. In the context of this rulemaking, EPA must interpret CAA section 202 rationally in relation to the current MD/HD market and the unique factors which dominate this market versus the LDV market. NHTSA is also constrained with respect to limits contained in 49 U.S.C. 32902(k) discussed in more detail in Section II.

**Organization:** American Iron and Steel Institute

## **B. NHTSA Has Comparable Authority to Use Life Cycle Analysis**

NHTSA derives its authority to address GHG emissions from motor vehicles from the Energy Policy Conservation Act (‘EPCA’), as amended by the Energy Independence and Security Act (‘EISA’).<sup>8</sup> NHTSA cites as statutory authority for this rulemaking EISA Section 103, 49 U.S.C. § 32902(k). As described in the Proposed Rule, this section ‘authorizes a fuel efficiency improvement program, designed to achieve the maximum feasible improvement to be created for commercial medium- and

heavy-duty vehicles and work trucks, to include appropriate test methods, measurement metrics, standards, and compliance and enforcement protocols that are appropriate, cost-effective and technologically feasible.' Thus, under the plain language of this section, NHTSA may promulgate 'appropriate' methods, metrics and standards for medium- and heavy-duty vehicles that may reasonably include life cycle analysis.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.5]

NHTSA has also indicated that it interprets its EPCA authority to include evaluation of energy use and energy conservation. Specifically, after citing authority in 49 U.S.C. § 32902(k) and CAA Section 202(a)(1)-(2), the Proposed Rule indicates that 'Congress enacted EPCA and EISA to, among other things, address the need to conserve energy . . . .' While, in the Proposed Rule, the general focus of energy use is with respect to the amount of fuel consumed, NHTSA may fairly interpret its EPCA authority in the context of the nation's overall energy policy. In other words, NHTSA's statutory mandate to consider energy conservation in setting fuel efficiency improvements for medium- and heavy-duty vehicles provides an ability for the agency to address broader concerns regarding the vehicle's life cycle impact on the use of energy. [EPA-HQ-OAR-2014-0827-1275-A1 p.5-6]

Indeed, EISA specifies that standards for medium- and heavy-duty vehicles are to center on 'a commercial medium- and heavy-duty on-highway vehicle and work truck fuel efficiency improvement program . . . .'<sup>12</sup> In contrast to 'fuel economy' standards that have been imposed in the light-duty sector, 'a fuel efficiency improvement program' is a new statutory term that provides broader authority in the area of medium- and heavy-duty vehicles. This can also be seen given the statutory structure of Section 32902(f) where, as a precondition to rulemaking, the National Academy of Sciences is directed to examine several factors, including consideration of the 'work' performed by vehicles and 'such other factors and conditions that could have an impact on a program to improve commercial medium- and heavy-duty on-highway vehicle and work truck efficiency.'<sup>13</sup> This serves as further confirmation that NHTSA may take into account a wide variety of factors that impact Class 2 to Class 8 vehicles. Also, as will be shown below, within the Proposed Rule, EPA and NHTSA have already interpreted their statutory authority to consider life cycle emissions with respect to at least a portion of the medium- and heavy-duty vehicle fleet.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.6]

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8 See 49 U.S.C. §32902(a)-(k).

11 It should be noted that with reference to light duty standards, NHTSA has asserted that it maintains significant discretion pursuant to 40 U.S.C. §32902(f) to weigh EPCA statutory factors which, in the case of such vehicles are technological feasibility, economic practicability, the effect of other governmental standards and energy conservation. While the Proposed Rule utilizes authority in 40 U.S.C. §32902(k) versus (f), arguably NHTSA would possess similar ability to weigh the statutory factors specified for 'commercial medium- and heavy-duty on-highway vehicle and work truck[s].' Indeed, NHTSA asserts that it has 'broad discretion to balance the statutory factors in Section 103 [of EISA] in developing fuel consumption standards to achieve the maximum feasible improvement.' 80 Fed. Reg. at 40,170. Further, NHTSA references authority within the Motor Vehicle Safety Act with reference to the regulation of trailers as 'vehicles.' *Id.* at 40,171.

12 49 U.S.C. §32902(k)(2). (Emphasis added).

13 49 U.S.C. §32902(k)(2).

14 It may additionally be noted that that even if NHTSA lacked statutory authority to consider lifecycle emissions, it could otherwise conform its regulations to those promulgated by EPA so as to avoid

inconsistency. Several differences in statutory authority, including the ability to impose regulations on the same timeframe, were accommodated by EPA and NHTSA in the Phase I medium- and heavy-duty truck rulemaking. NHTSA and EPA have also cited *Massachusetts v. EPA*, 549 U.S. 497 (2007) as support for their ability to proceed cooperatively on engine and vehicle standards despite issuing separate and distinct standards. In the MY 2012-2016 LDV rule, EPA cited the Supreme Court's conclusion in *Massachusetts* that '[t]he two obligations may overlap, but there is no reason to think that the two agencies cannot both administer their obligations and yet avoid inconsistency' as support for their different, but aligned regulatory approaches. 75 Fed. Reg. at 25,327. It should be noted that this perspective should apply equally to both EPA and NHTSA should the former agency believe it is constrained from incorporating lifecycle analysis within a final rule.

**Organization:** California Air Resources Board (CARB)

#### Alternative 4 is Consistent with NHTSA's Statutory Authority

NHTSA is promulgating the proposed fuel efficiency standards pursuant to the statutory authority of the EISA, which amends the Energy Policy and Conservation Act (EPCA) of 1975. Specifically, section 102 of EISA (49 USC section 32902(k)(2)) authorizes NHTSA to implement "a commercial medium- and heavy-duty on-highway vehicle and work truck fuel efficiency improvement program designed to achieve the maximum feasible improvement, and [to] adopt and implement appropriate test methods, measurement metrics, fuel economy standards, and compliance and enforcement protocols that are appropriate, cost-effective, and technologically feasible for commercial medium- and heavy-duty on-highway vehicles and work trucks." [EPA-HQ-OAR-2014-0827-1265-A1 p.27]

The fuel efficiency standards that correspond to the GHG emission standards associated with Alternative 4 are consistent with section 32902(k)(2) of EISA. In the Phase 1 rulemaking, NHTSA stated that it has the discretion to balance the factors specified in section 32902(k)(2) of EISA "in a way that is technology-forcing ... but not in a way that requires the application of technology which will not be available in the lead time provided by the rule, or which is not cost-effective, or is cost-prohibitive ..."<sup>13</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.27]

As demonstrated above, Alternative 4 is consistent with the statutory provisions of section 202(a)(2) of the CAA regarding adequate lead times and costs of compliance associated with the proposed greenhouse gas emission standards. To the extent that NHTSA's considerations of lead times and compliance costs for the technologies needed to comply with fuel efficiency standards are consistent with the lead time and cost of compliance factors that U.S. EPA considered in developing the GHG emission standards associated with Alternative 4, the corresponding fuel efficiency standards are arguably consistent with the factors specified in section 32902(k)(2), and are consistent with NHTSA's statutory directive to achieve the maximum feasible improvement in fuel efficiency standards from commercial medium- and heavy-duty on-highway vehicles and work trucks. [EPA-HQ-OAR-2014-0827-1265-A1 p.27]

#### **Support Comment**

##### **Comment - Interpretation that 49 U.S.C. 32919(a) does not extend to commercial medium- and heavy-duty on-highway vehicles and work trucks**

NHTSA states that in the Phase 1 rulemaking it concluded that EPCA's express preemption provision of 49 U.S.C. 32919(a) (which expressly preempts any State or local government from adopting or enforcing a law or regulation related to fuel economy standards or average fuel economy standards for

automobiles covered by an average fuel economy standard under 49 U.S.C. Chapter 329) does not extend to the fuel efficiency standards established in the Phase 1 rulemaking because commercial medium- and heavy-duty on-highway vehicles and work trucks are not “automobiles,” as defined in 49 U.S.C. 32901(a)(3). NHTSA states that it is reiterating that conclusion for the proposed Phase 2 standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.28]

CARB staff concurs with NHTSA’s reasoning and conclusion that 49 U.S.C. 32919(a) does not extend to the fuel efficiency standards established under the Phase 1 rulemaking or to the proposed fuel efficiency standards established under the Phase 2 rulemaking. [EPA-HQ-OAR-2014-0827-1265-A1 p.28]

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<sup>13</sup> Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, U.S. EPA Response to Comments, Document for Joint Rulemaking, p. 5-17, EPA-420-R-11-004, August 2011.

**Organization:** Center for Biological Diversity

The NHTSA is also expressly required to consider “the effect of other motor vehicle standards of the Government on fuel economy.”<sup>20</sup> This factor is implicated in two sets of regulations: (1) regulations developed by the State of California under its Clean Air Act § 202 waiver and (2) light-duty truck Corporate Average Fuel Economy (“CAFE”) standards promulgated by the Agencies. Both sets of regulations are “motor vehicle standards of the Government” that create important context for determining “maximum feasible improvement” for the purposes of the instant rulemaking. [EPA-HQ-OAR-2014-0827-1460-A1 p.5]

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<sup>20</sup> 49 U.S.C. § 32902(f).

**Organization:** Daimler Trucks North America LLC

**In-Use Standards** - NHTSA and the EPA propose to add an in-use requirement to NHTSA’s regulations, applicable through the regulatory useful life, appropriateness of seeking civil penalties for failure to comply with its fuel efficiency standards in these instances. 80 FR 40342. NHTSA also proposes to add civil penalties for failure to conform to such standards. While it is appropriate for NHTSA’s standards to mirror the EPA’s, we think that it would be inappropriate for NHTSA to assess civil penalties in addition to those that the EPA assesses. The two agencies have essentially identical regulations and should not assess duplicative penalties. [EPA-HQ-OAR-2014-0827-1164-A1 p.131]

**Organization:** Navistar, Inc.

Specifically for NHTSA, some of these concerns have added force. In particular, this includes the effective requirement to have a compliant engine over a year prior to the nominal start year of 2021. As we discussed extensively in our Comments in docket EPA-HQ-OAR-2014-0827, the need for an engine fuel map to use with the GEM tool prior to 2021 effectively pulls the requirement for a compliant engine over a year ahead of the 2021 nominal start year, as early as 15 months, which would be in 2019. By the time the Proposed Rule is adopted, it appears that this will not comport with the requirement for four years of lead time in the Energy Independence and Security Act. [NHTSA-2014-0132-0094-A1 p.3]

**Organization:** Newell Coach Corporation

We would like to note that while EPA has clear authority to regulate vocational vehicles like motorhomes, we disagree with NHTSA's view that the Energy, Independence and Security Act of 2007 (EISA) gives them the authority to regulate motorhomes. Motorhomes are not commercial vehicles and they should not be subject to NHTSA's proposed standards. Fundamentally, we believe that the EPA and NHTSA have an obligation to establish regulations that are consistent with each other. If NHTSA cannot legally regulate non-commercial vehicles, rather than establish conflicting requirements, EPA should exclude motorhomes from its rule. [EPA-HQ-OAR-2014-0827-1319-A1 p.2]

**Organization:** Recreational Vehicle Industry Association (RVIA)

RVIA sets forth the following points in its comments. As an initial matter, NHTSA lacks legal authority over non-commercial vehicles, such as motorhomes, and so cannot set fuel consumption standards for such vehicles. Thus, motorhomes should continue to be exempt from NHTSA fuel consumption standards as they were in the Phase 1 rule. Further, for the very purposes of consistency and uniformity the agencies espouse, EPA should recognize this limitation and exclude motorhomes from its standards as well. [EPA-HQ-OAR-2014-0827-1261-A1 p.4]

### **Motorhomes Should Be Exempt from the Proposed Rules**

NHTSA lacks authority to regulate motorhomes since they are not commercial vehicles.

NHTSA cannot establish Phase 2 regulations for motorhomes because it lacks the authority to set fuel efficiency standards for non-commercial medium and heavy-duty vehicles under the Energy Independence and Security Act (EISA). Section 102(b) of EISA, 49 U.S.C. § 32902(k), expressly authorizes NHTSA to set fuel efficiency standards for '*commercial* medium- and heavy-duty on-highway vehicles.' (emphasis added). [EPA-HQ-OAR-2014-0827-1261-A1 p.10]

When NHTSA first proposed its Phase 1 fuel efficiency standards for commercial medium and heavy-duty vehicles, it properly recognized its authority under EISA was limited to commercial vehicles; thus, it excepted from its regulation 'recreational vehicles, such as motor homes, since recreational vehicles are not commercial.' However, NHTSA announced in the final rule that it might revisit this interpretation of its EISA authority in light of a comment filed by Oshkosh Corporation. NHTSA added that, upon reconsideration, its phase 1 interpretation might 'effectively read words into the statutory definition' and create 'illogical results, *i.e.*, treating similar vehicles differently.' For purposes of Phase 1, NHTSA decided to continue to exclude motorhomes because they were not included in the proposed rule but would 'address this issue in the next rulemaking.' [EPA-HQ-OAR-2014-0827-1261-A1 p.10]

In the Proposed Phase 2 Rule, NHTSA did indeed reconsider its position; it completely retreated from its initial Phase 1 proposed interpretation, raising essentially the same arguments it set forth in the final Phase 1 rule. NHTSA asserted that the definition of 'commercial medium- and heavy-duty on-road highway vehicles' was based on weight alone: "on-highway vehicles with gross vehicle weight ratings of 10,000 pounds or more." NHTSA also repeated the same argument that excluding motorhomes would be illogical. It further added that including the category would be consistent with the goal of creating one national program since EPA already covers such vehicles. NHTSA offered no other evidence supporting its position. [EPA-HQ-OAR-2014-0827-1261-A1 p.10]

While the goal of uniformity may be desirable, it cannot create legal authority where there is none. Rather than avoiding reading words into a definition, NHTSA is effectively eliminating key statutory language from the definition. Congress plainly limited NHTSA's authority under EISA to 'commercial' medium and heavy-duty vehicles. There is no similar limitation for work trucks, a category which is defined separately, nor on NHTSA authority for regulating automobiles. Hence, the term 'commercial' cannot be mere surplusage; Congress must have intended a meaning if it used the term only in connection with medium and heavy-duty vehicles. Moreover, the term 'commercial' doesn't simply appear once in the relevant portions of EISA. Rather, Congress used the term repeatedly in section 32902(k). Indeed, the very title of that statutory section uses the term, and it is used before 'medium-and heavy-duty on-highway vehicles' every time those vehicles are mentioned in that section. Had Congress intended to include *all* medium and heavy-duty vehicles in its grant of authority to NHTSA, it surely would have done so and eliminated the 'commercial' modifier. [EPA-HQ-OAR-2014-0827-1261-A1 p.10-11]

When Congress defined the term 'commercial medium- and heavy-duty on-highway vehicles' in section 103 of EISA it didn't include the term 'commercial' in the definition but neither did it repeat any of the other words in that same term: 'medium- and heavy-duty on-highway vehicles.' It simply defined the full term, focusing on the weight of the vehicles. The most rational and reasonable reading of this definition would be that only 'commercial' vehicles of that weight would constitute 'commercial medium- and heavy-duty on-highway vehicles.' Yet NHTSA's reading unjustifiably expands its purported authority over any vehicle, commercial or not, based solely on weight. Rather than reading in a term to a definition, NHTSA proposes to entirely eliminate the key modifier established by Congress. Notably, in its own regulations implementing EISA, NHTSA doesn't go this far. It defines 'heavy-duty vehicles' as 'any *commercial* medium- and heavy-duty on highway vehicle or work truck,' as defined in section 32901(a)(7). Even NHTSA doesn't purport in its existing regulations to define 'heavy-duty vehicles' as *any* vehicles above a certain weight. [EPA-HQ-OAR-2014-0827-1261-A1 p.11]

Moreover, there is an important and rational reason for distinguishing between commercial heavy-duty vehicles and non-commercial vehicles like motorhomes. EISA authorizes NHTSA to set fuel consumption standards for heavy-duty vehicles used in commercial activities. As NHTSA recognized properly back in 2010, non-commercial recreational vehicles such as motorhomes are used by families and individuals for recreational purposes. Motorhomes are very different from commercial vehicles. For example, they are generally very low-mileage and their costs generally cannot be recovered through commercial use.<sup>19</sup> Indeed, the California Air Resource Board (CARB) expressly recognized this distinction in its proposed regulations for In-Use On-Road Diesel Vehicles, where it excluded personal use motor homes from regulation. CARB explained: [EPA-HQ-OAR-2014-0827-1261-A1 p.11]

Staff has proposed to exempt non-commercial motor homes from the scope of the proposed regulation for a number of reasons. First, owners of these vehicles do not have the ability to offset the compliance costs since personal use motor homes do not generate income nor appreciate in value. In addition, these vehicles typically operate very few miles in California, and as such, do not contribute significantly towards emissions relative to other vehicles covered by the proposed regulation.<sup>20</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.11-12]

Thus, motorhomes are not similar to commercial vehicles in the aspects that are most relevant in the Phase 2 proposal. They are not the same in terms of vehicles miles travelled so gas savings are less and payback time for fuel savings is longer. They are not the same in terms of cost offsets since typical motorhome owners cannot recoup cost outlays through income generation or appreciation in value. And they are not the same in terms of emissions because of the lower number of vehicle miles travelled. Thus, contrary to NHTSA's conclusions, Congress' decision to treat commercial vehicles and

motorhomes separately, as CARB and even NHTSA at one point have done, is a correct and entirely practical approach. [EPA-HQ-OAR-2014-0827-1261-A1 p.12]

NHTSA should exempt motorhomes entirely from its Phase 2 fuel consumption standards because it lacks statutory authority over non-commercial medium and heavy-duty vehicles in this regard. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

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<sup>19</sup> Some motorhomes are rented for commercial purposes, but this number is a statistically insignificant percentage of all motorhomes currently in use. In Phase 1, NHTSA did not attempt to distinguish between personal use and rental motorhomes, nor does RVIA believe such a distinction is even possible.

<sup>20</sup> CARB, Technical Support Document: Proposed Regulation for In-use On-road Diesel Vehicles, at 256 (Oct. 2008), available at <http://www.arb.ca.gov/regact/2008/truckbus08/tsd.pdf>. While the CARB regulation directly affected owners through a retrofit requirement, rather than chassis manufacturers as in the Proposed EPA Phase 2 Rules, the commercial/non-commercial distinction is still valid since the nature of motorhomes is the same. The cost is just imposed, in the first instance, on the chassis manufacturer and reaches the customer eventually through higher prices.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

In our “Authority Objections” section (3), we will discuss the legal rationale the agencies are putting forward for regulating trailers, why that rationale is flawed, and that the agencies should focus their efforts on end users, which they actually do have authority to regulate. [EPA-HQ-OAR-2014-0827-1172-A1 p.2]

EPA and NHTSA do not have statutory authority to adopt GHG emission and fuel efficiency standards applicable to trailers. [EPA-HQ-OAR-2014-0827-1172-A1 p.3]

NHTSA lacks statutory authority.

NHTSA’s claim to authority relies on the Energy Independence and Security Act (EISA), which does not itself define the term “vehicle” to include trailers. To do this, NHTSA relies on the language under its organic statute, the Motor Vehicle Safety Act.<sup>5</sup> It is important to note that the Safety Act’s definition is put forward “to reduce traffic accidents and deaths and injuries resulting from traffic accidents.” As we will describe below, many parts of the proposal are at odds with this mission and we urge NHTSA to carefully consider their mandate as they propose trading safety for assumed fuel savings. Here, the point is simply that NHTSA is grasping for statutory authority for the proposed rule by citing an enabling statute that has nothing to do with greenhouse gas emissions.

Additionally, NHTSA cites the EISA direction to create standards for commercial medium- and heavy-duty on-highway vehicles and work trucks in 49 USC 32902(k). That section includes a 24 month window for rulemaking to take place: “(2) RULEMAKING.—Not later than 24 months after completion of the study required under paragraph (1), the Secretary, in consultation with the Secretary of Energy and the Administrator of the Environmental Protection Agency, by regulation, shall determine in a rulemaking proceeding how to implement a commercial medium- and heavy-duty on-highway vehicle and work truck fuel efficiency improvement program designed to achieve the maximum feasible improvement, ...” The study referred to in paragraph (1) was to be completed within one year of the



publication of a National Academy of Sciences study that was published in 2010<sup>7</sup>. That brings the maximum window for NHTSA to bring regulations under this law to 2013. The proposal being put forward, coming after the window set forth under law, lacks congressional authorization.

Further, NHTSA contends that the Energy Independence and Security Act (“EISA”) gives it statutory authority to regulate trailers. Specifically, NHTSA points to a provision in the EISA that directs NHTSA to “determine in a rulemaking proceeding how to implement a commercial medium- and heavy-duty on-highway vehicle and work truck fuel efficiency improvement program designed to achieve the maximum feasible improvement . . . .” The EISA defines “commercial medium- and heavy-duty on-highway vehicle” to mean “an on-highway vehicle with a gross vehicle weight rating [GVWR] of 10,000 pounds or more.” NHTSA contends that, “[b]ecause Congress did not act to exclude trailers when defining GVWRs . . . it is reasonable to interpret the provision to include them.”

However, this definition shows just the opposite – that EISA’s definition of “commercial medium- and heavy-duty on-highway vehicle” excludes trailers. GVWR is distinct from the gross combined weight rating (“GCWR”), which includes both the weight of a loaded trailer and the weight of the tractor. EPA and NHTSA recognized this important distinction in promulgating GHG Phase One emission standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles in 2011, stating: “GVWR describes the maximum load that can be carried by a vehicle, including the weight of the vehicle itself. Heavy-duty vehicles also have a gross combined weight rating (GCWR), which describes the maximum load that the vehicle can haul, including the weight of a loaded trailer and the vehicle itself.” (emphasis added). In other words, the trailer is not included in the definition of “commercial medium-and-heavy-duty on highway vehicle” as previously interpreted by NHTSA, since that definition refers only to a tractor’s GVWR and does not refer to a combination tractor and trailer GCWR. It is therefore reasonable (and it is consistent with the agencies’ previous interpretation) to exclude trailers when interpreting 40 U.S.C. § 32902(k)(2).

We understand that the agencies may take issue with our claims as to the way the law interacts with the truck trailer industry and the agencies’ proposal, so we will address further comments at both EPA and NHTSA parts of the proposal. This is intended to instruct both agencies as to ways that the proposal could be improved with regard to the truck trailer industry without condoning the agencies’ proposed expansion without legal authority.

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5 80FR4071: “Although EISA does not define the term “vehicle,” NHTSA’s authority to regulate motor vehicles under its organic statute, the Motor Vehicle Safety Act (“Safety Act”), does.”

7 <http://www.nap.edu/catalog/12845/technologies-and-approaches-to-reducing-the-fuel-consumption-of-medium-and-heavy-duty-vehicles>

**Response:**

Generally, with respect to issues regarding NHTSA’s legal authority, please see Section I. E. of the final rule notice. Topics in this section not discussed in this document or in Section I. E. of the Preamble are discussed in the relevant sections of the associated rulemaking documents.

With respect to Daimler’s comment regarding duplicative civil penalties, NHTSA addressed a similar comment from EMA, Volvo, and the Truck Renting and Leasing Association in the Phase 1 rule. NHTSA maintains what it stated in those notices—that neither agency intended to impose duplicative civil penalties, and that both agencies would give consideration to civil penalties imposed by the other

in the case of non-compliance with its own regulations. See 75 FR 74280. The possibility of more than one prosecution or enforcement action arising from the same overall body of facts does not present a novel issue. It commonly arises where there is overlapping jurisdiction, such as where the federal government and a state government have jurisdiction. The issue of multiple or sequential prosecutions may be addressed as a matter of administrative policy and discretion. Both NHTSA and EPA are charged with regulating medium-duty and heavy-duty vehicles; NHTSA regulates them under EISA and EPA regulates them under EISA and EPA regulates them under the CAA. Both agencies also have compliance review and enforcement responsibilities for their respective regulatory requirements. The same set of underlying facts may result in a violation of EISA and a violation of the CAA.

## **1.4 General Compliance Provisions 76**

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Useful life and in-use standards for hybrids**

The NPRM “requests comment on the possibility of mismatched engine and vehicle useful-life values and on any possible implications this may have for manufacturers’ ability to design, certify, produce and sell their engines and vehicles.” (page 40326 of the NPRM). The NPRM notes that “This could lead to a situation where the engine and the vehicle are subject to emission standards over different useful-life periods.” However, the NPRM suggests that “While such a mismatch in useful life values could be confusing, we don’t believe it poses any particular policy problem that we need to address.” CARB staff believes that the mismatching in engine and vehicle classes is a significant issue that needs to be fully addressed. All heavy-duty engines that are certified for sale have to comply with warranty requirements, which apply to the proper functioning and performance of emission-related components over the warranty period. The useful life requirements for heavy-duty vehicles of different classes are shown in the table below. [EPA-HQ-OAR-2014-0827-1265-A1 p.90]

[Table 15 can be found on p.90 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

As can be seen from the table above, the useful period for a lighter vehicle class is much less than the emission warranty period for a heavier vehicle (i.e., 435,000 vs. 110,000 miles). If a light heavy-duty engine is used in a heavy heavy-duty vehicle, as in using a downsized engine in a hybrid vehicle, there is a disconnect between the two different sets of useful life requirements, a difference of 325,000 miles. The purchaser of a heavy heavy-duty vehicle is protected by regulations that provide 435,000 miles of emissions warranty if the vehicle has a heavy heavy-duty engine installed. However, if a light heavy-duty engine was installed in the same vehicle, the manufacturer of that engine is only liable for 110,000 miles of emissions warranty. Since the light heavy-duty engine and its emission-related components were designed to achieve the required target of 110,000 miles, it is highly uncertain whether it could continue to meet the certified emission standards if it is operated well beyond its useful life. As such, the purchaser of the vehicle would not be protected to the extent provided by the regulations. In addition, since the emissions performance of the light heavy-duty engine are only warranted for up to 110,000 miles, its installation in a heavy heavy-duty vehicle when being operated beyond that mileage is subject to potential emissions increases without recourse for corrective action. [EPA-HQ-OAR-2014-0827-1265-A1 p.90-91]

Another significant issue is engine durability. Heavy-duty engines are designed and manufactured for an acceptable period of use, separate from the emissions warranty useful life. A heavy-duty engine in an over-the-road tractor application is expected by fleet operators to have an operating life of one million miles. A light or medium heavy-duty engine, if installed in that vocational application, is not expected to be able to last that long and may need to be replaced with a new engine some number of times over the life of the vehicle. This would result in an additional cost that may not be anticipated by the purchaser, and may not have been accounted for in the cost analysis of the NPRM, if the NPRM is assuming a certain level of engine downsizing penetration into the heavy heavy-duty vehicle application. [EPA-HQ-OAR-2014-0827-1265-A1 p.91]

CARB staff believes that these are significant issues that need to be addressed in the Phase 2 rulemaking. One possible approach that was used by CARB in the Interim Certification Procedures for Heavy-Duty Hybrid Vehicles was the requirement that the hybrid vehicles, with or without engine downsizing, have to comply with the same useful life requirements as for the conventional diesel engine that would have been normally used in the same intended vehicle class. [EPA-HQ-OAR-2014-0827-1265-A1 p.91]

**Organization:** Daimler Trucks North America LLC

**DF process:** Continue the Phase 1 approach on DFs - EPA requests comments regarding the appropriateness of continuing the practice of engine manufacturers adopting assigned DFs for CO2 emissions. 80 FR 40206. During Phase 1 discussions, DTNA shared data from laboratory and field tests with EPA to demonstrate the in-use fuel efficiency performance of its products, showing that the DF should be zero. In particular, these data illustrated that fuel efficiency remains stable over the course of high mileage testing and thereby support EPA's rationale of allowing manufacturers to adopt a 0.0 g/bhp-h additive deterioration factor for CO2 emissions. DDC's experience with engine emissions supports that these past trends continue to today's products and can be expected to continue with its new products. DTNA similarly agrees with the agencies' proposal that it is prudent for EPA to consider, subject to good engineering judgment, allowing the same assigned DF for advanced or off-cycle technologies. [EPA-HQ-OAR-2014-0827-1164-A1 p.119]

**Useful Life and Maintenance** – The agencies discuss the concern that the EPA regulations apply for the useful life of a vehicle and therefore involve vehicle owners to perform maintenance, which bears associated costs. 80 FR 40325. We think that there is little need for additional regulation to enforce maintenance requirements, especially when it comes to fuel efficiency. The way that the EPA regulations for criteria pollutants have worked until now is that manufacturers pass maintenance instructions to the vehicle owners and then do useful life testing based on those maintenance intervals. With criteria pollutant emission-control systems, an emission failure would not necessarily bother a vehicle owner. For example, if the EGR system stopped pumping EGR or the DPF broke, the engine could still operate and perhaps even have better fuel efficiency than with the emission-control systems intact. (In fact, however, we design our engines and aftertreatment to be very robust and do not expect such failures, plus we use OBD systems to catch them and warn drivers). By contrast, with systems designed to optimize fuel efficiency and minimize GHG emissions, system failure would degrade fuel efficiency, thus providing vehicle owners more monetary incentive to maintain their vehicles and engines. Therefore, we believe that the agencies should expect an even higher likelihood of vehicles and engines being properly maintained under the proposed regulations than under past criteria pollutant regulations, and those regulations have worked. In short, the agencies should be adequately assured that FE-related maintenance is being performed in the field. [EPA-HQ-OAR-2014-0827-1164-A1 p.118-119]

We agree with the use of a zero DF for vehicles' and engines' CO<sub>2</sub>, based on the same data that we showed the agencies in Phase 1. Second, the agencies premise that the Phase 2 standards will use very costly technologies, like hybridization for which battery replacement can be cost-prohibitive, but the agencies explicitly state that they have not quantified maintenance costs for any technology other than hybrids. 80 FR 40325. Although we do not expect maintenance within the period of a DF test, there should be some maintenance requiring battery replacement during the vehicles' actual life. Accurately capturing both the up-front and in-use costs of technologies is extremely important in determining when the fuel saving technologies are cost-effective, and we believe that the agencies dramatically underestimated the costs of (for example) hybrids. In turn, we think it likely that customers will do as New York's hybrid bus operators did and not maintain the hybrid systems, converting back to conventional powertrains. So correcting underestimated costs for fuel saving technologies is an important part of the agencies' post NPRM work. [EPA-HQ-OAR-2014-0827-1164-A1 p.119]

**Organization:** Allison Transmission, Inc

### **Comments on Hybrid Battery Replacement/Useful Life**

EPA is proposing to continue its Phase 1 approach to deterioration factors and anticipates that hybrid systems will experience "some deterioration of effectiveness with age of the storage device." In EPA's opinion, the regulations at 40 C.F.R. 1037.241 provide adequate information to manufacturers in order to develop deterioration factors, but requests comment on whether any changes to this process are required. [EPA-HQ-OAR-2014-0827-1284-A1 p.61]

The criteria referenced in 40 C.F.R. 1037.241 are contingent upon an EPA finding that emissions controls are likely to deteriorate during useful life. We would note that although EPA anticipates that some hybrid powertrain systems may experience deterioration of effectiveness that the Agency is not acting specifically within this rulemaking to make such a determination with regard to any specific system. In general, Allison believes that each hybrid manufacturer can develop a method of determining a battery performance design limit. (Indeed, in the context of certification of hybrid systems, Allison would expect that the amount of credits generated for a hybrid system will be dependent, in part, to battery performance at that design limit). With respect to determining hybrid deterioration factors, we would therefore expect that such design limits should be a sufficient basis for any deterioration factors that are required. [EPA-HQ-OAR-2014-0827-1284-A1 p.61]

Otherwise, Allison would note that 40 C.F.R. 1037.125 provides for the provision of maintenance instructions for properly maintaining a vehicle, including its emission control systems. Allison recommends that a prognostic feature be included in vehicles to warn an operator when measured Amp-Hour throughput surpasses the battery design limit and maintenance must be performed. Such systems would ensure that maintenance was reasonably likely to be done at recommended intervals in accordance with this provision. This is also a good way to take into account each specific vehicle's duty cycle's effect on lifespan. In addition, under this recommendation, the costly battery would not need to be replaced until it had deteriorated to the set design limit. [EPA-HQ-OAR-2014-0827-1284-A1 p.61]

**Organization:** Daimler Trucks North America LLC

The agencies point out that there is the possibility of a mismatched engine useful life and vehicle useful life for components in the same vehicle, and the agencies correctly note that this does not pose any particular policy problem that needs to be addressed. 80 FR 40326. The engine UL is based on the engine's service class, which is the primary intended application of an engine. (See, e.g., 40 CFR § 86.085-2). It is not the sole application of an engine. So there might be, for example, a relatively small

number of medium heavy-duty engines that go into heavy heavy-duty vehicles. And the agencies should not seek to end this practice, as a 'downsized' engine that can meet a vehicle's driving needs can be lighter and more fuel efficient than the larger engine. In other words, if the agencies required that manufacturers certify each engine to the heaviest service class in which the engine will ever be used, then manufacturers would have to limit certain engines' usage, thus depriving fleets of potential fuel savings in those limited cases when a downsized engine will suffice for a vehicle. The agencies took the correct approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.119]

**Organization:** Caterpillar Inc., et al.

### **Regulation must appropriately reflect real-world reductions**

Reduced petroleum consumption and GHG mitigation depend on real-world reductions, not regulatory measurements and calculations. Fuel cost, typically one of the top two operating expenses for owners of heavy-duty vehicles, must be managed to survive in a transportation market with slim margins and many competitors. Vehicle owners are able to pay for efficiency technology only to the extent that it provides adequate return on investment in their operation. As manufacturers, we must design and specify our vehicles to comply with the Phase 2 regulation, while at the same time optimizing to the specific operation of each customer. This situation is only manageable if the regulation results accurately mirror real world results for the majority of applications, while also providing the flexibility to meet unique requirements of applications that do not match regulatory duty cycles. Of course, it is impossible, in any regulatory construct, to match the specific freight efficiency performance in many diverse operations. But it is both possible and our expectation that the regulation accurately compares the relative performance between any two vehicle specifications in the majority of applications. Unless this is achieved, the regulation will not accomplish its goals - goals fully shared by regulators, manufacturers, and vehicle owners. Regulatory outcomes that do not match real-world results will result in failure to meet environmental objectives, combined with economic disruption to our entire industry, because owners will not purchase expensive vehicles, particularly if burdened with complex new technologies that do not deliver adequate results by their measurement - the cost of fuel and other operational costs for these vehicles. [EPA-HQ-OAR-2014-0827-1215-A1 p.3-4]

**Organization:** Enovation Controls (ENC)

Combustion Type Classification - ENC agrees with classification of vehicle technologies based on end user expectations for useful life and emissions system upkeep. [EPA-HQ-OAR-2014-0827-1203-A1 p.1]

2.2 Emissions Warranty and Durability - ENC submits that EPA Phase 2 rules should be purely CO<sub>2</sub>-regulating. Emissions warranty language should be addressed in CARB and EPA standards (CCR Title 13, Section 1971.1 and 40CFR 86.010-18, respectively) to maintain consistency with the separation of emissions functionality guarantees enabled by extensive and sophisticated on-board diagnostics from regulation of OEM as-delivered products. Furthermore, all references to criteria pollutants should reflect the critical pollutants emitted from a specific combustion type. Specifically, critical emissions for Compression Ignition engines are NO<sub>x</sub> and PM, and critical emissions for Spark-Ignition engines are NO<sub>x</sub> and NMHC. [EPA-HQ-OAR-2014-0827-1203-A1 p.2]

**Organization:** FCA US, LLC

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 62.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 135.]

We support the flexibility mechanisms that are included in the rule, averaging, banking and trading, and the recognition of the benefits of technologies that are not fully captured on the laboratory drive cycles. We will work with the agencies to make these processes more efficient in the second phase of this program.

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 102-103.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 121.]

Third, we have been gaining valuable experience concerning the importance of flexibility mechanisms, contained in the light duty vehicle greenhouse gas and fuel efficiency regulations, and these lessons can be applied to the medium and heavy duty fleet.

All of these flexibility mechanisms that have been successful for light duty trucks can be applied equally to the Class 2B and Class 3 pickups and vans covered by this proposed regulation.

**Organization:** McNicols

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 274.]

Modifications to measurements and certification methods may be required, and flexibility to adapt these processes to accommodate promising and impactful technologies will be crucial. Some of these challenges include organizational empowerment, policy overhaul, working level encouragement and grace for risk taking, and flexible compliance throughout your organizations.

**Organization:** National Association of Clean Air Agencies (NACAA)

Finally, NACAA urges that EPA do everything feasible to implement in-use compliance verification. We support EPA's testing regime for engines and the requirement for manufacturers to submit data from chassis testing – these are good first steps. However, we believe the current whole-vehicle provisions should be complemented with some type of whole-vehicle validation to ensure long-term compliance by vehicles in-use. For example, tracking vehicle weight and speed with engine carbon dioxide and nitrous oxide emissions could be used as a tool to determine overall vehicle performance for corrections/correlations to EPA's Greenhouse Gas Emissions Model moving forward. [EPA-HQ-OAR-2014-0827-1157-A1 p.5]

**Organization:** Navistar, Inc.

Navistar feels the following are key areas the agencies must address: [NHTSA-2014-0132-0094-A1 p.2]

- The burdens of testing must be rational and related to ensuring compliance. [NHTSA-2014-0132-0094-A1 p.2]
- Customers should be allowed to make acceptable modifications to engines and vehicles in accordance with past standard practice. [NHTSA-2014-0132-0094-A1 p.2]
- Model years must be aligned so that the emission standards for engine and vehicle start at the same time and so that certain vehicle segments, such as school bus, are not overly impacted because of their unique sales seasons. [NHTSA-2014-0132-0094-A1 p.3]

For example, engine re-rating is a routine practice when a different engine horsepower is required by a second or third owner of a vehicle or the first owner if working conditions change or the initial specifications were not adequate to the task. Because of legitimate differences in use, an engine sometimes will be altered to a different horsepower rating. Transmission calibration may also be changed based on particular applications. Finally, rear axle ratios may be modified based on a particular use. [EPA-HQ-OAR-2014-0827-1199-A1 p.15-16]

By potentially incorporating these elements into certification, there is a significant danger that the opposite will occur to what is intended, that is, these elements will be discouraged. This may negatively impact stock trucks ordered by dealers and second and subsequent owners. Each of these potential modifications reflects a legitimate use. However, in the Proposed Rule, because these elements may have been part of the initial certification, these elements may be “frozen” in a way that has not been the case previously. Navistar is concerned that this could cause serious market disruption. It may cause a manufacturer to certify in a way that shows that vehicle as a “worst case” scenario to guard against the worst possible GHG emissions configuration. The other possibility is that dealers would halt buying stock trucks and wait for a particular customer to order their particular vehicle, which would significantly change that part of the market effectively eliminating stock trucks. A third possibility is that the secondary market for vehicles that have unusual but fixed configurations will be seriously restricted, impacting their value. [EPA-HQ-OAR-2014-0827-1199-A1 p.16]

We agree with EMA’s recommendations in this regard. The agencies should seek to avoid negative impacts to the market. [EPA-HQ-OAR-2014-0827-1199-A1 p.16]

We also have concerns regarding the anticipated technology penetration rates. For the majority of the technologies the agencies project 50% penetration in the vocational sector, with parasitic/friction reduction being the highest at 60% in the first year of this Proposed Rule. This creates two issues: 1) insufficient time, particularly with the vehicle and engine model year mismatch, to develop and implement the new standard, and 2) it would require that each manufacturer establish two parallel, complete engine development programs, given the basic engine architectural changes assumed by the Proposed Rule in the 2021 timeframe. [EPA-HQ-OAR-2014-0827-1199-A1 p.21]

Navistar feels that the provisions with regard to warranty have stricken the correct balance. Navistar does not feel it necessary to change the language as proposed. [EPA-HQ-OAR-2014-0827-1199-A1 p.41]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Impacts on niche segments of the industry

Niche segments such as oversized and heavy haul are recognized as being unique. The agencies have acknowledged that niche industries present unique concerns not shared with the most prevalent truck operations. However, one area that the agencies have not adequately addressed is post-purchase modification, which is a specialty for small business owner-operators. In particular, owner-operators are able to change their schedule in order to meet a customer's demands with relative ease. This can mean that a truck which was spec'd for one particular niche might need to be modified for use in another niche at a customer's request, or as the markets change. This could require different types, or even sizes, of tires and a completely different type of trailer. These small-business owner-operators should not be penalized or prevented from making changes to their equipment in order to stay in business. [EPA-HQ-OAR-2014-0827-1244-A1 p.46]

The proposed rules would prohibit the future post-purchase modification of the new proposed technologies in a truck unless it can be shown that the modifications improve fuel economy. While OOIDA appreciates this flexibility, it is concerned that this important issue is not explained in adequate detail. For example, as stated above, a standard truck built for pulling a dry van trailer might be used to pull a flatbed, or the original purchaser of the truck might decide to change from a dry van operation to flatbed operation by removing the dry van-focused roof fairing. According to the current proposal, such modifications could be a violation of the Clean Air Act, unless it would improve the vehicle's fuel efficiency. OOIDA members would appreciate more specific information on how they would be able to prove the merits of their modifications, well short of being a defendant accused of violating the Clean Air Act. [EPA-HQ-OAR-2014-0827-1244-A1 p.46-47]

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Model Year Mismatch

The agencies have proposed to require the use of engines and vehicles designated with the same model year. However, engine model years are generally aligned with the calendar year, while vehicle model years often extend up to one calendar year plus 364 days. The proposed Phase 2 requirement will disrupt the vehicle manufacturing process without achieving any true environmental benefit. [EPA-HQ-OAR-2014-0827-1269-A1 p.27]

Based on the current market dynamics for vehicle model implementation, model year 2021 vehicles will have either a model year ("MY") 2019, 2020, or 2021 engine installed in them. This is problematic for engine manufacturers as they may not have a certified Phase 2 engine map for pre-2021 engines for use in the 2021 vehicle. It is also an issue for vehicle manufacturers since the MY2019 and MY2020 engine will likely not be designed to comply with the Phase 2 stringencies. [EPA-HQ-OAR-2014-0827-1269-A1 p.27]

EMA is proposing an alternative to address the mismatch between the start of the vehicle and engine model years. Under this alternative, the model year of the installed engine would define the "greenhouse gas" year (GY) for the vehicle. The GY would define the stringency level for each vehicle. This would allow the engine and vehicle to be matched in model year for the purposes of the Phase 2 GHG/FE regulation. [EPA-HQ-OAR-2014-0827-1269-A1 p.27]

The diagram below shows the relationship between the vehicle marketing model year, which is used in the VIN as the vehicle model year, the vehicle GHG/FE year, and the engine model year. With this recommended implementation alternative, as is shown below, the engine MY2020 aligns with vehicle GY2020 and VIN for 2021. Engine MY2021 creates vehicle GY2021 and 2022 VIN. Thus, under this alternative, the issues stemming from the misalignment between available engine and vehicle



technologies – including an unwarranted one-year pull-ahead of the Phase 2 engine standards – are eliminated for all three steps in the Phase 2 regulation. The additional compliance burden of MY2019 and MY2020 engine fuel maps is also eliminated. [EPA-HQ-OAR-2014-0827-1269-A1 p.27]

[Graphic, 'Implementation Alternative - Engine MY = Vehicle GY', can be found on p.28 of EPA-HQ-OAR-2014-0827-1269-A1]

The proposal's definition of Model Year (see p 40663) differs from NHTSA's<sup>24</sup> and penalizes manufacturers who are making trailers with forward reaching model years for sales purposes. EPA staffers have verbally assured us that the model year as required under this rule does not need to be the same model year used for sales purposes. We will be in position of potentially selling trailers marketed and marked on the VIN plate as Model Year 2019, while marking on the EPA plate "THIS VEHICLE COMPLIES WITH U.S. EPA REGULATIONS FOR 2018 HEAVY-DUTY VEHICLES." Any proposed definition of Model Year should explicitly state this. For example, §1037.801 could be expanded to include a new paragraph: [EPA-HQ-OAR-2014-0827-1172-A1 p.15]

\* \* \*

(3) The model year as used in this part need not correspond with the model year used for VIN and marketing purposes. [EPA-HQ-OAR-2014-0827-1172-A1 p.15]

\* \* \*

while the same paragraph should be added to §535.4's definition of MODEL YEAR. [EPA-HQ-OAR-2014-0827-1172-A1 p.15]

Additionally, modify the labeling requirements in 1037.135(8) to read: [EPA-HQ-OAR-2014-0827-1172-A1 p.16]

(8) State: "THIS VEHICLE COMPLIES WITH U.S. EPA REGULATIONS FOR [MODEL YEAR] HEAVY-DUTY VEHICLES." Optionally, the word "MANUFACTURED" may be added after the model year. [EPA-HQ- OAR-2014-0827-1172-A1 p.16]

This will make it clear that if a trailer manufacturer adopts a calendar year model year for this rule, it can continue its practice of using an advance model year for VIN and marketing purposes and to avoid confusion, the Emission Control Label on a vehicle with a 2019 Model Year on the VIN plate manufactured in 2018 could read "THIS VEHICLE COMPLIES WITH U.S. EPA REGULATIONS FOR 2018 MANUFACTURED HEAVY-DUTY VEHICLES". If authority comes through NHTSA, a similar label requirement could be used in §535. [EPA-HQ-OAR-2014-0827-1172-A1 p.16]

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24 49CFR565.12(m) – "Model year means the year used to designate a discrete vehicle model, irrespective of the calendar year in which the vehicle was actually produced, provided that the production period does not exceed 24 months."

**Organization:** PACCAR, Inc.

## **Implementation and Definitional Issues**

## **Engine and Vehicle Model Year Designations**

The Agencies have proposed to require the use of engines and vehicles designated with the same model year. However, engine model years are generally aligned with the calendar year, while vehicle model years often extend up to one calendar year plus 364 days. The proposed requirement will disrupt the manufacturing process without achieving any true environmental benefit. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

Based on the current market dynamics for implementation, the model year 2021 vehicles will have either a model year 2019, 2020, or 2021 engine installed in them. This is problematic for the engine manufacturer as they may not have a certified engine map for pre-2021 engines for use in the 2021 vehicle. It is also an issue for the vehicle manufacturers since the MY2019 and MY2020 engine will likely not be designed to comply with the Phase 2 stringency. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

EMA has proposed an alternative to address the mismatch between the start of the vehicle and engine model years. In this alternative the model year of the installed engine would define the “greenhouse gas” year (GY) for the vehicle. This would allow the engine and vehicle to match in model year for purposes of the Phase 2 GHG regulation. This proposal is also included in EMA’s comments. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

EPA has suggested in a meeting with EMA and the other Agencies that this alternative would, in their view, delay the implementation of Phase 2 and somehow reduce the GHG emissions reductions. In fact, since the calculations for GHG reductions are by model year of the regulation, all emissions will be counted and no net shortfall would be realized in GHG reductions. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

PACCAR supports the EMA proposal and is committed to engaging with the Agencies either through EMA or alone to identify and mitigate issues with the above proposal so that a mutually acceptable alternative can be finalized. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

## **Powertrain Modifications**

The ability to modify powertrain components, such as engine ratings, transmission calibrations, and rear axle ratios in the field to optimize the performance of the vehicle for the vehicle’s actual job requirements and duty cycle is imperative for owners of commercial vehicles. A sub-optimized vehicle will burn more fuel and perform poorly. [EPA-HQ-OAR-2014-0827-1204-A1 p.28]

In Phase 2, with the powertrain components for the vehicle being added as input into GEM’s GHG vehicle assessment, these components become regulated by the GHG rule. As written, the draft regulation would make any modifications to these components illegal under the tampering provisions of the Clean Air Act. EMA’s comments provide extensive details supporting the need for the ability to modify powertrain components in the field without this modification being deemed “tampering.” [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

It is typical of fleets to buy numerous vehicles with the same spec and then modify the powertrain calibrations based on where the vehicle will operate, such as on flatter terrains versus more mountainous regions. [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

To mitigate the concern regarding extensive use of powertrain changes shortly after vehicle build to improve GHG scores of vehicles, PACCAR would be willing to update the GHG end of year reporting data for a chassis to reflect any field modifications that are made known to us. If changes are made to the powertrain configurations post manufacturing, then the modifying party is responsible for communicating these to the vehicle manufacturer for inclusion in their 270 day report. If communication of the change is not provided to the vehicle manufacturer, then the party responsible for modifying the configuration will be held responsible for reporting the change to the Agencies. [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

PACCAR strongly supports the EMA recommendation to add language to the regulation that spells out that these modifications are not tampering actions. [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

**Organization:** Volvo Group

### **Tampering Prohibitions**

As with the Phase 1 regulation, the Phase 2 regulation restricts the ability of an OEM, dealer, or vehicle owner to modify an engine or vehicle's operating parameters anytime within the vehicle's life. The agencies do allow for post-useful life vehicle modifications to reduce emissions of GHGs under 40 CFR 1037.655 where there is a "reasonable technical basis for knowing that such modification will not increase emissions of any other pollutant" and where you "have information that would lead an engineer or other person familiar with engine and vehicle design and function to reasonably believe that the modifications will not increase emissions of any regulated pollutant". The post-useful life flexibility does not apply to engine modifications or recalibrations. [EPA-HQ-OAR-2014-0827-1290-A1 p.57-58]

Under the Phase 1 GHG and current criteria emissions regulations, there is limited concern that prohibited modifications may occur due to the fewer regulated components and the engine family construct, under which all engines within the family are certified to the parent engine level. Under Phase 1 and criteria emissions regulations, the engine calibration, transmission gear ratios and calibration, and drive axle ratios can be modified at any time without impacting a vehicles certified emissions. Dealers use this flexibility in the case of stock trucks that are ordered in the absence of a specific customer order; and owners use it to meet the changing demands of a vehicle's application or to improve resale value. In Phase 2, this is no longer the case. [EPA-HQ-OAR-2014-0827-1290-A1 p.58]

In the proposed Phase 2 regulation, engines may be optionally certified as part of a powertrain and, in any case, the torque rating will have some impact on the vehicle's GHG emissions. As well, since the transmission efficiency, gear ratios and calibration, along with drive axle ratios would all become part of the vehicle's certified configuration, they would also become subject to tampering restrictions, and could not be modified unless it could be demonstrated that the changes did not increase GHG emissions (a task that few dealers or owners could accomplish). The result of this would be a disruption of the new, used, and in-use vehicle markets. Dealers would no longer be able to stock new trucks to meet the needs of customers who require a truck immediately. Buyers on the secondary market would not be able to either purchase a used truck that met their requirements, or modify a truck to do so. The primary purchaser's overall cost of ownership would necessarily increase due to this lack of flexibility to make a used truck more suitable for the secondary market, the result of which would be longer trade cycles and increased operation of older vehicles, along with the resultant decrease in new truck sales and loss of emissions benefits from those new trucks. Lastly, those customers who must modify a vehicle's configuration to meet changing operational demands (e.g. moving a vehicle from a mostly flat to hilly region) will no longer be able to modify that vehicle, since the resultant emissions would likely be greater (and even if not, could not be easily demonstrated). [EPA-HQ-OAR-2014-0827-1290-A1 p.58]

Truck owners will not have the capability or knowledge to determine whether any modification may result in increased emissions to the extent required by the agencies in Section 1037.655. Most modifications of this type would require a new GEM analysis which would require OEM support. Given the number of trucks in the fleet it would not be possible for OEMs to support this activity without excessive burden, even if the OEM knew of the modification. In many cases, and particularly for vendor supplied components, the OEM has no means to know that a modification has occurred. From this perspective, it would unfairly burden OEMs to quantify and report the impact of changes to OEM supplied components while vendor components could be modified without consequence. [EPA-HQ-OAR-2014-0827-1290-A1 p.58]

Volvo Group requests that the agencies allow for vehicle modifications such that disruption to the market is limited. In this regard, Volvo Group supports the EMA comments in this area and the proposal wherein OEMs would only be required to track new vehicle modifications that occur prior to delivery to the ultimate purchaser and to include such modifications in year-end reports when those modifications occur at least 60 days ahead of submission of the final report to the agencies. [EPA-HQ-OAR-2014-0827-1290-A1 p.58-59]

**Response:**

*Useful Life and DFs – Including for Engines in Hybrid Vehicles*

We are adopting as proposed our approach regarding deterioration factors. Vehicle manufacturers may certify that installed technology will remain effective throughout the vehicle useful life by either demonstrating that critical emission-related maintenance will occur or by applying deterioration factors, or both. However, in light of comments expressing concerns with mismatched engine and vehicle useful life, we have reconsidered those provisions. As provided in 40 CFR 1037.140 of the final regulations, we have structured the vehicle regulations to generally apply the same useful life for the vehicle that applies for the engines. However, these regulations also allow vehicle manufacturers to certify their vehicles to longer useful lives. The agencies see no problem with allowing vehicles to have longer useful lives than the engines.

For hybrid vehicles, Allison is correct that we are not making a determination with regard to the need for a non-zero DF for any specific hybrid systems. Rather, we are highlighting that manufacturers must use good engineering judgment to account for any deterioration of emission controls.

*Representativeness of Test Methods*

While no test methods can perfectly replicate in-use performance for each operator and each application, the methods developed by the agencies should accurately reflect in-use *improvements* in a relative sense. Thus, we expect operators to be generally satisfied with the performance they observe.

Eaton commented in support of powertrain testing. In some respects, powertrain testing can be considered to be a reference method for this rulemaking. Because manufacturers have the option to perform powertrain testing instead of engine-only fuel mapping, the stringency of the final standards can be traced to powertrain testing. In other words, methods that can be shown to be equivalent to powertrain testing, can be considered to be consistent with the testing that was used as the basis of the final Phase 2 standards.

In a related context, it may be useful in the future to consider equivalency to powertrain testing as an appropriate criterion for evaluating changes to GEM to address new technologies. Consider, for example, a new technology that is not represented in GEM, but that is reflected in powertrain testing.

The agencies could determine that it would be appropriate to modify GEM to reflect the technology rather than to require manufacturers to perform powertrain testing. In such a case, the agencies would not consider the modification to GEM to impact the effective stringency of the Phase 2 standards because the new version of GEM would be equivalent to performing powertrain testing.

Finally, we agree with Navistar that testing should be rational and related to ensuring compliance.

#### *Flexibility Provisions*

Several commenters expressed support for the numerous flexibility provisions proposed. General Motors also commented in support of applying light-duty vehicle flexibility provisions to heavy-duty vehicles. As discussed in Chapter 7, we do not believe it is invariably appropriate to apply light-duty provisions directly to heavy-duty vehicles because of differences in test procedures and in-use duty cycles.

McNicolis stated that “[m]odifications to measurements and certification methods may be required, and flexibility to adapt these processes to accommodate promising and impactful technologies will be crucial.” We believe the final regulations will provide the agencies significant ability to adapt methods to address unforeseen circumstances.

#### *In-use Compliance Assurance*

NACAA urged EPA to “do everything feasible to implement in-use compliance verification.” As described later, EPA has adopted substantial program to evaluate both certification and production engines and vehicles. In addition, EPA will collect in-use CO<sub>2</sub> data as part of our existing in-use testing program. The agencies are also requiring all technologies to be durable.

#### *Post-Production Modifications*

Navistar commented that “[c]ustomers should be allowed to make acceptable modifications to engines and vehicles in accordance with past standard practice.” Under 40 CFR part 1037, it is generally prohibited for any person to remove or render inoperative any emission control device installed to comply with the requirements of part 1037. However, in 40 CFR 1037.655 EPA clarifies that owners may modify a vehicle for the purpose of reducing emissions, provided they have a reasonable technical basis for knowing that such modification will not increase emissions of any other pollutant. This essentially requires the owner to have information that will lead an engineer or other person familiar with engine and vehicle design and function to reasonably believe that the modifications will not increase emissions of any regulated pollutant.

Other manufacturers also commented that manufacturers (and their authorized agents) should be allowed to modify powertrain components, such as engine ratings, transmission calibrations, and rear axle ratios after production to optimize the performance of the vehicle for the vehicle’s actual job requirements. The agencies agree that manufacturers should be allowed to make such modifications, provided the final configurations are accurate in the end of year reports. For example, this could allow reconfiguration of stock vehicles at dealerships. However, any modifications made prior to the delivery to the ultimate purchaser that are not reflected in the end of year reports will be considered violations, whether more or less than 60 days before the end of year reports.

OOIDA expressed similar concerns for trucks owned by independent operators. However, the CAA generally prohibits removal of emission controls. While EPA has in the past interpreted this to not restrict modifications that maintain or improve emissions performance, the CAA clearly does not allow modifications that increase emissions. Thus, an independent operator wishing to maintain operational

flexibility should purchase a lower technology vehicle, which is permissible if the vehicle is certified to a higher FEL under the emissions averaging program for manufacturers. For example, an operator concerned about aerodynamic fairings on the tractor could purchase a Bin I tractor (which includes no upper limit on aerodynamic drag), which would allow the operator to make any aerodynamic modifications without risking the modification taking the vehicle out of its certified configuration.

Volvo suggested that operator will often lack the expertise necessary to provide the reasonable technical basis for the modifications. However, they overstate the level of knowledge EPA assumes when referring to a “reasonable technical basis”. Nevertheless, operators should be aware that some knowledge is required before modifying the vehicle. While this may disrupt prior practices, the Clean Air Act creates a fairly clear presumption that vehicles should remain in their certified configurations in-use.

#### *Model Year Mismatch*

Under the normal engine and vehicle manufacturing processes, many vehicles may be produced with engines having an earlier model year than the commercial model year of the vehicle. For example, we expect that most Class 6 and heavier vehicles commercially sold as model year 2021 vehicles will be produced in calendar year 2020 with MY 2020 engines. Some manufacturers commented that MY 2020 engines should not be subject to Phase 2 requirements, based on NHTSA’s statutory 4-year lead-time requirement and because the potential higher fuel consumption of MY 2020 (i.e., Phase 1) engine maps could force vehicle manufacturers to install additional technologies that were not projected by the agencies for compliance. The agencies considered these comments along with the potential cost savings for manufacturers to align the timing of both their engines’ and vehicle’s Phase 2 product plans and certification paths. The agencies also considered how this situation would repeat in MY 2024 and MY 2027 and possibly with future standards as well. Based on these considerations, we have decided that it would be more appropriate to harmonize the engine and vehicle standards, starting in MY 2021.

#### *Other General Comments*

Enovation supported narrowing the scope of the EPA Phase 2 standards with respect to issues such as warranty and “critical emissions”. However, such changes would be inconsistent with the general regulatory construct provided by the Clean Air Act. Navistar commented that it does not support the proposed changes to the warranty language, but these changes are primarily clarifications, rather than fundamental changes.

With respect the McNicols’ general comment in support of compliance flexibility, we note that the agencies are committed to maintaining the proper balance of compliance assurance, flexibility, and conformance with statutory requirements.

### **1.4.1 Advanced Technology Credits and Multipliers**

**Organization:** Allison Transmission, Inc.

#### **EPA and NHTSA Should Not Continue Phase 1 Programs to Incentivize Hybrids, Fuel Cell and EVs**

Allison supports provisions of the Proposed Rule that would end specific Phase 1 incentives for hybrids, fuel cell and electric vehicles (“EVs”). We concur with the agencies that the potentially large credits that may be available for such vehicles through certification of very low emission rates should provide

sufficient incentive for improved introduction of such vehicles into the commercial MD/HD fleet. As the agencies indicate at the beginning of the Proposed Rule, the Phase 2 standards are intended to be technology-forcing. While the agencies' ability to require technology-forcing standards is not unbounded,<sup>82</sup> manufacturers should not receive what could amount to a "double credit" of meeting their compliance obligations through hybrids, fuel cell and electric vehicles are receiving additional credits on account of this action. [EPA-HQ-OAR-2014-0827-1284-A1 p.51]

As the agencies indicate at the beginning of the Proposed Rule, the Phase 2 standards are intended to be technology-forcing. While the agencies' ability to require technology-forcing standards is not unbounded,<sup>82</sup> manufacturers should not receive what could amount to a "double credit" of meeting their compliance obligations through hybrids, fuel cell and electric vehicles are receiving additional credits on account of this action. In addition, we would note that expanded delegated assembly for vehicles is an additional avenue whereby new technologies can be introduced into the market. [EPA-HQ-OAR-2014-0827-1284-A1 p.51] 89

**Organization:** American Gas Association (AGA) et al.

**We Recommend that the Agencies Incorporate an Advanced Technology Credit that Incentivizes Engines that Emit No More than 0.02 g/bhp-hr of NOx Emissions**

The HD Phase 1 Rule provided Advanced Technology Credits ("ATC") for hybrid powertrain designs that included energy storage systems, Rankine cycle waste heat recovery systems attached to an engine, all-electric vehicles, and fuel cell vehicles.<sup>42</sup> The agencies justified the use of this credit for these specific technologies on the notion that the Phase 1 standards could be met without the use of advanced technologies, and that, therefore, the standards were not premised on their use. Thus, the agencies felt that there needed to be additional incentives to stimulate those particular technologies. [EPA-HQ-OAR-2014-0827-1223-A1 p.10-11]

In the Phase 2 Proposal, the agencies have opted not to include the ATC because the proposed rules "are premised on the use of some advanced technologies, making them equivalent to other fuel-saving technologies in this context."<sup>43</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.11]

However, given the low market penetration of the technologies afforded the ATC and the expectation of further air quality and GHG imperatives over the course of the timeline of the proposed rule (i.e., 2021-2027), we strongly urge the agencies to include an expanded ATC in the final Phase 2 rule. [EPA-HQ-OAR-2014-0827-1223-A1 p.11]

More specifically, we strongly urge the agencies to reinstitute the ATC and expand it to provide credit for engines that are certified at NOx levels at or below 0.02 grams per brake horsepower-hour (g/bhp-hr) (ultra-low NOx engines). [EPA-HQ-OAR-2014-0827-1223-A1 p.11]

We see multiple benefits from an expanded ATC that includes ultra-low NOx engines:[EPA-HQ-OAR-2014-0827-1223-A1 p.11]

- It will align with California's efforts to incentivize the commercialization of these engines through their Optional Low NOx Standard for on-road heavy-duty engines.<sup>44</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.11]

- If successful, it will help spur the commercial development of engines that will be necessary to help states meet their obligations under any future ozone National Ambient Air Quality Standard (NAAQS).[EPA-HQ-OAR-2014-0827-1223-A1 p.11]
- It will lay the groundwork for the next generation of heavy-duty engine technology. Given that EPA has not adopted criteria pollutant standards since 2001, it is timely to consider—and to signal to industry—the next level of potential emissions performance.[EPA-HQ-OAR-2014-0827-1223-A1 p.11]
- It will help incentivize engines that will reduce ground-level ozone, a short-lived climate pollutant that should be reduced for both climate and health reasons.[EPA-HQ-OAR-2014-0827-1223-A1 p.11]
- It is worth noting that an expanded ATC that includes ultra-low NOx engines would be available to all engines regardless of fuel type. This would maintain the fuel-neutrality of the overall program, and incentivize cleaner diesel engines, as well as cleaner natural gas engines.[EPA-HQ-OAR-2014-0827-1223-A1 p.11]

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42 HD Phase 1 Rule, page 57245.

43 Phase 2 Proposal, page 40158.

44 “Optional Reduced NOx Emission Standards for On-Road Heavy-duty Engines”. California Environmental Protection Agency, Air Resources Board.  
<http://www.arb.ca.gov/msprog/onroad/optionnox/optionnox.htm>, December 9, 2014.

**Organization:** American Lung Association

The American Lung Association offers the following recommendations to strengthen the stringency and timing of the proposal and address several key elements of California’s commitment to protecting public health and air quality. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.143-144.]]

Advanced technology credits, or a similar mechanism, should be maintained in Phase 2, rather than phased out. Given the severe air quality conditions in the South Coast and San Joaquin Valley, California needs truly zero emission technologies to be moving our freight. Without a strong commitment to advanced technologies and electrification in this sector, the overall proposal is missing a critical tool that California needs. In particular, battery electric, fuel cell, hybrid and other advanced technologies are vital to achieving the major reductions needed here. Retaining the focus on advanced technologies will also allow for a stronger overall standard and greater health and fuel saving benefits to be achieved. Zero emission technologies must be moved forward to protect public health from pollutants today and an unsustainable dependence on fossil fuels that threatens health for generations. [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.145-146.]]

**Organization:** American Trucking Associations (ATA)

**Use of Advanced Technology Credits Should Continue**



Hybrid and electric technology applications continue to be of interest to the trucking industry, especially in the vocational segment. While these technologies provide fuel savings and reduced tailpipe emissions, the cost of these technologies can be substantial. EPA estimates the added cost of hybrid technologies are in the range of \$20,000 to \$40,000 for larger vocational vehicles and tractors while full electric technologies are in the \$50,000 to \$150,000 range. These costs are the highest of all the fuel efficient technologies identified and, as previously discussed, are likely to result in lower adoption rates than estimated. [EPA-HQ-OAR-2014-0827-1243-A1 p.23]

In order to continue to advance these technologies and their adoption, the incentive-based approach used in Phase 1 should be retained. Specifically, the agencies should preserve the advanced technology credits which provide a credit of 1.5 in order to promote the use of hybrid and electric vehicles in larger vocational vehicles and tractors. A continuation of these credits will provide an incentive for OEM's to pursue the development and sale of hybrid and electric vehicles. These credits will likely help drive down costs while more effectively promoting the advantages of this green-technology path as a path towards achieving the goals of the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.23]

**Organization:** BYD Motors

My concern is that I do not believe that the rules alone will drive the adoption of advanced technologies like fuel cell, hybrid, and electric vehicles. These technologies are available today and should see continued growth in market share as component prices fall and fuel price volatility remains a fleet concern. [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.227.]]

To achieve this outcome BYD must make sizable research and development investments and must generate a significant number of orders to support the large scale manufacturing build out and associated scale economies. At BYD we believe that the best approach to accelerate the necessary growth of the electric truck market is consistent and aggressive regulations in combination with incentives for advanced technology adoption. [EPA-HQ-OAR-2014-0827-1182-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.227.]]

The agencies noted appropriately that advanced technology credits should be eliminated for hybrid electric vehicles because while they are an important strategy for reducing fuel use from heavy-duty trucks in the vocational vehicle sector, the stringency of the regulation is based on significant adoption of the technology. Technologies such as plug-in electric vehicles and fuel cell vehicles are at the nascent levels of adoption, however, and could play a significant role in reducing fuel from the heavy-duty truck sector beyond 2029. A revised advanced technology program combined with a stronger rule could help drive the innovation necessary to achieve future reductions from the work truck fleet. The agencies should retain an advanced technology credit program that incentivizes manufacturers to innovate beyond the technologies considered broadly applicable in the timeframe of this rule, including battery-electric vehicles and hydrogen fuel cell vehicles. Such a program would not significantly undermine the environmental and oil reduction benefits of the rule due to relatively low sales volumes, but they could provide manufacturers sufficient incentive to begin ramping up production of these advanced technologies. [EPA-HQ-OAR-2014-0827-1182-A1 p.3]

Also, BYD supports programs like the Diesel Emission Reduction Act (DERA) and the funding opportunities that it provides. [EPA-HQ-OAR-2014-0827-1182-A1 p.3]

**Organization:** California Air Resources Board (CARB)

### **3. Include a greater reliance on advanced technologies**

The Phase 2 proposal lacks sufficient stringency to drive market development of battery electric or fuel cell electric technologies. The proposal assumes only a modest level of hybrid technology and no use of battery electric or fuel cell electric technology, is generally pessimistic on the future of battery electric and fuel cell electric vehicles, and, in fact, eliminates the advanced technology credits included in the Phase 1 program that were intended to encourage development of these technologies. This is contradictory to CARB's position that the early deployment of advanced technologies is the foundation of California's pathway to achieving both its climate and air quality targets. [EPA-HQ-OAR-2014-0827-1265-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.24-25.]]

Furthermore, without any significant reliance on advanced technologies built into the proposed standards, CARB estimates that projected increases in truck activity will completely overtake projected greenhouse gas reductions by 2043 (with respect to the 2010 baseline), resulting in greenhouse gas levels from medium- and heavy-duty trucks in 2050 that are about six percent higher than 2010 levels. To actually offset the expected activity growth, advanced, near-zero emission technologies must be a significant part of the long-term solution. [EPA-HQ-OAR-2014-0827-1265-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.26.]]

#### **Support Comment**

##### **Comment – Termination of the advanced technology multiplier for Rankine engines and class 2b-6 hybrids**

The NPRM requests comment on the proposed termination of the advanced technology multiplier. CARB staff agrees that it is appropriate to terminate the advanced technology multiplier for Rankine cycle WHR at this point, since the standards proposed for Phase 2 presume some use of this technology. In addition, hybrids for class 2b through 6 trucks are also reasonably developed at this point, and the vocational vehicle standards were set assuming some penetration of hybrids. Thus, it would be appropriate to terminate the multiplier for these classes of hybrids as well. However, CARB staff believes that the advanced technology multiplier should be continued for class 7/8 hybrids as well as BEVs and FCEVs, as discussed in the following comment. [EPA-HQ-OAR-2014-0827-1265-A1 p.81]

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Advanced technology credits**

Effective with the 2021 MY, U.S. EPA and NHTSA propose eliminating all Advanced Technology Credits (1.5 multiplier) that were included in the Phase 1 GHG regulations to promote early implementation of advanced technologies. The Phase 2 standards anticipate the use of hybrids and Rankine cycle technology, for which advanced technology credits were previously allowed, as part of the technology path used by manufacturers to meet the proposed Phase 2 standards. U.S. EPA and NHTSA believe that the Phase 2 standards alone should provide sufficient incentive to continue to develop these and other advanced technologies. U.S. EPA and NHTSA welcome comments on the need for advanced technology credits for BEVs and FCEVs in Phase 2, including information on why an incentive in this time frame may be warranted, recognizing that the incentive would result in reduced benefits in terms of CO<sub>2</sub> emissions and fuel use due to the Phase 2 program. CARB staff agrees that there is no further need for advanced technology credits for class 2b through 6 hybrids and Rankine cycle technology, but believes that these credits provide a further impetus to manufacturers to

manufacture other technologies such as BEVs and FCEVs, and that the furtherance of this technology development will, over time, offset the temporary reduction in benefits attendant with the use of a multiplier credit. To minimize the potential emissions impact, the incentive could be phased out at a certain manufacturer volume or with a certain MY. Advanced technology credits, as they relate to class 7 and 8 vehicles, are discussed in the following comment. [EPA-HQ-OAR-2014-0827-1265-A1 p.81-82]

### **Oppose (Comment on Topic Where NPRM Requests Comment)**

#### **Comment – Reinstate advanced technology multiplier for class 7/8 hybrids, BEVs, and FCEVs**

The Phase 1 GHG regulation included an advanced technology multiplier to create an incentive for the adoption and early introduction of advanced technologies, namely, Rankine cycle technology, hybrids, BEVs, and FCEVs. According to U.S. EPA and NHTSA, the advanced technology incentives were “intended to promote the commercialization of technologies that have the potential to provide substantially better GHG emissions and fuel consumption if they were able to overcome major near-term market barriers” (page 40389 of the NPRM). CARB staff believes such incentives are needed, especially given the magnitude of California’s GHG emission reduction goals. Accelerated deployment of hybrid and zero-emission trucks and buses is critical for California to meet its air quality, climate and petroleum reduction goals. We anticipate these technologies will be increasingly critical nationally in the years ahead as federal ozone standards become more stringent and the impacts of climate change continue to manifest themselves. [EPA-HQ-OAR-2014-0827-1265-A1 p.82-83]

Thus, CARB staff believes that the advanced technology multiplier should be continued for BEVs and FCEVs in all classes and for full hybrids in class 7 and 8 tractor and regional vocational applications, for the reasons discussed below. In addition to maintaining the advanced technology multiplier, CARB staff encourages U.S. EPA and NHTSA to look for other creative ways in the context of the Phase 2 standards to encourage the development of these critical advanced technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.83]

- Proposed standards are not based on these technologies. 40 CFR 1036.615 (k)(7) of the Phase 2 proposal limits the advanced technology multiplier to Phase 1 vehicles, based on the premise that the Phase 2 standards presume the use of Rankine engines, as well as some hybrids. However, hybrid technologies for class 7 and 8 long haul tractor applications, as well as heavy heavy-duty hybrid technologies for regional vocational applications, were not assumed to have any penetration when setting the proposed Phase 2 standards. Hybrid technologies for such applications are still not fully developed and the costs of available hybrid technologies for these applications are still high. In addition, because U.S. EPA and NHTSA anticipate very limited use of BEVs and FCEVs and did not include any anticipated use of these advanced technologies when setting the emission standards proposed in the NPRM, it is appropriate to continue to offer the advanced technology multiplier to accelerate their development and adoption. [EPA-HQ-OAR-2014-0827-1265-A1 p.83]
- These technologies are potential game-changers and are worth the potential small emission disbenefit. These multipliers would reduce some of the benefits from the rule because manufacturers could use the advanced technology credits in lieu of reducing emissions. For example, a 1 ton emission reduction from using advanced technologies would allow a manufacturer to avoid 1.5 tons in emission reductions they would otherwise need to achieve from traditional vehicles. However, CARB staff expects this reduction in benefits to be insignificant, even under an extremely optimistic penetration scenario for advanced technologies in the Phase 2 timeframe.<sup>37</sup> Also, in the long term, the reduction in benefits would

be worthwhile due to the anticipated support for development of advanced technologies. A footnote in the NRPM (page 40389 of the NPRM) expresses U.S. EPA and NHTSA's opinion when applying multipliers for advanced technology in the light-duty vehicle fleet for MYs 2017 to 2021: It is "worthwhile to forego modest additional emissions reductions and fuel consumption improvements in the near-term in order to lay the foundation for the potential for much larger 'game changing' GHG and oil consumption reductions in the longer term." U.S. EPA and NHTSA believe it was appropriate to provide multipliers in the light-duty vehicle fleet; BEV development and penetration for the light-duty vehicle fleet is at a much more advanced commercial level than BEVs for the medium- and heavy-duty fleet, with many light-duty vehicle models available in a variety of configurations with ever-increasing consumer acceptance. It is therefore even more appropriate to allow these credits to continue for the medium- and heavy-duty fleet. [EPA-HQ-OAR-2014-0827-1265-A1 p.83-84]

- These technologies currently have substantial incremental costs, which advanced technology credits could help bring down. These advanced technologies currently have higher initial costs compared to diesel or gasoline approaches due to low production volumes and higher manufacturer costs. For instance, incremental costs for vehicles using battery electric approaches is estimated at up to about \$90,000 for a medium-duty vehicle (8,501 to 14,000 lbs GVWR), and substantially more for a vehicle in the heavier classes. Maintaining the 1.5 multiplier would help these technologies transition from prototype and small scale production to assembly line production, thereby reducing vehicle costs. By further encouraging early sales of these technologies, the multiplier would help drive down production cost and help zero-emission technologies become more cost-competitive. [EPA-HQ-OAR-2014-0827-1265-A1 p.84]
- Advanced technology credits would promote research, development and production of advanced technologies and eventual transfer of these technologies to other applications: These multipliers promote the investment by manufacturers in advanced technologies. Further encouraging development and deployment of plug-in hybrid and zero-emission truck and bus technology would help accelerate the rate of these technologies transfer to other applications, such as off-road equipment and marine vessels. [EPA-HQ-OAR-2014-0827-1265-A1 p.84]
- Advanced technology credits would accelerate consumer acceptance: One of the barriers to commercialization of plug-in hybrid and zero-emission trucks and buses is consumer reluctance to purchase unfamiliar technologies. The "energy paradox" identified in the NPRM (page 40435 of the NPRM) – whereby many readily available technologies that appear to offer cost-effective fuel efficiency benefits have not been widely adopted – is particularly difficult to overcome for the most advanced technologies such as hybrids and zero-emission vehicles. As the NPRM notes, there are numerous potential causes for the energy paradox, including behavioral rigidity among vehicle operators, imperfect information in the new and resale vehicle markets, and inherent distrust of new technologies. California has experienced these consumer acceptance challenges as we begin our transition to zero- and near-zero-emission technologies. These challenges, where the market does not act rationally to enable cost-effective technologies, underscore the need not only for robust federal standards to help bring these technologies to market, but potentially also for additional strategies to overcome initial consumer resistance to the most advanced technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.84-85]

The advanced technology multiplier provides an incentive for manufacturers to continue to develop BEVs and FCEVs in all class 2b through 8 categories, as well as hybrid technologies for the class 7 and 8 long haul tractor and regional vocational applications. CARB staff believes that continuing the advanced technology multiplier is an important part of promoting these technologies that, in the long term, offer a key approach to significant reduction of GHG emissions. In addition to the supply-level incentive that these credits support, CARB staff has and will continue to incentivize these technologies as well at the consumer level (demand incentive) through the use of its voucher programs, incentive

funds, and other types of consumer based credits to promote demand. These programs provide funds to partially offset the incremental costs of advanced technology heavy-duty vehicles compared to equivalent conventional vehicles. CARB has planned rulemakings that will promote substantial requirements for zero-emission transit buses as well as promote advanced technologies for last mile delivery applications and airport shuttles. These planned rulemakings are part of CARB's Sustainable Freight Transport Initiative. [EPA-HQ-OAR-2014-0827-1265-A1 p.85]

By continuing to allow advanced technology credits for these technologies in the Phase 2 rule, the synergy between the Phase 2 rule and California's incentive and regulatory programs for heavy-duty technologies could push further acceleration of advanced technologies development. To minimize the potential emissions impact, the incentive could be phased out at a certain manufacturer volume such as two percent of vehicles produced in that class or application. We encourage U.S. EPA and NHTSA to maintain the 1.5 multiplier for these critical technologies. [NHTSA-2014-0132-0093 p.85]

The status of hybrid, battery electric, and fuel cell electric technologies is presented through technology assessment reports, which will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. These technology assessments support our belief that these technologies are on the cusp of major potential deployment, which the continued use of the advanced technology multiplier will support. [EPA-HQ-OAR-2014-0827-1265-A1 p.85-86]

### **Oppose/Requested Change Comment**

#### **Comment –Excess weight associated with fuel cell**

CARB staff has significant concerns regarding the following assertion: [EPA-HQ-OAR-2014-0827-1265-A1 p.101]

Hybrid powertrains, fuel cells and auxiliary power would not only present complex packaging and weight issues, they would further increase the need for reductions in the weight of the body, chassis, and powertrain components in order to maintain vehicle functionality. [EPA-HQ-OAR-2014-0827-1265-A1 p.101]

CARB staff disagrees with the statement made in the RIA that fuel cells present complex packaging and weight issues. With regard to packaging, the stack power density for a heavy-duty proton exchange membrane fuel cell (PEMFC) system (commonly used in on-road vehicles) ranges between 1,500 and 1,800 watts per liter (W/L) and the system power density is 200 to 300 W/L. The system specific power for heavy-duty PEMFCs is similar to conventional engines. For instance, a Cummins ISB 6.7 diesel engine that is used in hybrid transit buses is rated at 209 kW and with a system weight of 616 kg has a system specific power of 339 watts per kilogram (W/kg), falling in the range of a heavy-duty fuel cell system. The stack and system specific power and density are equivalent to commercial conventional engine products. Therefore, the volume and weight of a fuel cell system does not pose a "complex packaging and weight issue" for heavy-duty vehicles, nor does it compromise the vehicle's functionality. [EPA-HQ-OAR-2014-0827-1265-A1 p.101-102]

The additional weight of FCEVs is not actually associated with the fuel cell engine. It is the electrified components that are used in hybrid electric vehicles, BEVs, and FCEVs that have some additional weight. Also, similar to compressed natural gas (CNG) vehicles, on-board hydrogen storage tanks weigh more than diesel tanks. CARB staff anticipates that weight reductions in both electrical components and hydrogen storage tanks are feasible within the Phase 2 timeframe and that heavy-duty FCEVs should

not be discounted merely on a near-term assessment of weight. [EPA-HQ-OAR-2014-0827-1265-A1 p.102]

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<sup>37</sup> CARB staff estimates if 3 percent of all vehicles covered by the Phase 2 standards received advanced technology credits for model year 2027 and later (for example if 3 percent were battery or fuel cell electric), emissions will be increased by about 0.5 MMT in California as a result of the multiplier. This would reduce projected Phase 2 benefits by about 3% in 2050.

**Organization:** California Air Resources Board (CARB) – Supplemental Comments

In general, ARB tended to propose multipliers somewhat higher than the calculated cost ratios because manufacturers will need a push to take risks and try new technologies. A multiplier that exactly balanced the additional cost would be less likely to incentivize technological development. However, ARB’s proposed multipliers are not simply the calculated cost ratios “plus some” for several reasons. First, since these technologies are at different stages of development for different applications, the development risk to manufacturers varies. Second, for simplicity in the regulation, staff is recommending minimizing the number of different multipliers being used. For example, for simplicity, the proposed BEV multipliers for vocational vehicle and Class 2B/3 pickups and vans were all set to 4.5, despite the cost ratios ranging from 2.4 to 5.6 for these categories (see Table 1 and Table 2). Third, as previously mentioned, each of the categories contains a wide variety of vehicles, some of which are more suited to these technologies than others. In supplemental comments, CARB proposed the following values:

**Table 2: CARB Staff’s Proposed Phase 2 Multipliers**

|               | Proposed Multipliers |     |      |
|---------------|----------------------|-----|------|
|               | PHEV                 | BEV | FCEV |
| Class 7/8     | 3.5                  | 4.5 | 5.5  |
| Vocational    | 3.5                  | 4.5 | 5.5  |
| Class 2B/3    | 3.5                  | 4.5 | 5.5  |
| Transit Buses | 3.5                  | 4.5 | 5.5  |

**Organization:** CALSTART

– Restore Advanced Tech credits – provide more flexibility for suppliers to generate for OEs (delegated assembly expansion) [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

Advanced Technology Credit Inclusion. If combined with higher stringency, we believe greater flexibility to achieve the greater stringency levels is appropriate. We therefore believe mechanisms such

as the advanced technology credit should be restored to provide an early incentive to OEMs to start to integrate advanced technologies into their portfolio. We have heard some OEM objection to this on the grounds that it gives preference to certain technologies when the rule should remain neutral and performance-based to meet the stringency required. Generally, we are very sensitive to this concept. However, we believe it misses a critical point, and that is the need to be meeting current goals while also laying the framework for the next set of technologies needed, at higher volume, beyond Phase 2. Given the need for steep and continuing reductions in GHG emissions for the next 30 to 40 years, to meet climate stability while coping with transportation growth, the Phase 2 rules would be wise to include a mechanism for supporting development and early implementation of technologies that must be counted on next. This becomes doubly important, and achieves a co-benefit, when these same technologies are vital components of several regions' criteria reduction plans, notably California, which relies on more advanced technologies to be moving into the market during the Phase 2 timeline for NOx reduction. [EPA-HQ-OAR-2014-0827-1190-A1 p.5-6]

An additional consideration involves market barriers to change. Even technologies showing strong results and solid payback face resistance in a marketplace where risk avoidance remains high. As an example, there is now strong data showing that technologies such as post-transmission hybrids can achieve 15-35 percent fuel economy gains in the right vocational applications, and their costs are dropping below \$20,000 and approaching in some cases \$10,000. Yet overcoming market inertia likely requires early and innovative measures to encourage OEMs and fleets to take this step. [EPA-HQ-OAR-2014-0827-1190-A1 p.6]

The credit could be available for technologies that are not included in the baseline assumptions of the rule but support regional goals (such as California and the Northeast states) for additional NOx reductions, are not currently expected to be widely utilized by the end of the rule, but will result in significant fuel and emission reductions. By way of example, advanced technology credits for plug-in electric and electric drive vehicles could incentivize earlier integration and production of these technologies. The exact structure of such a credit requires more time to develop than provided in the short timeline for rule comments. It is critical that the credits not be allowed to undermine the benefits from the rule, so a cap or declining credit multiplier might be reasonable. [EPA-HQ-OAR-2014-0827-1190-A1 p.6]

We can envision that a sliding scale of credit value, tied both to the performance benefit of the technology, and also starting higher in the early years of Phase 2 and ramping down over its life, might be an appropriate framework for encouraging early integration of the technology that will likely start in vocational niche markets. Some technology providers, which are currently often not OEMs and therefore not the point of regulation, have wondered about structures that could enable them to offer credits to OEMs to help reduce OEM risk and support innovation. We are discussing these ideas with industry and would welcome the opportunity to further flesh out these framework ideas as the rule is finalized. [EPA-HQ-OAR-2014-0827-1190-A1 p.6]

Equally important is that the process to apply for the credits be streamlined and clarified. In Phase 1, while the primary reason that advanced technology credits weren't used was that the stringency was not high enough to drive their need, another barrier was the long process involved. Companies reported what they called an "open loop" approach whereby the exact level of testing or specific test results needed to qualify was not always clear. We would strongly urge establishment of a streamlined, clear set of data requirements and rules for qualifying for such credits so that companies could assess the costs and time required to fulfill the requirements in advance of starting the process. [EPA-HQ-OAR-2014-0827-1190-A1 p.6]

**Organization:** Center for Biological Diversity

The Center also requests that the Agencies restore advanced technology credits to incentivize the most advanced technologies, particularly those related to plug-in hybrid and battery electric trucks. These technologies have the potential to provide significant fuel savings but are still at a stage in development that necessitates continued incentives to promote early adoption and increased market penetration. [EPA-HQ-OAR-2014-0827-1460-A1 p.10]

**Organization:** Cummins, Inc.

*Cummins supports the elimination of advanced technology credits in Phase 2* [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

The Agencies are requesting comment on discontinuing extra credit for Phase 1 advanced technologies after MY 2020. Cummins agrees with the elimination of advanced technology credits and 1.5x multiplier since GHG/FE improvements achieved with eligible technologies (e.g., hybrids, waste heat recovery (WHR)) will provide sufficient CO2 benefits to encourage implementation of such technologies. Furthermore, advanced technology credits can be exchanged between engines and vehicles which undermines the proposed separation of engine and vehicle standards. Eliminating advanced technology credit generation in Phase 2 mitigates this concern. [EPA-HQ-OAR-2014-0827-1298-A1 p.31-32]

**Organization:** Daimler Trucks North America LLC

#### 5. Advanced Technology Credits

- **Ending the Advanced Technology Credit** - The agencies propose to stop providing extra credit for advanced technologies and request comment, including comment on whether there is sufficient incentive to develop fuel-savings technologies such as electric vehicle, plug-in hybrid, and fuel cell technologies. 80 FR 40331. Consistent with DTNA's core philosophy that FE technologies should compete in the market—and in the regulations—based on their real-world total cost of ownership, we think it is appropriate to end credits for certain technologies and not for others. [EPA-HQ-OAR-2014-0827-1164-A1 p.120]

The agencies request comment on the need for incentives for advanced technologies in Phase 2, including information on why an incentive for specific technologies in this time frame may be warranted, recognizing that the incentive would result in reduced benefits in terms of CO2 emissions and fuel use due to the Phase 2 program. We think that the agencies' proposed approach of crediting technologies proportionally to their FCRs, rather than distorting the scale with extra credits for some, is the right way to make the market decide on the best approach for meeting FCR targets. [EPA-HQ-OAR-2014-0827-1164-A1 p.81-82]

**Organization:** Edison Electric Institute

EI is the association that represents all U.S. investor-owned electric companies. Our members provide electricity for 220 million Americans, operate in all 50 states and the District of Columbia, and directly employ more than 500,000 workers. With more than \$108 billion in annual capital expenditures, the electric power industry is responsible for millions of additional jobs. Reliable, affordable, and sustainable electricity powers the economy and enhances the lives of all Americans. EEI has previously



engaged in the joint EPA and NHTSA rulemakings to address GHG emissions from both light-duty and medium- and heavy-duty vehicles, focusing on EVs and their potential to reduce significantly both GHG and criteria pollutant emissions from the transportation sector. In these rulemakings, EEI has focused on appropriate recognition for the environmental benefits of transportation electrification and the creation of the incentives needed to drive the commercial success of EVs to capture these benefits. EEI's comments on the needed to drive the commercial success of EVs to capture these benefits. EEI's comments on the proposed Phase 2 Program continue these themes. [EPA-HQ-OAR-2014-0827-1327-A2 p.2-3]

Electricity as a transportation fuel is a critical pathway to reducing GHG emissions and petroleum consumption in the transportation sector and the Phase 2 Program can be better designed to further the electrification transition. Furthermore, deployment of plug-in vehicles into the transportation sector represents an opportunity for our industry to offer new value-added services to our customers while ensuring that the integration of these vehicles into the grid provides benefits for all customers. In addition, EEI member companies operate a fleet of approximately 160,000 vehicles, the majority of which fall into the medium- and heavy-duty vehicle categories.<sup>2</sup> Member company fleets, particularly vocational vehicle fleets, can incorporate electrification to further reduce US reliance on petroleum and reduce emissions. [EPA-HQ-OAR-2014-0827-1327-A2 p.3]

Finally, transportation electrification is beneficial to electric customers. First, as utilities are the primary "fuel" provider for plug-in vehicles, transportation electrification opens up new opportunities to serve customers and provide solutions, particularly as it relates to charging infrastructure. Second, as determined by ICF and E3 in the recent Transportation Electrification Assessment Phase 2 study, "additional revenue from [plug-in electric vehicles (PEVs)]/charging exceeds the marginal costs to deliver electricity to the customer, providing positive net revenues that put downward pressure on rates."<sup>3</sup> Accordingly, transportation electrification can benefit all of our customers, not just those who drive PEVs. [EPA-HQ-OAR-2014-0827-1327-A2 p.3]

While adoption of PEVs in the medium- and heavy-duty vehicle market has not yet reached the mainstream success of the light-duty vehicle sector, significant growth opportunities do exist. In fact, signs of progress and momentum are already emerging and should be fostered wherever possible and across all of the various technologies. PEV technologies occur along a wide spectrum, from plug-in battery powered electric vehicles to e-PTO systems that eliminate work site idling. This spectrum of PEV technologies are sufficiently distinct and impactful enough, in terms of fuel efficiency and emissions reductions that each should be supported, such as through the continuation of the advanced technology credits for heavy-duty pickups and vans, as well as through off-cycle technology credits for e-PTO systems, transport refrigeration units, and truck stop electrification. [EPA-HQ-OAR-2014-0827-1327-A2 p.4]

EPA and NHTSA should also recognize that one of the historic limitations to the growth of PEVs in these sectors has been the energy storage system, and more specifically, the energy density and cost of batteries. The continued advancements in battery technology, which are projected to be significant in as little as five years, stand to bring an even broader and more affordable set of vehicle applications to PEVs in this class. Given the potential fuel efficiency and emissions reduction potential of such advances, this is an important trend to note when considering proposed rules for the 2019-2027 timeframe. [EPA-HQ-OAR-2014-0827-1327-A2 p.4-5]

## **II. Significant Growth Opportunities Exist and Should be Fostered in the Medium- and Heavy-Duty Electric Vehicle Market**

Technology and policy drivers have succeeded in growing the electric transportation market substantially in the last few years. In the light-duty vehicle sector, plug-in electric vehicle sales have surpassed 350,000 units since the Chevrolet Volt and Nissan LEAF first went on sale in December 2010, more than twice the adoption rate of hybrid electric vehicles in their first entry into the market.<sup>4</sup> Today, more than 22 plug-in vehicle models are available from 15 mainstream automotive brands.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.5]

In the medium- and heavy-duty sectors that are the focus of this proposed rule, adoption of plug-in vehicles have not yet reached a similar mainstream success, but signs of progress and momentum are emerging. A primary example is EEI's efforts to lead by example through its Fleet Electrification Initiative, in which member companies commit at least five percent of their annual fleet procurement budget to plug-in vehicles and technologies. Over 70 EEI member operating companies have committed to this initiative.<sup>6</sup> As announced in June, this commitment represents a \$90 million investment by EEI members for the 2015 fleet budget cycle.<sup>7</sup> Most of the PEVs procured as part of this initiative fall into the medium- and heavy-duty vehicle categories. [EPA-HQ-OAR-2014-0827-1327-A2 p.5]

Outside of the utility industry, there are many other examples of plug-in vehicles proliferating in the specific medium- and heavy-duty sectors. A few recent examples are: [EPA-HQ-OAR-2014-0827-1327-A2 p.6]

- United Parcel Service (UPS) procuring 125 plug-in hybrid delivery trucks from Workhorse;<sup>8</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.6]
- The port of Shanghai and PG&E demonstrating vehicles built by EDI; and, [EPA-HQ-OAR-2014-0827-1327-A2 p.6]
- Growing deployment of electric transit buses from BYD, Proterra and New Flyer. [EPA-HQ-OAR-2014-0827-1327-A2 p.6]

While these procurements are relatively small, they are demonstrating the capabilities and benefits of electric drive in the medium- and heavy-duty sectors. Clearly, plug-in vehicles are not right for every application. For example, the energy density limitations of battery storage alone are not feasible for long haul trucks traveling hundreds of miles per day. However, these examples and many others show that PEVs can deliver operational and environmental benefits for a growing number of uses. These include certain applications for long haul trucks, such as in-cab driver comfort while the truck is stationary, and reducing engine idling. [EPA-HQ-OAR-2014-0827-1327-A2 p.6]

One of the major limitations to the feasibility of PEVs in the medium- and heavy-duty sectors is the energy storage system, specifically the current energy density and cost of batteries. However, improvements in battery technology are occurring rapidly. With respect to energy density, the recently released Quadrennial Technology Review notes that "in the next roughly five years, advances in lithium-ion technology could more than double the battery pack energy density from 120 Wh per kilogram to 250 Wh per kilogram."<sup>9</sup> With respect to cost, the report notes that "R&D has made significant progress, reducing the cost of lithium-ion batteries by nearly 70% and improved their energy density by 60% during the last five years."<sup>10</sup> These advances are happening quickly, in a timescale of approximately five years. As energy density and cost improve, a broader set of vehicle applications will be economically and operationally feasible for PEVs—an important trend to note when considering proposed rules for the 2019-2027 timeframe. [EPA-HQ-OAR-2014-0827-1327-A2 p.6]

### **III. The Proposed Phase 2 Program Must Recognize the Environmental Benefits of Electricity as a Transportation Fuel**

Electricity as a transportation fuel offers significant long-term environmental benefits. This point was reinforced most recently by a report jointly released by the Electric Power Research Institute (EPRI) and the Natural Resources Defense Council (NRDC) that found that broad electrification of the transportation sector would reduce GHG emissions by 52 percent compared to current levels.<sup>11</sup> Specifically within the commercial vehicle sector, which the report describes as including many of the medium-duty vehicle categories subject to this proposed rule, electrification would decrease net emissions by 39 percent in 2050.<sup>12</sup> Similarly, the *Transportation Electrification Assessment Phase 1* study forecasts material adoption of electrification technologies in the medium- and heavy-duty vehicle segments within the timeframe of the proposed rules, even in its most conservative adoption scenario.<sup>13</sup> Third, as also noted by this report, PEVs have the long-term potential to help integrate more intermittent renewable energy resources into the electric system.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.7]

#### **IV. Incentives Should Recognize the Environmental Benefits of EVs and Support Their Deployment into All Appropriate Vehicle Classes**

In general, NHTSA and EPA are proposing to offer fewer incentives and credit programs for advanced technologies, including EVs in the Phase 2 Program than are available under the Phase 1 Program. In particular, the agencies propose to end advanced technology credit incentive multipliers for HD pickups and vans beginning in MY 2021<sup>28</sup> and to merge the innovative technology and off-cycle credit programs for vocational vehicles.<sup>29</sup> The agencies specifically seek comment on whether the advanced technology credits for HD pickups and vans should be extended for advanced technologies, like EVs, and generally seek comment on the role of electrified accessories in the off-cycle technology credit program for vocational vehicles.<sup>30</sup> Terminating any incentive credits and the incentive multipliers for HD pickups is premature, at least with respect to EVs, and EPA and NHTSA should create a pathway to recognize and incentivize the emission reductions benefits of electrification of accessories used in vocational vehicles. [EPA-HQ-OAR-2014-0827-1327-A2 p.12-13]

PEV technologies occur along a spectrum, from e-PTO systems that eliminate worksite idling, to plug-in electric hybrid vehicles (PHEV) that offer some all-electric range (AER) in addition to conventional petroleum-powered propulsion, to battery electric vehicles (BEVs) that operate on electricity only. PEVs are distinct from hybrid electric vehicle (HEV) technologies, which offer some ability to store energy, but do not source electricity from the grid. The spectrum of PEV technologies are sufficiently distinct and impactful that they should be given due credit within the proposed rulemaking. [EPA-HQ-OAR-2014-0827-1327-A2 p.13]

As discussed below in greater detail, e-PTO systems are sufficiently “mainstream” (and will likely continue to be more so in the model years subject to the proposed rules), that EEI believes these systems are best treated by considering the technology in the standard setting. If they are not considered when determining the stringency of the standards, their benefits should be captured through the test procedures and off-cycle technology credit procedures. In contrast, PHEV and BEV technology in the medium- and heavy-duty classes is more appropriately characterized today as being in the “pilot and demonstration” phase of the technology cycle. To incentivize the mainstream deployment of these technologies within the model years of the proposed rules, it is appropriate to continue advanced technology credits to vehicles equipped with these technologies. The vehicle classes most likely to adopt PEV technologies in the model years in the proposed rule are vocational vehicles and HD pickup trucks and vans. [EPA-HQ-OAR-2014-0827-1327-A2 p.13]

##### **A. EPA and NHTSA Should Continue the Advanced Technology Credits for HD Pickups and Vans to Drive Increased EV Deployment in this Vehicle Class**

With respect to HD pickups and vans, the agencies state that “[t]he advanced technology incentives are intended to promote the commercialization of technologies that have the potential to provide substantially better GHG emissions and fuel consumption if they were to overcome major near-term market barriers.”<sup>31</sup> EPA and NHTSA also state that these incentives are not intended to become permanent parts of the programs to reduce GHG emissions from the transportation sector and that it would be inappropriate to include credits for technologies upon which the standards are based.<sup>32</sup> The continued availability of advanced technology credits for EVs is appropriate as EVs are not yet commercialized in the HD pickup and van category and the stringency of proposed Phase 2 Program standards for these vehicles is not predicated on the use of EVs in this category. [EPA-HQ-OAR-2014-0827-1327-A2 p.14]

As the agencies note, EVs (and fuel cell vehicles) “are not projected to be part of the path used by manufacturer[s] to meet the proposed Phase 2 standards for HD pickups and vans...” but “have the potential to provide the highest level of benefit.”<sup>33</sup> By definition, then, EVs are exactly the type of advanced technology that should qualify for credits. The agencies, however, appear to predicate the denial of credits for EVs on concerns about “reduced CO2 emissions” if such credits were provided.<sup>34</sup> As discussed in detail in Section III, above, contrary to the agencies’ unsupported assertions, upstream emissions related to electricity production will not erode the benefits of vehicle standards, which both agencies appropriately propose to be measured at the tailpipe. As NHTSA has noted, lifecycle emissions from EVs are less than those from conventional fueled vehicles. Accordingly, the final Phase 2 Program should retain the advanced technology credits for EVs in the HD pickup and truck category. [EPA-HQ-OAR-2014-0827-1327-A2 p.14]

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2 Edison Electric Institute, member company survey results.

3 ICF International and Energy and Environmental Economics, California Transportation Electrification Assessment, Phase 2: Grid Impacts, p. 17 (Oct. 2014) (California Transportation Electrification Assessment, Phase 2: Grid Impacts).

28 *See id.* at 40,388.

29 *See* 80 *Fed. Reg.* at 40,330.

30 *See id.* at 40,389 and 40,330.

31 80 *Fed. Reg.* at 40,389.

32 *See id.*

33 *Id.*

34 *See id.*

**Organization:** Eaton Vehicle Group

From a regulatory perspective, we agree with the EPA approach to Hybrids, namely that these should be powertrain tested for actual fuel consumption. We believe that while the EPA is looking at not

continuing the Advanced Technology Credits program for Hybrids after 2021, the Hybrid market is still very fragile and driven by the cost of fuel. As we look toward a long period of lower cost fuel as predicted by the EIA, we do not see market conditions improving for Hybrid commercial vehicles except for a few mild Hybrid applications in the Class 3-4 segment. We are not optimistic that Hybrid technology will evolve significantly before the rule comes into effect, a situation similar to 2012-13 when the slump in Hybrid sales occurred. We believe contributing factors included hybrid OBD requirements during the low-volume phase of commercialization and unclear battery warrantee associated with useful life requirements that shifted development resources away from Hybrid cost reduction. [EPA-HQ-OAR-2014-0827-1194-A1 p.18-19]

**Recommendation:** Maintain the Phase 1 ATC program, at least until a certain threshold of hybrid market penetration is reached. ATC credits can use either powertrain test results or GEM simulations for the baseline vehicle in an A-to-B approach. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

**Organization:** Electric Drive Transportation Association (EDTA)

### **Recognizing the Benefits of Electrification**

As an important suite of technologies for reducing emissions and increasing efficiency of medium and heavy duty vehicles, EDTA recommends that the proposed rule appropriately recognizes and incentivizes battery electric, hybrid, and plug-in hybrid and fuel cell technologies and ensure that testing protocols accurately measure their emissions and efficiency benefits. [EPA-HQ-OAR-2014-0827-1217-A1 p.1]

In the medium-and heavy-duty segments, electric drive technologies offer flexible and diverse configurations for electrification in hybrid, plug-in hybrid, electric and fuel cell systems. These diverse systems offer substantial current and future benefits in reducing fuel consumption and emissions. The most recent documentation of the emissions benefits of electric drive released in 2015 by the Electric Power Research Institute and the National Resources Defense Council, the Environmental Assessment of a Full Electric Transportation Portfolio, found that use of grid electricity in fleets would result in substantial net emissions reductions on a life cycle basis. Specifically, "...widespread electrification of light-duty vehicles, medium-duty vehicles and non-road equipment could reduce greenhouse gas emissions by 540 million metric tons annually in 2050; equivalent to removing 100 million passenger cars from the road"<sup>2</sup> [EPA-HQ-OAR-2014-0827-1217-A1 p.1-2]

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2 New EPRI-NRDC Report Finds Widespread Adoption of Electric Transportation Could Curb Greenhouse Gas Emissions and Improve Air Quality <http://www.nrdc.org/media/2015/150917.asp>. For full report: <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002006881>

### **Advanced Technology Credits**

In the light-duty segment, electric drive is growing, with a 3 percent market share that includes hybrid and plug-in electric vehicles; fuel cell vehicles are moving into the consumer market this year. In the medium- and heavy-duty segment, fleets are utilizing electric drive systems on the road today. Notably, the utility industry has made a substantial commitment to procuring plug-in electric vehicles in utility fleets in its 2015 Fleet Electrification Initiative, with medium- and heavy-duty vehicles comprising a majority of the vehicles to be procured by the participating utilities. Nevertheless, electric drive systems are still an emerging suite of technologies in the medium- and heavy-duty segment. Adoption is being

aided by aggressive public and private sector efforts to reduce costs and further enhance performance throughout the value chain. [EPA-HQ-OAR-2014-0827-1217-A1 p.2]

The proposed rule requests comment on the issue of discontinuing advanced technology credits provided in Phase I of the medium-and heavy-duty program for technologies, such as hybrid powertrains, all-electric vehicles, and fuel cell vehicles.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1217-A1 p.2]

Electric drive technologies, the proposed rule acknowledges, have unique potential to reduce emissions; are in an early market stage, and are not the basis for the standards being proposed. Based on the agencies' enumerated criteria, electric drive is appropriately incentivized in both Phase I and Phase II of the program. We recommend maintaining the advanced technology credits for electric drive in Phase II. Further, noting that Phase 1 credits at a value of 1.5 were not heavily utilized, we suggest that the value of the credits should be increased above 1.5 to effectively drive adoption of the most advanced technologies. Concerns regarding over-reliance on credits could be addressed by instituting a cap on their availability. By facilitating adoption of advanced technologies, credits will also help to drive the advances in technology performance and cost reduction that will enable faster commercialization on a wider scale. [EPA-HQ-OAR-2014-0827-1217-A1 p.2]

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5 Op cit.

**Organization:** FedEx Corporation

Maintain Incentives and Flexibilities: Credits intended to incentivize early market adoption of advanced GHG/Fuel Efficiency technology should be retained. The ATC and ITC programs from Phase 2 should be improved to increase the attractiveness of early adoption of advanced and emerging technologies (Hybrids; EVs; Route Automation, etc.). [EPA-HQ-OAR-2014-0827-1302-A1 p.3]

**Organization:** International Council on Clean Transportation (ICCT)

### **Advanced technology**

We recommend that the agencies acknowledge the importance of advanced electric-drive technologies in order to achieve societal goals for long-term climate change mitigation in the transportation sector that are consistent with climate stabilization. Especially noting, based on the agencies' analysis, that the Phase 2 regulation does not even guarantee absolute reduction in carbon emissions over the long-term, it is evident that the Phase 2 standards are not nearly sufficient to meet societies long-term climate goals. We suggest the EPA acknowledge the body of evidence that suggests that the heavy-duty sector will have to, like the automobiles, shift to electric-drive technology (including battery electric and hydrogen fuel cells), over the long-term. Such a shift would mean electric-drive vehicles start entering the market around 2020-2030 to pave the way for 2040-2050 ultra low carbon freight trucks. Along with the California Air Resources Board's 2012 "Vision" analysis (CARB, 2012), there is Sharpe (2013), Silver and Brotherton (2013), Boer et al (2013), and Fulton and Miller (2015) that highlight many aspects of this long-term question that EPA and NHTSA will likely have address in the near future. [EPA-HQ-OAR-2014-0827-1180-A4 p.17]

**Organization:** Manufacturers of Emission Controls Association (MECA)

Furthermore, without incentives or credits, manufacturers will be forced to halt further development and optimization of emerging technologies to achieve the type of return on investment the trucking industry demands. [EPA-HQ-OAR-2014-0827-1210-A3 p.2]

In the absence of sufficiently stringent standards innovative technologies depend on incentives to achieve initial market penetration. Some of these technologies are not yet optimized to deliver the return on investment that truck owners require in today's low cost fuel environment. We urge EPA to include the advanced technology credits, which were part of the first phase of these regulations, in the final Phase 2 regulation. These credits would help to support continued development, optimization and testing of efficiency technologies to deliver cost-effective CO2 reductions in the out years of the Phase 2 regulation and to meet future heavy-duty GHG requirements. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

Similarly experimental or developmental engine efficiency technologies rely on a stringent set of CO2 standards and incentives or advanced technology credits to penetrate the market. Credit opportunities offered under the Phase 1 program should be extended in the final Phase 2 rule. [EPA-HQ-OAR-2014-0827-1210-A3 p.14]

**Organization:** McNicols

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 272-274.]

As far as the ABT Program, it appears that the credits for applying advanced technology for the manufacturers has disappeared. The way the current proposal seems to be written still stops with the chassis OEMs, and does not allow for rollup of credits for applying energy saving technologies by delegated final stage manufacturers, such as vocational vehicle manufacturers.

We encourage you to take a broader view of how final stage or delegated assembly manufacturers might add additional carbon reduction value that could flow back to the OEM. Without a return for the tedious work of bringing a new innovative product or technology to market, vehicle developers and manufacturers are not incentivized to take such risks. The cost of bringing a game changing technology or product to market faces many obstacles in breaking out of the status quo and the established market inertia. The lack of adequate incentives and credits for this taking this path makes it less desirable, potentially keeping new technologies from impacting our environment due to the lack of sufficient inducement or flexibility in accounting for these general credits.

We are concerned that stringency levels alone may not drive the advanced technology, but there are also no credits to encourage them. Perhaps you will reconsider adding back in the credits for implementing advanced technology and find an equitable means of delegated final assembly OEMs to receive or roll up these credits. Your challenge will be to objectively new and innovative technologies and method applying these advanced approaches that do not fit the status quo.

**Organization:** Moving Forward Network

*Add Provisions to Promote for Advanced Technologies* – For many of our communities zero emission technologies are the solution to address toxic pollution from the freight industry. The current regulation does not advance many zero emission technologies beyond traditional fossil fuel hybrid technologies in a meaningful way. We are seeing first hand that technology developers from around the country have solutions to the pollution crisis from the freight industry, but we must align our regulations and

incentives to provide the impetus to make these technologies a reality. The pessimism in the final rule about advanced technologies is unwarranted. In fact, the nation's two largest seaports, the Ports of Los Angeles and Long Beach, are advancing programs to increase the use of battery and/or fuel cell technologies. This regulation can go a long way in sending a market signal to large entities like ports and railroads, in addition to private industry that EPA and NHSTA are serious about advanced technologies. [EPA-HQ-OAR-2014-0827-1130-A2 p.1-2]

**Organization:** National Association of Clean Air Agencies (NACAA)

Additionally, EPA assumes in the proposal only a modest level of hybrid technology and no use of other advanced technologies, such as electric or fuel cell. Further, the proposal lacks sufficient stringency to drive market development of these technologies and eliminates the Advanced Technology Credits included in the Phase 1 program intended to encourage development of these technologies. Therefore, we also recommend that EPA reinstate Advanced Technology Credits to help advance zero- and near-zero emission technologies and to make Alternative 4 more attractive and attainable. [EPA-HQ-OAR-2014-0827-1157-A1 p.3-4]

**Organization:** Natural Resources Defense Council (NRDC)

Consider regulatory incentives that promote the deployment of electric-drive technologies. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

### **Incentivize Electric-Drive Technologies**

The agencies recognize that the stringency of the proposed rule is insufficient to drive the deployment of electric-drive technologies, include plug-in battery electric vehicles, plug-in hybrids and fuel cell vehicles. Numerous analyses point to the need for and benefits of widespread transportation electrification, including in feasible medium- and heavy-duty applications as necessary to meet 2050 climate and air quality targets.<sup>20</sup> Recognizing the slow turnover of the on-road vehicle fleet, extensive electrification of new vehicles needs to start now to ensure high-levels of all-electric drive by 2050. For the Phase 2 rule, NRDC recommends that the agencies consider a regulatory incentive for electric-drive technologies to encourage industry investment in them. [EPA-HQ-OAR-2014-0827-1220-A1 p.8-9]

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20 See Williams et al., "The Technology Path to Deep Greenhouse Gas Emission Cuts by 2050: The Pivotal Role of Electricity," *Science*, January 2012; Yang, C., McCollum D., McCarthy, R., and Leighty, W., "Meeting an 80% reduction in greenhouse gas emissions from transportation by 2050: a case study in California," *Transportation Research Part D: Transport and Environment 14*, 2009; International Energy Agency, *World Energy Outlook 2012*, OECD/IEA, 2012; Melaina, M., and Webster, K., "Role of fuel carbon intensity in achieving 2050 greenhouse gas reductions within the light-duty vehicle sector," *Environmental Science and Technology 45 (9)*, 2011; "Pathways to Deep Decarbonization, Interim 2014 Report," Sustainable Development Solutions Network and Institute for Sustainable Development and International Relations, July 2014; Electric Power Research Institute and Natural Resources Defense Council, *Environmental Assessment of a Full Electric Transportation Portfolio*, September 2015. Available at <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002006881>.

**Organization:** Odyne Systems LLC



### *Advanced Technology Credits*

Critical to achieving the highest level of fuel efficiency increases in medium and heavy-duty trucks is the ability to develop regulations that encourage the deployment of both incremental efficiency improvement technology and more advanced technologies. While Odyne Systems and others in the stakeholder community understand the rationale for the EPA to assume that these advanced technologies will be deployed within standard compliance without additional credits, we believe that including advanced technology credits in the Phase Two final rules will be critical for the development and near term deployment of these sorts of technologies that may not be considered by technology developers and manufacturers without these credits – even if they are deployed in small volumes. [EPA-HQ-OAR-2014-0827-1239-A1 p.27]

The current efficiency improvement assumptions of 16% across the nine categories of vocational vehicles proposed in Scenario Three would not likely drive incremental deployment of advanced technologies, like advanced hybrid systems, based on efficiency increases from current weight reduction, LRR tires, engine improvements, start/stop and idle improvement technologies. More stringent standards -- like those proposed in Scenarios Four and Five -- would need to be instituted for advanced technology like Odyne's to be deployed through standard compliance. But even at that point, we believe OEMs should be given an incentive to drive accelerated adoption of more advanced technologies to drive further private sector R&D in these technologies, provide realistic pathways for proving and commercializing these technologies, and lowering their costs -all resulting in accelerated fleet wide increases in fuel efficiency. [EPA-HQ-OAR-2014-0827-1239-A1 p.27-28]

While hybrid technology can be extremely effective in lowering GHG emissions in appropriate vocational applications, the cost of hybrid systems are still relatively high (mostly due to battery cost) and may require higher engineering and development costs initially. The higher upfront costs of new technology can deter the availability of investment. In addition, the relatively low initial adoption rates of new technology in the commercial trucks sector can drive hybrid system designs that may be largely composed of components that are not physically located within existing powertrain components and are not always integrated with the powertrain at the time of chassis manufacturing (incomplete vehicle manufacturing stage). While those innovative systems can minimize initial integration cost, they may not be as cost effective in comparison to much more integrated systems that reach very high manufacturing volumes. There are also many other costs associated to introducing innovative or advanced technologies, other than higher component costs, that need to be accounted for such as non-recoverable engineering costs, the ability and need to prove the technology in the field, and educating the market and consumer on the technologies benefits and functionality. As this market is low volume and very fragmented with higher incremental costs, the current advanced credit multiplier of 1.5 is not currently a sufficient incentive for industry adoption and use in Phase One. Odyne recommends, in addition to adopting Scenario 4 or above (or a more stringent rule with Scenario 3 timelines), inclusion of a limited volume of credits per class of advanced technology credits at a multiplier/additionally factor higher than Phase One to help offset the high cost of new, more effective, advanced technology. We believe that a limited volume credit of at least 3x, or preferably higher dependent on volume limitations, could decrease overall fuel consumption and emissions based on the ability to bring more aggressive emission saving technology to market faster in higher volumes outside of demonstration volumes. [EPA-HQ-OAR-2014-0827-1239-A1 p.28-29]

Should EPA choose to retain advanced technology credits and include a volume, we would urge care taken to ensure equal opportunity for a diversity of advanced technologies to be deployed with credits. If the credits were to be designed to encourage deployment of advanced fuel and emission saving technology, it would not be in the interest of the program to allow a single technology, or worse, a

single OEM developed technology to crowd out available credits. [EPA-HQ-OAR-2014-0827-1239-A1 p.29]

**Organization:** Optimus Technologies

Concerning 80 FR 40596 (Columns 2-3), more clarification is needed as to how the EPA determines which technologies meet the requirements for these credits. Optimus' current understanding is that alternative fuel engine conversions that reduce GHG emissions are not eligible for this credit. The purpose of these credits, as stated by the EPA, is to recognize technologies that "achieve CO2 reductions in the real world but where those reductions are not adequately captured on the test procedure used to determine compliance with the CO2 standards."<sup>8</sup> This seems to be a way to incentivize technologies that reduce lifecycle emissions (and cannot therefore be measured at the tailpipe). As such, Optimus Technologies believes the EPA should consider adding alternative fuel conversion technologies to the credit program to incentivize their use by engine/vehicle OEMs; this could be similar to the Advanced Technology Credits allowed in the Light-Duty Program for alternative-fueled vehicles (until MY 2015). [EPA-HQ-OAR-2014-0827-1276-A1 p.4]

An example of how Optimus' system reduces lifecycle GHG emissions: Using the baseline MPG for flat terrain at 80 FR 40247 of 7.33 MPG in 2015 and the Alternative 3 fuel economy improvement goal of 16.2% by 2027 (see 80 FR 40356), we can assume that a truck (with a useful life of ten years) purchased in 2027 that meets the fuel economy improvement goals reduces lifecycle CO2 emissions over ten years by 585,095 pounds (using assumptions in footnote).<sup>9</sup> In comparison, the same truck purchased in 2015 and outfitted with Optimus' biofuel conversion system reduces lifecycle CO2 emissions over ten years by 2,725,398 pounds. Today in 2015, Optimus' biofuel conversion system can achieve almost 5 times that of the lifecycle CO2 emissions reductions achieved by 2037, 22 years from now. [EPA-HQ-OAR-2014-0827-1276-A1 p.4]

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8 <http://www3.epa.gov/otaq/regs/ld-hwy/greenhouse/documents/420r15014.pdf>

9 <http://biodiesel.org/using-biodiesel/handling-use/emissions-calculator>

**Organization:** PACCAR, Inc.

### **The Agencies Should Provide Credits for Advanced/Innovative Technologies**

Credits for innovative technologies and off-cycle improvements have been an integral part of EPA and NHTSA's fuel economy/GHG programs for both light-duty and heavy-duty on-road vehicles. PACCAR believes the concept of credits helps promote innovation by incentivizing manufacturers to go beyond traditional research, development, and marketing programs. With this in mind PACCAR offers the following concepts and suggestions. However, none of these technologies should be taken into consideration when establishing baselines or setting stringency improvements in the final rule. [EPA-HQ-OAR-2014-0827-1204-A1 p.23-24]

### **B-20 Capability**

The use of non-petroleum based bio-fuels or fuels derived from other non-petroleum sources not only reduces petroleum demand, but can lead to lower fuel cycle GHG emissions. In order to accommodate higher bio-fuel blends, manufacturers need to modify engine designs and fuel system materials on the

vehicles to accommodate the use of such fuels. PACCAR believes credits should be provided for engines/vehicles that are capable of operating on levels at 20% biofuels. PACCAR will work with the Agencies to develop the proper credit value taking into account projected usage of such fuel blends. [EPA-HQ-OAR-2014-0827-1204-A1 p.24]

### **Hybrid Technology Multipliers**

As noted earlier, concepts that are theoretically promising such as hybridization have experienced market resistance. For those manufacturers who continue to pursue this technology, the Agencies should provide a multiplier over and above the values derived from test cycles. PACCAR suggests 50% credit increase to encourage the development and use of this technology. Additionally, in no case should the Agencies consider hybridization as a baseline or stringency technology for the achievement of proposed standards. [EPA-HQ-OAR-2014-0827-1204-A1 p.24-25]

### **Other Advanced Technology Multipliers**

The Agencies should encourage the development of ultra-low emission technologies such as fuel cells or other advanced technologies. The Agencies should provide significant, not incremental, credits for these technologies, as they can provide both fuel savings and emission reductions in certain priority applications – e.g., at ports or other distribution centers. The 50% credit bonus suggested above for hybridization is a concept for other advanced technologies. [EPA-HQ-OAR-2014-0827-1204-A1 p.25]

### **Organization: Proterra**

Proterra supports the intended purpose of advanced technology credits, namely, 'to promote the commercialization of technologies that have the potential to provide substantially better GHG emissions and fuel consumption if they were able to overcome major near-term barriers.' That purpose is as true today as it was in 2011, when the agencies adopted the Phase I standards. And while market acceptance for zero-emission technology in the heavy-duty space is growing, incentive programs and rebates continue to play a major role in driving early adoption of electric transit vehicles, including the growth of programs such as the FTA's Lo or No Emission Vehicle Deployment Program, Chicago's Drive Clean Truck Voucher Program and New York's Truck Voucher Incentive Program. [EPA-HQ-OAR-2014-0827-1160-A1 p.2]

Notwithstanding the above, Proterra strongly disagrees with the proposal to eliminate advanced technology credits in Phase 2 for any technology. The Phase 2 standards are critical to the U.S.' continued development of world-leading advanced fuel-efficient technologies and to 'spur[ring] innovation, encouraging the development and deployment of existing and advanced cost-effective technologies for a new generation of cleaner, more fuel efficient' vehicles. [EPA-HQ-OAR-2014-0827-1160-A1 p.3]

During Phase I, the agencies had adopted a 1.5 credit value for advanced technologies with the purpose of promoting the early implementation of such technologies that were not expected to be widely adopted in the market in the 2014-2018 timeframe. (40 CFR 1037.150(i)) A 1.5 credit multiplier properly rewards innovation and the commitment of resources needed to develop and deploy advanced technologies that further reduce GHG emissions. [EPA-HQ-OAR-2014-0827-1160-A1 p.3]

The proposal to eliminate advanced technology credits in Phase 2 will slow the deployment of innovative, clean, and fuel efficient transit solutions. And the failure to provide advanced technology

credits for such innovations would surely bias the industry toward deploying only those technologies that meet - but not exceed - current regulatory standards. [EPA-HQ-OAR-2014-0827-1160-A1 p.3]

The agencies justify the revised approach in the Phase 2 NPRM based principally on two assumptions, which, with clarification, do not support the elimination of advanced technology credits. [EPA-HQ-OAR-2014-0827-1160-A1 p.3]

The initial rationale to propose eliminating the Phase 2 credits is that 'any vehicle certified with this technology would provide such a large credit to a manufacturer that an additional incentive credit would not be necessary.' But the focus should not be on what is 'necessary' for a manufacturer, but rather on how to effectively accomplish the primary purpose of the Phase 2 standards—to reduce carbon pollution, improve fuel efficiency, save money on fuel and other costs (e.g., healthcare) and support innovation. Manufacturers such as Proterra are contributing to these critical societal goals. Credits encourage manufacturers and suppliers to invest in developing more advanced and costly technology earlier, thereby obtaining significant emissions benefits, rather than simply meeting compliance standards today and developing new technology at a later date to meet a new regulatory standard. The additional incentive credits are necessary to accelerate the adoption of zero-emission advanced vehicle technology to meet the stated goals of the Phase 2 standards. Specifically, maintaining the Phase 2 credits are essential to sustaining a strong spark to accelerate deployment of state-of-the-art, ultra-low carbon vocational vehicles, such as fully-electric public transit buses. [EPA-HQ-OAR-2014-0827-1160-A1 p.3]

Second, the assumption that the 'incentive would result in reduced benefits in terms of CO<sub>2</sub> emissions and fuel use due to the Phase 2 program' needs to be revisited. Any such reduction in benefits is only potentially true in the short-term because the deployment of zero-emission battery-electric buses will accelerate lower GHG emissions and fuel use in the long run. The Phase 2 incentives are key to driving manufacturers to innovate and develop the most fuel-efficient and lowest emitting vehicles and to contribute to the EPA's stated goal of building on the United States' position as a world leader in fuel-efficient trucking technologies. The earlier that advanced technology vehicles are brought to market, the sooner they can move along the adoption curve and become deployed on a widespread basis. The direct result of industry innovation will be less carbon pollution and more fuel saved. To date Proterra vehicles have saved nearly 300,000 gallons of fuel and prevented > 5 million pounds of CO<sub>2</sub> emissions. Incentives will ensure that Proterra and other manufacturers continue to improve upon their clean mobility solutions that will help accelerate the deployment of more efficient vehicles to help local communities improve air quality, reduce GHG emissions and save fuel. Therefore, we recommend that the EPA continue advanced technology credits for zero-emission vehicles throughout the entire time frame of Phase 2. [EPA-HQ-OAR-2014-0827-1160-A1 p.3-4]

Proterra agrees with the agencies' proposal to extend the Heavy-Duty National Program beyond model year 2018. The Phase 2 Program will significantly reduce carbon emissions and improve fuel efficiency for heavy-duty vehicles, while at the same time address the challenges of global climate change and energy security. But these objectives should not come at the expense of those manufacturers pioneering the effort to produce the very advanced technology necessary to create a sustainable transportation system for generations to come. Rather than spur more innovation and improve upon today's clean and fuel efficient transit solutions, the proposed elimination of advanced technology credits has the potential to achieve the opposite result. We respectfully request that the agencies retain advanced technology credits for all-electric vehicles and extend the credits to later model years. [EPA-HQ-OAR-2014-0827-1160-A1 p.4-5]

**Organization:** Securing America's Future Energy

While we believe additional reductions are possible, the enabling (advanced engine and road load) technologies are less certain and more costly than those expected under Phase 2. Nevertheless, we believe that the Phase 2 rule could facilitate the early introduction of such technologies, providing valuable production and operating experiences prior to the adoption of Phase 3 standards, by incorporating provisions for advanced technology credits. [EPA-HQ-OAR-2014-0827-1282-A1 p.1]

#### Advanced Technology Credits for CO<sub>2</sub>

The EPA and NHTSA have proposed to eliminate the advanced technology credits that were available under the heavy-duty vehicle Phase 1 rule. Under that rule, credits (expressed in terms of a 1.5 times production multiplier, with specified class transfer caps) were available to promote the introduction of hybrid, Rankine cycle waste heat recovery, all-electric, and fuel cell technology. Under the proposed Phase 2 rule, these credits would be discontinued under the premise that the applicable standards presume the use of advanced technology and will, therefore, sufficiently incentivize market introduction. [EPA-HQ-OAR-2014-0827-1282-A1 p.7]

Here again, there is a stark contrast with regard to the treatment of advanced heavy-duty vehicle technology as compared to similar technology under the 2017-2025 light-duty rule. Under the light-duty rule, manufacturers can generate CO<sub>2</sub> credits (expressed in terms of a production multiplier) through model year 2021 by introducing all-electric, plugin hybrid electric, fuel cell, and dedicated and dual fuel natural gas vehicles.<sup>23</sup> These credits are intended to incentivize the early introduction of advanced technology to overcome market barriers and facilitate compliance with subsequent, more stringent standards. Natural gas is recognized for both its ability to serve as a bridge technology toward the introduction of hydrogen fuel cell vehicles and the fact that it faces similar market barriers to those of other advanced technologies (77 FR 62816). [EPA-HQ-OAR-2014-0827-1282-A1 p.7]

While the most stringent proposed Phase 2 standards for heavy-duty trucks may indeed presume some degree of advanced technology, with regard to waste heat recovery in particular, little if any hybrid, all-electric, fuel cell, or natural gas vehicle technology will be *required* to achieve the proposed standards. Thus, there is little difference in the role of these technologies in achieving the standards as currently proposed or adopted (as applicable) in the light- and heavy-duty sectors. The rationale offered by EPA and NHTSA for adopting advanced technology credits in the light-duty sector applies at least equally and without exception to the heavy-duty sector. In fact, the rationale is more pronounced in the heavy-duty sector given that the magnitude of advanced technology market barriers is higher due to substantially greater cost and engineering issues associated with heavy-duty vehicle development, production, and use. [EPA-HQ-OAR-2014-0827-1282-A1 p.7-8]

This differential treatment across sectors is amplified when one considers that under the light-duty rule, EPA and NHTSA adopted credits even for non-plug-in hybrid (and effectively equivalent) technology when installed on a full sized pickup truck.<sup>24,25</sup> Supporting justification included: [EPA-HQ-OAR-2014-0827-1282-A1 p.8]

'The agencies believe that offering incentives in the earlier years of this program that encourage the deployment of technologies that can significantly improve the efficiency of these vehicles and that also will foster production of those technologies at levels that will help achieve economies of scale, will promote greater fuel savings overall and make these technologies more cost effective and available in the later model years of this rulemaking to assist in compliance with the standards.' (77 FR 62738) [EPA-HQ-OAR-2014-0827-1282-A1 p.8]

'Although there may not be inherent reasons for a lack of hybrid technology migration to large trucks, it is clear that this migration has nevertheless been slow to materialize for practical/economic reasons, including in-use duty cycles and customer expectations. These issues still need to be addressed by the designers of large pickups to successfully introduce these technologies in these trucks, and we believe that assistance in the form of a focused, well-defined incentive program is warranted.' (77 FR 62739) [EPA-HQ-OAR-2014-0827-1282-A1 p.8]

For so-called strong hybrids, these credits can be earned through the duration of the currently adopted light-duty standards (i.e., through model year 2025).<sup>26</sup> As was the case for the general advanced technology credits, these same justifications not only hold true, but are magnified when expressed in terms of the 'in-use duty cycles and customer expectations' of the heavy-duty sector. [EPA-HQ-OAR-2014-0827-1282-A1 p.8]

While the introduction of advanced technology in the heavy-duty sector is worthy of a credit program based solely on cost and engineering issues that are compounded with size, the disparate treatment of such technology under the adopted light-duty and proposed heavy-duty programs is itself sufficient evidence of such need. There is simply no rational reason that heavy-duty manufacturers should be held to less flexible requirements than their light-duty counterparts. EPA and NHTSA should reconsider their proposal in this regard and implement a 'focused, well-defined' advanced technology incentive program for heavy-duty vehicles. Ideally, this program would mimic that of the light-duty sector, covering the same technology that is common to both and including any additional advanced technology specific to the heavy-duty sector. Thus, credits should, at a minimum, be established for hybrid, all-electric, fuel cell and natural gas technology. The earning period for the heavy-duty program should be adjusted from that of the light-duty rule to reflect the differential time periods of standards implemented under the applicable rules, allowing credits to be earned at least through model year 2026 (the last model year prior to the implementation of the most stringent proposed heavy-duty standards). [EPA-HQ-OAR-2014-0827-1282-A1 p.8-9]

[Figure 1, 'Comparison of Non-Petroleum Vehicle Allowance', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1282-A1]

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<sup>23</sup> Note: Specific production multipliers are: (1) for all-electric and fuel cell vehicles, 2.0 in model years 2017 through 2019, 1.75 in model year 2020, and 1.5 in model year 2021, (2) for plugin hybrid electric and natural gas vehicles, 1.6 in model years 2017 through 2019, 1.45 in model year 2020, and 1.3 in model year 2021.

<sup>24</sup> Note: Full sized pickup means a pickup with bed length and width of at least 60 and 48 inches respectively and payload and towing capacities of at least 1700 and 5000 pounds respectively.

<sup>25</sup> Note: The specific credits are 10 grams CO<sub>2</sub> per mile (equivalent to 0.00113 gallons per mile) for mild hybrids, 20 grams CO<sub>2</sub> per mile (equivalent to 0.00225 gallons per mile) for strong hybrids, 10 grams CO<sub>2</sub> per mile (equivalent to 0.00113 gallons per mile) for vehicles demonstrating CO<sub>2</sub> performance 15 percent better than their footprint-based target, and 20 grams CO<sub>2</sub> per mile (equivalent to 0.00225 gallons per mile) for vehicles demonstrating CO<sub>2</sub> performance 20 percent better than their footprint based target. The 10 gram credits can be earned in model years 2017 through 2021, while the 20 gram credits can be earned in model years 2017 through 2025. To earn mild hybrid credits, the technology must be installed on 20, 30, 55, 70, and 80 percent of full sized pickup trucks in model years 2017 through 2021 respectively. To earn the 10 gram performance credits, the enabling technology must

be installed on 15, 20, 28, 35, and 40 percent of full sized pickup trucks in model years 2017 through 2021 respectively. Strong hybrid and 20 percent performance credits require installation on 10 percent of full sized pickup trucks in each model year 2017 through 2025. A vehicle cannot earn both a hybrid and performance credit.

<sup>26</sup> A strong hybrid is a hybrid electric vehicle that recovers at least 65 percent of the braking energy used over the fuel economy test cycle.

**Organization:** Sierra Club

### ***Incentivize advanced technology***

Our organizations applaud the agencies for considering hybrid technology when setting the overall stringency. However, it is critical that the agencies account for the full effectiveness of hybrid technology and further incentivize advanced technologies such as battery electric and plug-in hybrid electric trucks. [EPA-HQ-OAR-2014-0827-1277-A1 p.2]

To fully account for the benefits of hybrid technology, the agencies should use real-world duty cycle data in addition to the GEM. This will help account for the benefits of electric power takeoff, now used in some utility bucket trucks. By accounting for the full benefits of hybrid technology, the agencies should increase the stringency of vocational vehicle standards. [EPA-HQ-OAR-2014-0827-1277-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.189.]]

Additionally, the agencies should restore advanced technology credits to incentivize the most advanced technologies, particularly plug-in hybrid and battery electric trucks. Early adoption and increased penetration of these technologies can help provide the needed cuts in carbon pollution and fuel consumption. [EPA-HQ-OAR-2014-0827-1277-A1 p.2-3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.190.]]

**Organization:** South Coast Air Quality Management District (SCAQMD)

U.S. EPA is proposing to eliminate the Advanced Technology Credits included in the Phase 1 regulation. The SCAQMD staff is strongly opposed to the proposed elimination of the credits given the work that is currently underway in California and by the U.S. Department of Energy to develop advanced zero-emission technologies for heavy-duty vehicles. These efforts include development and demonstration of traditional hybrid systems, plug-in hybrid electric trucks with all electric range, and dedicated battery-electric and fuel cell trucks that are appropriately designed for niche applications including package delivery and over the road Class 8 trucks. Elimination of the Advanced Technology Credits will impede the early market development of these technologies. Attachment 1 provides a summary of the zero-emission heavy-duty truck projects that are currently underway in the South Coast Air Basin that the SCAQMD staff strongly believes will be commercialized within the next five years if strong signals are provided to the technology providers and engine and truck manufacturers that zero-emission technologies are needed as early as possible to further reduce greenhouse gas emissions not only in the near-term, but also well beyond the timeframe of the proposed regulation. ***As such, we recommend that U.S. EPA reinstate the Advanced Technology Credits to help advance zero- and near-zero-emission technologies and to make Alternative 4 more attractive and attainable.*** [EPA-HQ-OAR-2014-0827-1181-A1 p.2-3]

[Attachment 1 can be found on p.10 of this docket]

**Organization:** Union of Concerned Scientists (UCS)

#### ADVANCED TECHNOLOGY VEHICLE CREDITS

The agencies noted appropriately that advanced technology credits should be eliminated for hybrid electric vehicles—while hybrids are an important strategy for reducing fuel use from heavy-duty trucks in the vocational vehicle sector, the stringency of the regulation is based on significant adoption of the technology, so therefore they cannot be considered “advanced”. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

However, technologies such as plug-in electric vehicles and fuel cell vehicles are at the nascent levels of adoption and could play a significant role in reducing fuel from the heavy-duty truck sector beyond 2029. A revised advanced technology program could help drive the investment in innovative technologies necessary to achieve future reductions from the work truck fleet. The agencies should therefore retain an advanced technology credit program, applicable only for advanced technologies which are expected to have little penetration in the near-term: plug-in electric vehicles, hydrogen fuel cell vehicles, and line-haul hybrid vehicles. Such a program would not significantly undermine the environmental and oil reduction benefits of the rule due to relatively low sales volumes, but they could provide manufacturers sufficient incentive to “pull forward” these advanced technologies. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

The value of any such credit is dependent entirely upon the stringency of the regulation—the use of these credits for compliance must partially offset more expensive research and development programs for technologies that will sell only in low volumes in the near-term. Therefore, it is critical that the agencies strengthen the stringency of the proposed regulations, to drive investments in innovative technologies in the timeframe of this rule and beyond. [EPA-HQ-OAR-2014-0827-1329-A2 p.24-25]

**Organization:** United Parcel Service (UPS)

#### Rule Must Encourage the Further Advancement of Hybrid Vehicles

Hybrid and electric technology applications continue to progress into the trucking sector, especially in the vocational segment. While these technologies provide fuel savings and reduced tailpipe emissions, the cost of these technologies can be substantial. EPA estimates the added cost of hybrid technologies are in the range of \$20,000 to \$40,000 for larger vocational vehicles and tractors while full electric technologies are in the \$50,000 to \$150,000 range. These costs are the highest of all the fuel efficient technologies identified, and as previously discussed, likely to result in lower adoption rates than estimated. [EPA-HQ-OAR-2014-0827-1262-A1 p.13]

In order to continue to advance these technologies and their adoption, the incentive-based approach used in Phase 1 should be retained. Specifically, the agencies should preserve the advanced technology credits which provide a credit of 1.5 in order to promote the use of hybrid and electric vehicles in larger vocational vehicles and tractors. A continuation of these credits will provide an incentive for OEM's to pursue the development and sale of hybrid and electric vehicles. These credits will likely help drive down costs while more effectively promoting the advantages of this green-technology path as a path towards achieving the goals of the rule. [EPA-HQ-OAR-2014-0827-1262-A1 p.13]

**Organization:** US Hybrid Corporation



[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 306.]

While regulation is the main driver for technology and clean transportation, incentives are also needed to ensure that transition to a sustainable commercial deployment. Thus, we urge you to establish more incentive or zero and near-zero emission technologies. And this way, you can provide a path for companies that work hard to develop a product that enables us to reach our goal of 90 percent NO<sub>x</sub> reduction.

**Organization:** US Hybrid Corporation

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 305-306.]

We urge you to further support zero-emission technologies, especially fuel cell. The impact of fuel cell and hydrogen is often overlooked. Recently our fuel cell power plant running, driving an a/c transit fleet up in Oakland exceeded 20,000 hours with zero stack failure, which putting the fuel cell on par with diesel and CNG engine.

Combustion engine technologies have improved a lot and can make a major contribution to vehicle fuel economy and emission for long-haul applications. However, they do little for operation in congested traffic. And traffic is not getting any better. For decades, the industries has tried various controller strategies, such as EGO and other methods. And now it is all of the last couple of decades we have been working on after treatments. After all of this effort and time and time again shows that combustion engine has reached a level of technology limit that is financially prohibitive to improve.

In contrast, fuel cell not only provides better fuel economy and the zero tailpipe emission, but also they are not sensitive or as sensitive to drive cycles, traffic congestions, and emission test method, steady-state versus cycle average, et cetera.

Therefore, on behalf of U.S. Hybrid, I urge you to further support zero-emission fuel cell medium-duty/heavy-duty vehicle, especially in urban settings. We really need this technology to achieve the California target of 90 percent NO<sub>x</sub> reduction, and your recommendations cannot get us there.

**Organization:** VNG

### **The Need for Incentives**

While NGVs are a relatively established technology compared to EVs and FCVs, they are still a very small part of the market and face significant near-term barriers to adoption with many fleets due to less infrastructure availability and higher up-front costs than petroleum-fueled vehicles. The fall in petroleum-based fuel prices has also reduced the economic case for NGVs, which was expected to drive market development after the shale gas boom. And, from a regulatory perspective, the growing likelihood that NGVs will be fueled by RNG creates positive externalities that are not captured by a focus on tailpipe emissions alone. [EPA-HQ-OAR-2014-0827-1208-A1 p.3-4]

While a lifecycle emissions focus could be a possible solution in theory, VNG agrees with Natural Gas Vehicles for America's (NGVA) position that the incorporation of full lifecycle emissions in the GHG rule would create enormous complications and uncertainty in the accounting for every fuel, including

gasoline and diesel as well as alternatives like electricity, hydrogen, and natural gas. Keeping the regulation's primary focus on tailpipe emissions will greatly simplify compliance planning for OEMs and ensure that emissions are reduced across vehicles of all fuel types. [EPA-HQ-OAR-2014-0827-1208-A1 p.4]

At the same time, the continued use of advanced technology incentives could play a distinct but important role in encouraging the development of technologies and fuels that will be able to provide more game-changing emissions benefits in the future. Moreover, because the majority of NGV fueling going forward can be expected to be RNG, the overall emission benefits of the rule are likely to increase instead of being reduced. Thus, it would be most effective – as well as most consistent with the precedent established by the Phase 1 regulation as well as the 2017-2025 light-duty vehicle regulations – to use a simple multiplier of at least 1.5 for NGVs, EVs, and FCVs. [EPA-HQ-OAR-2014-0827-1208-A1 p.4]

Regulatory incentives to encourage manufacturers to continue pursuing this vital near-term, near-zero alternative could be critical to sustaining this market during this challenging economic time for non-petroleum fuels, allowing for the long-term investments needed to reduce vehicle costs through higher production volumes. And, beyond the benefits for EPA's GHG agenda, the promotion of RNG development through greater NGV demand will help EPA achieve its goals for the increase of cellulosic biofuel use under the RFS and the reduction of methane emissions. [EPA-HQ-OAR-2014-0827-1208-A1 p.4]

**Response:**

At the time of the proposal, the agencies believed it was no longer appropriate to provide extra credit for any of the technologies identified as advanced technologies for Phase 1, although we requested comment on this issue. The Phase 1 advanced technology credits were adopted to promote the implementation of advanced technologies that were not included in our basis of the feasibility of the Phase 1 standards. Such technologies included hybrid powertrains, Rankine cycle waste heat recovery systems on engines, all-electric vehicles, and fuel cell vehicles (see 40 CFR 1037.150(i)). The Phase 2 heavy-duty engine and vehicles standards are premised on the use of some of these technologies, making them equivalent to other fuel-saving technologies in this context. We stated that we believed the Phase 2 standards themselves will provide sufficient incentive to develop those specific technologies.

*The Need for Advanced Technology Credit Multipliers*

Several commenters expressed the view that advanced technology multipliers are needed to drive the development of "zero-emission" and other very advanced technologies. CARB agreed with the agencies' previously stated principle that multipliers lay the foundation for game-changing GHG and oil consumption reductions in the long term. It also argued that increased incentives are needed to overcome "consumer reluctance to purchase unfamiliar technologies." MECA commented that "without incentives or credits, manufacturers will be forced to halt further development and optimization of emerging technologies to achieve the type of return on investment the trucking industry demands." DTNA commented that technologies should compete in the market without extra credit incentives. While we agree to some extent with the DTNA comment as a general principle, we also agree with the other commenters that sometimes additional incentives are appropriate for very advanced technologies.

As already noted, a key principle behind the agencies' decisions for advanced technologies is that these multipliers should not apply for technologies that we project would be adopted in significant volumes

without additional incentives. This is consistent with Allison's comment that "manufacturers should not receive what could amount to a "double credit" of meeting their compliance obligations through hybrids, fuel cell and electric vehicles are receiving additional credits on account of this action." However, Allison's comment goes further than this principle to support not providing these incentives for any advanced technologies, even if the agencies project neither the standards nor market forces would lead to their adoption by a significant portion of the fleet. Thus, the agencies do not agree completely with Allison. We believe it is appropriate to provide such large multipliers for these very advanced technologies at least in the short term, because they have the potential to provide very large reductions in GHG emissions and fuel consumption and advance technology development substantially in the long term. The potential to advance technology development ('game changing') is not fully encompassed in a tailpipe measurement, so that an additional credit can be appropriate. Nevertheless, because the advanced technology credits are so large, we also believe that we should not necessarily allow them to continue indefinitely. Therefore, the agencies are adopting them as an interim program that will continue through MY 2027. If the agencies determine that these credit multipliers should be continued beyond MY 2027, we could do so in a future rulemaking.

### *Qualifying Technologies*

We specifically requested comment on this issue with respect to electric vehicle, plug-in hybrid, and fuel cell technologies. Although the Phase 2 standards are premised on some use of Rankine cycle waste heat recovery systems on engines and hybrid powertrains (which are considered to be advanced technologies for Phase 1), none of the Phase 2 standards are based on projected utilization of certain other even more-advanced technologies (e.g., all-electric vehicles, fuel cell vehicles). 80 FR 40158. Commenters generally supported providing credit multipliers for these advanced technologies, while ending the multipliers for waste heat recovery and conventional hybrids. Many agreed with the agencies' general principle of basing this on whether or not such technologies were included in the feasibility analysis. However, Allison also supported ending the incentives for hybrids, fuel cells, and electric vehicles in Phase 2. Nevertheless, given the overall support for such incentives among operators, suppliers, and states, the agencies are adopting advanced technology credits for these three types of advanced technologies.

### *Multiplier Values*

CARB provided suggestions for values larger than 1.5 that could be used to incentivize plug-in hybrids, electric vehicles, and fuel cell vehicles. CARB proposed specific larger values in supplemental comments. CALSTART commented in support of a sliding scale of credit value, tied both to the performance benefit of the technology, and also starting higher in the early years of Phase 2 and ramping down over its life. Other commenters supported adopting multipliers of 1.5 or larger.

The agencies are adopting advanced technology multipliers for these three types of advanced technologies equal to the estimates provided by CARB. Specifically, we are adopting the following multipliers:

- 3.5 for plug-in hybrid electric vehicles
- 4.5 for all-electric vehicles
- 5.5 for fuel cell vehicles

Our intention in adopting these multipliers is to create a meaningful incentive to those considering adopting these qualifying advanced technologies into their vehicles. CARB's values were based on a cost analysis that compared the costs of these technologies to costs of other conventional technologies. Their costs analysis showed that adopting multipliers in this range would make these technologies much

more competitive with the conventional technologies and could allow manufacturers to more easily generate a viable business case to develop these technologies for heavy-duty and bring them to market at a competitive price.

Another important consideration in the adoption of these larger multipliers is the tendency of the heavy-duty sector to significantly lag the light-duty sector in the adoption of advanced technologies. There are many possible reasons for this, such as:

- Heavy-duty vehicles are more expensive than light-duty vehicles, which makes it a greater monetary risk for purchasers to invest in unproven technologies.
- These vehicles are work vehicles, which makes predictable reliability even more important than for light-duty vehicles.
- Sales volumes are much lower for heavy-duty vehicles, especially for specialized vehicles.

As a result of factors such as these, adoption rates for these advanced technologies in heavy-duty are essentially non-existent today and seem unlikely to grow significantly within the next decade without additional incentives. The agencies believe it is appropriate to provide such large multipliers for these very advanced technologies because they have the potential to provide very large reductions in GHG emissions and fuel consumption and advance technology development substantially.

#### *Other Technologies*

Some commenters suggested that the agencies provide advanced technology credits for alternative fuels or engines with very low NO<sub>x</sub> emissions. SAFE pointed to the light-duty rules in support of providing credit for natural gas vehicles. PACCAR believes credits should be provided for engines/vehicles that are capable of operating on levels at 20% biofuels. However, the advanced technology multipliers being finalized are intended to address technologies for which industry is unlikely to develop and adopt without these incentives. This does not apply for these other alternative fuel technologies. We also note that EPA regulates NO<sub>x</sub> emissions separately and may mandate lower NO<sub>x</sub> emissions in the future.

CARB initially commented that the agencies should provide multipliers for conventional hybrids *in long-haul tractor* application because we did not consider such technologies in the feasibility analysis. Eaton and PACCAR supported credits for conventional hybrids more generally. However, other commenters supported the elimination of credit multipliers for conventional hybrids. Given our position that these multipliers should not apply for technologies that we project would be adopted in significant volumes without additional incentives, we are not finalizing Phase 2 multipliers for conventional hybrids.

#### *Other Advanced Technology Issues*

CARB staff also disagreed with the statement made in the Draft RIA that fuel cells present complex packaging and weight issues. Although we continue to believe this, we note that this position did not affect our decisions in this rule.

CALSTART commented that approval process needs to be streamlined and clarified. We remain open to improving the process.

EDTA commented that the agencies must ensure that testing protocols accurately measure emissions and efficiency benefits for advanced technologies. Sierra Club commented that the agencies should use real-world duty cycle data in addition to the GEM to fully account for the benefits of hybrid technology. We believe the final test procedures will appropriately recognize the advanced technologies.

McNicol's commented that the rule should allow for credits for delegated final stage manufacturers, such as vocational vehicle manufacturers. However, as discussed in Sections 1.4.2 and 1.4.4, there are important policy reasons why credits are limited to certifying manufacturers.

## **1.4.2 Innovative and Off-Cycle Technologies 119**

**Organization:** Allison Transmission, Inc.

EPA and NHTSA should also expand off-cycle programs to credit other technologies. Proposed regulations do not appear to allow a manufacturer to submit an A to B test plan for technologies that do not fit within the prescribed powertrain test. [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

### **EPA and NHTSA Should Adopt Powertrain Testing With Several Revisions**

#### **EPA and NHTSA Should Expand Off-Cycle Program Or Create Other Methodology To Credit Technologies Not Included in GEM or Measured By Powertrain Testing**

The agencies are proposing to continue the innovative technology program from Phase 1 but to redesignate this program as an "off-cycle program." Allison supports continuation of this program, but recommends that the program be expanded to consider technologies that are not recognized in powertrain testing generally. [EPA-HQ-OAR-2014-0827-1284-A1 p.34]

In this regard, Section 1037.610 as proposed is designed to address vehicles with off cycle technologies. Section 1037.610(d) recommends that a manufacturer submit a test plan for approval prior to running an A to B test through either chassis or on-road testing. Section 1037.550 separately contains the required procedures for powertrain testing. But within Section 1037.550, there appears to be no accommodation for a manufacturer to submit an A to B test plan for technologies that do not fit within the prescribed powertrain test. [EPA-HQ-OAR-2014-0827-1284-A1 p.34-35]

Allison has fuel-saving technologies that are available today, but would not be recognized via the powertrain test process. Allison recommends that the off-cycle program be expanded to include the ability for manufacturers to propose an A to B powertrain test to recognize off-cycle powertrain technologies. This could be accomplished either through clarification of Section 1037.610 or 1037.550. Specifically, there are technologies associated with ATs that are not accounted for via powertrain testing and are not proposed for crediting within GEM. EPA and NHTSA should therefore create a mechanism by which such real world technology and resulting benefits can be recognized and credited. [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

The benefits of this approach are substantial. In this regard, Allison would highlight these specific technologies: [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

(1) Dynamic Shift Sensing ("DSS"); this technology is used to select the optimal shift strategy based on mass and grade. DSS is becoming more common in the marketplace. In 2015 (to date), 63% of North American sales incorporated DSS. But DSS is not included within GEM and will not be measured through powertrain testing. Where DSS has been applied, it has resulted between 3 and 6% improvement in fuel economy, with some customers reporting as much as 13% improvement. [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

(2) Acceleration Rate Management (“ARM”) is a feature which controls the acceleration of a vehicle from a stop. ARM is standard on the TC10 and in transmissions for transit buses; it also is growing in penetration in other vocational vehicles. ARM can result in 2 to 8% improvement in fuel economy. [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

(3) Super Econ Shift Schedule is a feature which activates while the vehicle is cruising in traffic and will operate the engine at the lowest speed possible while still maintaining vehicle speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

(4) Short shifting strategies: reducing engine speeds within reason leads to better fuel economy. Testing and analysis has shown reducing transmission shift speeds can improve fuel economy while only negligibly impacting vehicle performance. For example, reducing the shift speed 200 rpm from governed speed can result in a 2% improvement in fuel economy yet results in nearly identical 0-30 mph times (10.2 seconds vs 10.35 seconds).<sup>56</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

(5) Automatic preselects for engine braking has logic to avoid decelerating the vehicle below desired speed. If a vehicle slows down too much, then fuel is required to regain speed. Automatic preselect logic will learn a desired speed and select the proper transmission range for a given engine brake torque to obtain this speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.35]

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56 The configurations were 3000 Series (CR), Cummins ISB, P&D single axle truck, 5.04 rear axle ratio, 28,000 lb. Shift speed changed from 2600 (gov speed) to 2400.

**Organization:** American Iron and Steel Institute

EPA and NHTSA must also abandon or substantially revise weight reduction values that have been proposed for various vehicle components. There is a complete absence of technical support for these values in the administrative record for this rulemaking. If EPA and NHTSA decide to incorporate such weight reduction values into the final rule, the agencies must consider additional information concerning the weight reduction and performance benefits of steel, including the life cycle GHG benefits of steel. In the alternative, EPA should remove all weight reduction values for components included within the Proposed Rule. [EPA-HQ-OAR-2014-0827-1275-A1 p.3]

If GEM cannot reasonably be altered for this purpose, EPA and NHTSA could consider providing 'off-cycle' credits for emission reductions associated with life cycle emissions similar to the existing process for such credits that the agencies established in the Phase 1 rulemaking. To reduce administrative burdens, the agencies could specify such credits in advance of this rulemaking. For example, in the MY 2017-2025 LDV Rule, a 'pre-approved' list of off-cycle technologies was utilized to provide emission credit for the efficiency gains associated with such items as high efficiency exterior lighting and solar roof panels that would not be measured during normal certification of the vehicle. [EPA-HQ-OAR-2014-0827-1275-A1 p.11-12]

As explained in Part IV of this document, poor data quality can seriously undermine realization of regulatory objectives. Whatever life cycle analysis tool may be adopted for future Class 2 through 8 truck regulations, it must use data for materials manufacturing that is current, credible and verifiable. [EPA-HQ-OAR-2014-0827-1275-A1 p.12]

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment –Tractor- off-cycle technology credits, penetration rate**

The NPRM requests comment on providing credit for off-cycle innovative technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.77]

We agree with the concept of providing such credits, as credits can be an incentive for innovation. For example, such credits could support continued innovation in connected vehicle technologies such as platooning. The proposed Phase 2 standards were developed including benefits for predictive cruise control, a type of connected vehicle technology, and CARB staff supports allowing off-cycle credits for other connected vehicle technologies such as platooning. As discussed further in CARB's Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency,<sup>36</sup> platooning is being tested in Southern California and can yield fuel consumption reductions of 10 to 21 percent. [EPA-HQ-OAR-2014-0827-1265-A1 p.77]

We also agree with the proposed removal of some types of off-cycle credits allowed in Phase 1 in light of Phase 2 GEM accounting directly for some of the Phase 1 innovative off-cycle strategies. [EPA-HQ-OAR-2014-0827-1265-A1 p.77]

The NPRM proposes requiring A to B testing on a chassis dynamometer to demonstrate the effectiveness of off-cycle technologies. CARB staff suggests caution in using A to B testing on a chassis dynamometer or by using portable emissions measurement systems (PEMS) to quantify sub percentage point efficiency gains. Care must be taken when the expected change is on the same order of magnitude as the test-to-test repeatability of the test method used. [EPA-HQ-OAR-2014-0827-1265-A1 p.77]

**Support Comment/Request Clarification**

**Comment – Off-cycle credits and adjustments**

CARB staff supports the requirements in 40 CFR 1036.610 (c), (e), and (f) that sufficient technological descriptions and data be required to allow adjustment of emission results for off-cycle credits, as well as the demonstration of the durability of the off-cycle technology. This section allows the use of the approved adjustments to be retained through the 2020 MY but that new approval will be required for MY 2021. CARB staff recommends clarification of whether approval for MY 2021 and beyond must be renewed annually or whether that approval will continue for similar off-cycle approaches as had been previously allowed under Phase 1 of the GHG regulations. CARB staff believes the latter approach would be appropriate. [EPA-HQ-OAR-2014-0827-1265-A1 p.78]

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36 (CARB, 2015c) California Air Resources Board, “Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency,” June 2015, .

**Organization:** CALSTART

Work site vehicles have huge opportunities to use “off cycle” idle reduction tech that is not easily included in current rule design because most of it gets integrated in later production stages [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

We offer some possible approaches to consider: [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

– Streamline Off Cycle and AT credit testing processes with clear up front data needs and limits – eliminate open loop process [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

**Organization:** Daimler Trucks North America LLC

And there are several costs that we could not find in the agencies' cost-benefit analysis but that should have been included. One is the costs avoided when drivers do not have accidents and do not have to sit in traffic resulting from accidents. Such traffic has associated costs in unnecessary fuel consumption from idling engines, in wear on engines and brakes, in lost time (which is of particular importance to heavy-duty vehicle operators, for whom lost time is lost money). And avoiding such traffic decreases fuel consumption and GHG emissions. So the agencies should have considered as cost-beneficial technologies that reduce accidents, like Electronic Stability Control and Forward Collision Avoidance and Mitigation technologies. Considering those as beneficial FE technologies, and crediting them accordingly, would result. [EPA-HQ-OAR-2014-0827-1164-A1 p.129]

**Organization:** Dana Holding Corporation

Innovative Technology and Off-Cycle Credits

Dana is currently working on various innovations that will further improve the efficiencies of tractors and vocational vehicles by utilizing waste heat in other areas of the vehicle to quickly bring transmission oil and axle oil up to operating temperatures and to hold these oils at their operating temperature throughout the vehicle's drive cycle. To achieve this, Dana is working on three technologies that have provided the light vehicle segment a 3% - 5% efficiency boost. The three technologies include: Exhaust Gas Heat Recovery heat exchanger (EGHR); Active Warm-up(AWU) for transmission oil; Axle Warmer heat exchanger. [EPA-HQ-OAR-2014-0827-1138-A1 p.4]

As noted in the proposed rule, these technologies are not currently commercially available for diesel engines (Section II.D.2.(a)(vii), pg. 40196). However, variations of these technologies have recently been launched within the light vehicle sector and range from full production components to prototype systems depending on the vehicle manufacturer considered. In fact, in 2012 Dana received a PACE "Innovation Partnership Award" for collaboration with Ford on our active warm-up technology. However, these technologies are not currently available for the heavy-duty and medium-duty segments. Dana continues to work on expanding the reach of these technologies for the commercial vehicle market. [EPA-HQ-OAR-2014-0827-1138-A1 p.4-5]

As Dana continues to develop these technologies, it is imperative that the rule provide a way to receive direct credit for the efficiency they provide. For this reason, Dana supports the redesignation of the Innovative Technology Credits as Off-Cycle Credits as proposed in Section I.C.1.(c), pg. 40158 of the proposed rule. We understand that this will be the mechanism to obtain efficiency credit for technologies that are not currently available. [EPA-HQ-OAR-2014-0827-1138-A1 p.5]

**Organization:** Edison Electric Institute

**C. The Agencies Should Consider Transport Refrigeration Units and Truck Stop Electrification to be Eligible for Off-Cycle Technology Credits**



In addition to the off-cycle technology credits for e-PTO systems, EEI suggests the agencies consider two additional technologies to be eligible for off-cycle technology credits: [EPA-HQ-OAR-2014-0827-1327-A2 p.16]

- Transport refrigeration units: petroleum is displaced by grid-sourced electricity when cooling units on vehicles and trailers are plugged in while parked, rather than idling. Electrified Transport Refrigeration Units (eTRU), also known as “electric standby,” are available from a number of manufacturers. Carrier Transicold includes electric standby as standard on all of its Vector products, for example.<sup>39</sup> While allowing vehicles to plug-in requires capital outlay at facilities, incentivizing the technology on the vehicle side through this rule would encourage more facilities to offer the capability. The Transportation Electrification Assessment Phase 1 study found favorable cost-benefit ratios and greenhouse gas savings for this technology.<sup>40</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.16-17]
- Truck stop electrification: petroleum is displaced by grid-sourced electricity when long-haul trucks are plugged in at rest stops, rather than idling or relying on petroleum-powered auxiliary power units (APUs). ShorePower is an example of a company offering plug-in capability for truck stop locations across the country.<sup>41</sup> Like transport refrigeration units, incentivizing the technology on the vehicle side through this rule would encourage more facilities to offer the capability. The Transportation Electrification Assessment Phase 1 study also found favorable cost-benefit ratios and greenhouse gas savings for this technology.<sup>42</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.17]

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39 For more information, see [http://www.carrier.com/carrier/en/us/news/news-article/flex\\_power\\_option\\_makes\\_carrier\\_transicold\\_s\\_vector\\_units\\_more\\_versatile\\_than\\_eve\\_r.aspx](http://www.carrier.com/carrier/en/us/news/news-article/flex_power_option_makes_carrier_transicold_s_vector_units_more_versatile_than_eve_r.aspx).

40 *California Transportation Electrification Assessment, Phase 1: Final Report* at 35.

41 For more information, see <http://www.shorepower.com/locations/>.

42 *California Transportation Electrification Assessment, Phase 1: Final Report* at 33.

**Organization:** Enhanced Protective Glass Automotive Association (EPGAA)

EPGAA strongly recommends the NHSTA and the EPA to adopt a final rule providing off-cycle credits and incentives for the use and installation of advanced glazing window technology as a means to reduce vehicle emissions, increase fuel efficiency and lower fuel costs for owners and operators of vehicles with medium and heavy duty engines. [EPA-HQ-OAR-2014-0827-1024-A1 p.2]

Advanced glazing is increasingly being applied to multiple window openings in vehicles in order to provide a variety of benefits. In terms of fuel economy and emissions, advanced glazing with optional solar control features offers significant reduction of air conditioning loads as recognized within the off cycle credits within the latest light duty vehicle GHG and fuel economy standards. In addition, advanced glazing can weigh less than the tempered glass windows used widely today, and by its nature, filters over 98% of ultra violet rays, thus reducing associated occupant health risks. It also provides enhanced occupant retention as recognized in FMVSS 226, improves vehicle security and reduces transmitted noise. [EPA-HQ-OAR-2014-0827-1024-A1 p.2]

In response to the Agencies’ request for comments regarding high efficiency glass, the EPGAA submits that recognition of the benefits offered by this technology should be part of any comprehensive package

to assist Original Equipment Manufacturers (OEMs) in meeting emissions requirements as effectively as possible. OEM's, based on their own manufacturing circumstances, should be provided with, and incentivized to use, as many options or tools as possible to improve overall engine performance, enhance vehicle efficiency and lower emissions. [EPA-HQ-OAR-2014-0827-1024-A1 p.2]

There should be no doubt that solar control cooling load reduction offers real and measurable benefits. Moreover, it as has been proven and recognized by the previous work of the National Renewable Energy Laboratory (NREL), California Air Resources Board (CARB) and the 2017 light duty vehicle Greenhouse Gas and Emission Standards and Corporate Average Fuel Economy (CAFÉ) Standards. By providing credit for as many viable technologies as possible, the Agencies would enable OEM's to optimize cost-effective approaches and thereby better manage the total cost of achieving the fleet emission requirements. In addition, this approach further encourages development of non-traditional technologies. [EPA-HQ-OAR-2014-0827-1024-A1 p.2]

In the 2017 light duty rule, the Agencies appropriately recognized the contribution of solar control advanced glazing by providing a calculation of an off-cycle credit based upon the enhanced glazing solar performance level versus the typical glass. The calculation is based upon the metrics of ISO 13837 Tts (Total Solar Transmission and the area of glazing affected. This calculation afforded advanced glazing the highest possible credit amongst off-cycle thermal control technologies. It should be noted that the credit within the light-duty rule is based upon benefits derived from reduced temperature of the parked vehicle only and its effects on initial cool down. It does not account for any driving benefit. Some may argue that this benefit is partially diminished while a vehicle is operating at speed due to an increase in convective cooling, -. Nevertheless, overall, the solar control technology will achieve beneficial results when a vehicle is stopped in traffic or idling. [EPA-HQ-OAR-2014-0827-1024-A1 p.2]

Although the cooling load for a light duty passenger vehicle represents a larger portion of the vehicle's total load than is experienced in most heavy duty vehicles, many heavy duty vehicles spend far more time idling as a percentage of their operating time than do passenger cars; travel many more miles per year; thereby operating for much longer periods. Based on NREL study data<sup>1</sup> the Agencies provided a light-duty passenger truck credit for solar control glazing of up to 3.9 g/mile (0.0004 gal/mile). The glazing area and configuration of heavy duty truck cabs in general is similar to that of light duty trucks. In further testing on Class 8 truck cabs, NREL studied reductions in idle cooling loads<sup>2</sup>. In those tests a continuous cooling load reduction of 13% was achieved by covering the forward glazing with a white film. The white film solar transmission was measured and compared with advanced solar glazing options which could provide appropriate visibility levels and meet safety standards. The advanced solar glazing options were found, based on this testing result, to be capable of reducing the cooling load by 6.5% or provide about 50% of the white opaque film benefit<sup>3</sup>. [EPA-HQ-OAR-2014-0827-1024-A1 p.3]

Given the aforementioned emissions reduction benefits, the EPGAA urges that the Agencies provide an appropriate off-cycle credit for solar control advanced glazing. The credit should be based on performance criteria of the glazing (Tts) which takes into account both the idling and initial cool down benefits. As the data above indicates, the idling benefit is likely more significant in heavy duty vehicles. And, as is the case in the light duty rule, we also urge that the credit be based on functions of Tts as well as glazing area affected in order to provide the best estimates of real world benefits as well as drive incentives to continually improve technology. [EPA-HQ-OAR-2014-0827-1024-A1 p.3]

1 NREL 2007-01-1194 John P Rugh, Reduction in Vehicle Temperatures and Fuel use from Cabin Ventilation, Solar-Reflective Paint, and a new Solar-Reflective Glazing.

2 NREL Project VSS075, Jason Lustbader, June 19, 2014 Report, Coolcab Test and Evaluation

3 Measurement of the white film on glass in a spectrophotometer and integration per ISO 13837 resulted in a Tts of 19.5% for the test configuration. Base tinted glass commonly used in HD vehicle glazing has a typical Tts of 57-60%. Commercially available solar control advanced glazing can demonstrate Tts values as low as approximately 40% while meeting the 70% visible transmission regulations for highway operation. Hence, solar control advanced glazing would represent approximately 50% of the benefit experienced in testing or approximately 6.5% cooling load reduction during idling since Tts is linearly related to the actual solar energy passing through the glazing into the cab.

**Organization:** FedEx Corporation

Drive GHG/Fuel Efficiency Improvement Technologies in Commercial Vehicles. [EPA-HQ-OAR-2014-0827-1302-A1 p.3]

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 102-103.]

For example, the pre-defined and pre-approved list of mobile air conditioner greenhouse gas credits has incentivized a rapid improvement in the efficiency and leak integrity of light duty vehicle air conditioners. These incentives are now paving the way for an early transition to lower global warming air conditioner refrigerants as millions of new vehicles are being produced with the new refrigerants, many years in advance of any mandate to make the switch.

The success of these air conditioner provisions led to the expansion of this approach in 2014 for the light duty fleet with the introduction of an expanded off cycle list of pre-assigned and pre-approved credits for other technologies that reduce fuel usage and conditions not comprehended in the standard fuel economy test, such as colder weather, higher speeds, or extended idle times.

**Organization:** Lubrizol Corporation

Higher-performing lubricants will play an important role in helping the OEMs comply with the Phase 2 Rule. Indeed, as shown in Figure 1 below, many of the technologies and strategies that will be used by the OEMs will require HPLs to operate cleanly, efficiently, and without compromising equipment performance and durability. [EPA-HQ-OAR-2014-0827-1325-A1 p.2]

[Figure 1 can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1325-A1]

**Organization:** Meritor, Inc

**Allow a Supplier Driven Off-Cycle Technology Path**

Meritor is a strong supporter of building flexibility into the regulation by providing a mechanism to validate Off-Cycle Technologies. This is especially important since the regulatory timeframe is lengthy and thus cannot foresee new, currently-unaccounted-for technologies. Meritor is concerned, however, that the proposed regulation, by restricting Off-Cycle Technology applications solely to OEMs, will underutilize this important option. OEMs have limited resources which artificially restricts the number of technologies that they can pursue at any one time through the current Off-Cycle Technology path while the technology supplier has the resources and financial incentive to pursue the Off-Cycle credit. [EPA-HQ-OAR-2014-0827-1254-A1 p.2-3]

Meritor advocates developing a detailed process by which Off-Cycle Technologies can be proposed, tested and certified in coordination with the government by either the OEM or the technology supplier. We believe this approach will leverage the capabilities and investment of the supplier community, encourage smart technology development and, ultimately, offer the OEMs greater options to comply with this regulation. Greater choice is in the best interest of the consumer, the OEM and the government. [EPA-HQ-OAR-2014-0827-1254-A1 p.3]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Allow Suppliers to Apply for Pre-Approval of Innovative Off-Cycle Technologies** [EPA-HQ-OAR-2014-0827-1274-A1 p.10]

In the proposed rule, the agencies offer to account for future emerging innovative off-cycle technologies, by retaining the existing Phase 1 paths. However, this process is only open to the vehicle manufacturers. Suppliers must also be allowed to participate in this process independently. [EPA-HQ-OAR-2014-0827-1274-A1 p.10] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.196.]]

Under Phase 1, the application/petition path was not well utilized by vehicle manufacturers likely due to the lengthy and arduous process. Even though the agency is proposing to retain the same path options as Phase 1 in Phase 2, we are concerned that it may continue to be significantly under-utilized. Suppliers would seek a component-level pre-approval, similar to the light vehicle program off-cycle structure such that it can be broadly applied to any vehicle that utilizes that pre-approved technology. [EPA-HQ-OAR-2014-0827-1274-A1 p.10]

Only allowing vehicle manufacturers to petition for pre-approval limits the scope of potential for other improved, innovative off-cycle technologies offered by suppliers. Moreover, not including suppliers may impact commercially-viable technologies; if there is not a way to account for these technologies, then there is little incentive for the vehicle manufacturer to utilize the technologies. The resulting disbenefit could inadvertently stifle development and innovation of more effective and efficient technologies. This would be an unfortunate consequence and would be contrary to the overarching goals of the rule. [EPA-HQ-OAR-2014-0827-1274-A1 p.10]

Permitting only vehicle manufacturers to apply and petition for approval perhaps comes from the notion that only the OEMs are able to provide the data and substantive information needed to demonstrate the potential fuel efficiencies/emission reductions of commercialized, in-production systems or components. However, suppliers have a wide range of models and design tools available to them (such as high-performance computer simulation and functional 3D prototyping) to provide detailed information and supporting data necessary for evaluation of applications. Suppliers simply want the equal opportunity to apply and present the potential benefits of innovative off-cycle technologies provided they meet the criteria laid out in 40 CFR 86.1869-12, 1036.610, and 1037.610. Suppliers are

highly incentivized to dedicate resources, data collection and documentation to support the performance and efficiency benefits of their materials, components and systems. They have always worked closely with their customers, but even more so over the years as the technologies transition from “bolted on” to more fully integrated. Further, suppliers can adequately quantify the contributions of the technology for agency review. [EPA-HQ-OAR-2014-0827-1274-A1 p.10-11]

The ability for suppliers to be part of the innovative off-cycle pre-approval process is particularly critical if the agencies do not find a way to make the GEM more adaptable, as MEMA suggested above. [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

Suppliers are well positioned to provide the resources, test protocols, data and documentation required to present viable petitions that can demonstrate “known quantifiable benefits.” Allowing suppliers to participate in this approval path enhances the viability of the program because it could potentially include a larger cross-section of innovative off-cycle technologies. Therefore, MEMA urges the agencies to allow suppliers direct access to the pre-approval process. [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

**Organization:** Navistar, Inc.

The NPRM requests comment on whether the requirement to demonstrate that a technology was not in use prior to 2010 as part of an off-cycle demonstration should carry forward in this rule. Navistar opposes carrying forward that requirement. First, as the NPRM acknowledges, by the time this rule is fully mature 2010 will be 17 years in the past. That requirement will turn both the agencies and manufacturers into historians for no purpose. Second is that the requirement itself serves no purpose. As it relates to fuel economy technologies, 2010 was a somewhat arbitrary date to begin with and its relevance will continue to diminish. The main point should be whether a technology shows a benefit that cannot be captured on the test, whether GEM or the engine tests. Navistar expects that many technologies may not be captured by the tests and thus might be considered off-cycle technologies, including many of those under development as part of the SuperTruck program. [EPA-HQ-OAR-2014-0827-1199-A1 p.14]

In addition, the agencies should continue to explore areas of improvement as to the review of off-cycle technologies. During the implementation of the Phase 1, discussions regarding appropriate test methods for these technologies have been challenging. Standardized test methods for similar technologies should be developed. We recommend that EPA issue guidance for manufacturers setting out lessons learned from off-cycle application reviews. These could be anonymous as to the particulars of the technology, but give general guidance on comparison methods that have been acceptable to the agency. The guidance should also include templates and guidelines for meeting with agencies to reduce the burden of gaining approval for these technologies. [EPA-HQ-OAR-2014-0827-1199-A1 p.15]

We note that the NPRM states a general intention to develop an approach like the one suggested, with pre-approved testing methods as one route and a public approval route as a second option. However, this approach is not set forth clearly in the rule language itself. In fact, the contrast between this provision and the provision for light duty off-cycle technologies is stark. Whereas the light duty rule sets out detailed criteria for various potential technologies in the rule itself, that level of detail, or even mention of particular technologies, is entirely absent from the heavy duty equivalent. [EPA-HQ-OAR-2014-0827-1199-A1 p.15]

There should also be a high degree of flexibility as to what may be considered as an off-cycle technology. For instance, if a technology is difficult to model because it is highly dependent on user

activity (for example, an in-use based technology such as platooning), the agencies should consider real time data collection methods showing actual field usage as a way to establish some credits for those technologies. Real time connected vehicles may afford opportunities that did not exist in the past to incentivize technology. [EPA-HQ-OAR-2014-0827-1199-A1 p.15]

Given the key role that off-cycle technologies are to play in the Phase 2 standards, we urge the agencies to make it as easy as possible to achieve recognition of the benefits of these technologies. As such, we request that the rule better set out methodologies to the extent possible or set out a method of developing pre-approved methods, such as the guidance method we suggested. [EPA-HQ-OAR-2014-0827-1199-A1 p.15]

The EMA comments discuss the potential for disruption carried in the Proposed Rule by limitations imposed on changes that were heretofore routinely made on certain vehicle elements that may be prohibited by the Proposed Rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.15]

The dropdown tables in GEM will force manufacturers to create separate families for each off-cycle technology. As these technologies grow, we anticipate that being required to track each of these families individually will become unwieldy and create an unnecessary burden. There is no reason to establish separate vehicle families for off-cycle technologies. Just like all other vehicle attributes the off-cycle technologies can be accounted for individually for each vehicle. The unique configurations are already accounted for in the GEM runs. [EPA-HQ-OAR-2014-0827-1199-A1 p.41]

**Organization:** Odyne Systems LLC

#### *Off-Cycle Credits*

EPA's draft proposal moves innovative technology credits from Phase One to an Off-cycle program in Phase Two. In 2021, technologies that are not fully accounted for in the GEM or other testing would be considered Off-cycle, including technologies that may not be considered innovative. The concern that Odyne has relative to Off-cycle credits is how our system fits into this category. Since the EPA considers the hybrid system a part of the transmission and not a separate system, hybrids would then be fully accounted for in the GEM. Odyne does not believe that efficiency benefits are fully accounted for when considered as a part of the transmission. As there is not a well-defined path for hybrids in the GEM, we believe that the Off-cycle credit process would need to be used, and it needs more clarification on how that would be handled.

In Phase One, the process was unclear for technologies to become eligible for these credits, which we believe was a major hindrance for industry to drive these types of innovations. Odyne and other aligned stakeholders like the EDTA and CalStart would also welcome the opportunity to work with the EPA on developing these conditions and clear timelines for earning Off-cycle credits for the deployment of hybrid or hybrid PTO technologies. [EPA-HQ-OAR-2014-0827-1239-A1 p.26] [This comment can also be found in EPA-HQ-OAR-2014-08267-1372, pp.232-233.]

Should the EPA in its final rule decide not to base its standards for vocational trucks on the use of hybrid or e-PTO, Odyne strongly encourages the EPA to develop and establish clear and bounding conditions for technologies to become eligible for Off-cycle credits. [EPA-HQ-OAR-2014-0827-1239-A1 p.26] [This comment can also be found in EPA-HQ-OAR-2014-08267-1372, p.232.]

#### *Regulatory Coherence*

The California Air Resources Board (CARB) has put a strong focus on hybrid technology in its efforts to achieve its zero emission goals, as improvements in electrification technologies are necessary to going beyond incremental fuel efficiency increases. Odyne would recommend any methods to streamline Phase Two regulations with CARB Innovative Technology Regulation (ITR) efforts to ease regulatory burden on Innovative Technology in this space, and set common goals for the heavy-duty industry to meet. More detailed comments on commonalities sought between EPA and other regulatory bodies like CARB are included in other sections of these comments. [EPA-HQ-OAR-2014-0827-1239-A1 p.32]

**Organization:** Plastics Industry Trade Association (SPI)

#### Revising the Lightweight Credit Menu

SPI recommends that the agencies include a supplier-driven process for adding to the lightweight credit menu. This will encourage the development of new technologies over the course of Phase 2. Further, there should be an opportunity to adjust existing credits if such changes are required. These potential adjustments are necessary because many of the parts currently being translated from the light duty market will be commercialized for the medium and heavy duty markets by the time Phase 2 takes effect. [EPA-HQ-OAR-2014-0827-1225-A1 p.2]

Few credit petitions were received during Phase 1<sup>2</sup>, which is likely the result of requiring vehicle manufacturers to sponsor the credit petitions. The resources and incentive to document credits is with suppliers and they should be permitted to sponsor credit petitions. The agencies can ensure only legitimate applications are filed by placing testing and evidentiary requirements on suppliers. [EPA-HQ-OAR-2014-0827-1225-A1 p.3]

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2 U.S. EPA, Peer Review of the Greenhouse Gas Emissions Model (GEM) and EPA's Response to Comments, EPA-420-R-15-009, June 2015, p. 30.

**Organization:** SABIC Innovative Plastics US LLC

We also encourage the agencies to consider supplementing the existing petition process with a supplier-driven process for adding additional technologies to the off-cycle credit menu during Phase 2. Advances in tools to validate new parts, including computer-aided design and modeling, predictive engineering, and rapid prototyping, have equipped suppliers to substantiate the benefits of such components independent of OEM commercialization and validation. Allowing suppliers to lead credit petitions will accelerate the pace at which innovative products enter the marketplace. [EPA-HQ-OAR-2014-0827-1207-A1 p.2]

#### IV. Allow Suppliers to Lead Off-Cycle Petitions

Since the inception of the Phase 1 program for medium- and heavy-duty vehicles, the agencies have required that petitions for off-cycle credit be brought forward by OEMs. The process of OEM validation was relied upon as substantive support for the commercial viability and real world fuel and emission benefits of new technologies. However, that requirement has likely hampered innovation, as few credit petitions were received during Phase 1.[EPA-HQ-OAR-2014-0827-1207-A1 p.5]

Recent years have seen rapid advances in tools to validate new parts, including computer-aided design and modeling, predictive engineering, and processes like 3D printing that allow for rapid prototyping. These tools place suppliers in a position to submit very substantive credit petitions that can demonstrate the real world fuel and emission benefits of for new technologies. These advanced modeling and prototyping techniques can also would support petitions to modify existing credits in light of new information. The same tools will prove useful to the agency in evaluating such petitions. [EPA-HQ-OAR-2014-0827-1207-A1 p.5-6]

Allowing suppliers to lead credit petitions will accelerate the pace at which innovative products enter the marketplace. SABIC recommends that the agencies supplement the existing OEM-led petition process for off-cycle credits with a supplier-led petition process during Phase 2. The Motor Vehicle Manufacturers Association (MEMA), of which SABIC is an active member, will address in its comments how a program could be structured to incentivize supplier-led innovation, while ensuring the merit of credit petitions. SABIC supports that proposal. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

SABIC encourages the agencies to provide a supplier-driven process for adding to the credit menu, which will accelerate the pace at which innovative products enter the marketplace. Advances in tools to validate new parts, including computer-aided design and modeling, predictive engineering, and rapid prototyping, have equipped suppliers to substantiate the benefits of such components independent of OEM commercialization and validation. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

**Organization:** Safety-Kleen Systems

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 257-260.]

We recommend allowing the manufacturers of relevant vehicles to obtain credit for significant greenhouse gas reduction benefits associated with re-refining lubricating oil when this oil is supplied as an original factory fill. And further, we would like to explore with the agencies how ABT mechanisms can be used to allow credit for re-refined oil supplied during subsequent routine maintenance. [EPA-HQ-OAR-2014-0827-1372 p.257]

Re-refining used lubricating oil generates significant environmental and energy benefits, and has been deemed by Federal agencies and national labs as an appropriate use for -- I'm sorry -- for conserving crude oil that is a non-renewable resource. [EPA-HQ-OAR-2014-0827-1372 p.257]

Our independent life cycle analysis published in the American Chemistry Society Journal after peer review describes how the use of re-refined oil reduces greenhouse gas emissions compared to the use of engine oil made from virgin crude. This analysis, conducted by Envira, a leading environmental consulting firm, estimates that production of re-refined engine oil generates 70 percent fewer greenhouse gas emissions than production of oil from virgin crude. For example, the total greenhouse gas savings from use of 50 million of refined oil is approximately 159,000 metric tons of CO<sub>2</sub>Eq. That's equal to avoiding emissions from the combustion of 15 million gallons of number two fuel oil. Simply put, every three gallons of re-refined engine oil used avoid emissions equivalent to burning a gallon of diesel fuel. [EPA-HQ-OAR-2014-0827-1372 p.257-258]

Our published analysis shows that even if we conservatively include other factors, such as emissions from collection of used oil, the use of re-refined oil represents 56 percent reduction in greenhouse gas emissions when compared to emissions from the production of lubricants made from the virgin crude.



This is because refining engine oil from previously refined used oil is a more efficient process than refining comparable engine oil from virgin crude. [EPA-HQ-OAR-2014-0827-1372 p.258]

Significant carbon reductions are achievable through use of re-refined oil to lubricate engines as original equipment and as part of maintenance of the vehicles. Allowing OEMs to receive credit for these greenhouse gas savings will provide them with additional flexibility to achieve the targets being set by the EPA and DOT. Further, allowing credits for initial fill and future maintenance will encourage more companies to use re-refined oil when studies show -- which studies show is preferable in terms of reducing greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1372 p.258-259]

When the total life cycle benefits are factored in, the use of re-refined oil has benefits comparable to the use of low rolling resistance tires. With this type of tire, the standards are drafted to provide environmental benefits throughout the prescribed lifetime of the vehicle. The same standard could be adapted to avoid greenhouse gas emissions with re-refined oil in original factor fill and service fill. [EPA-HQ-OAR-2014-0827-1372 p.259]

Credit for future maintenance could be provided on a tradable basis allowing the manufacturer to buy GHG reduction benefits each time the oil is changed using re-refined oil in the future and maintenance cycles. By allowing future tradable credit, the manufacturer would be given an incentive to promote the use of re-refined oil in future oil changes through sales of re-refined oil to their own network of maintenance facilities and dealers. [EPA-HQ-OAR-2014-0827-1372 p.259-260]

**Organization:** Truck & Engine Manufacturers Association (EMA)

Vehicle Families for “Off-Cycle” Technologies

The Agencies are proposing that vehicle manufacturers certify as a separate family any vehicle configuration that utilizes a unique innovative or “off-cycle” technology. As an initial matter, it is unclear whether this requirement necessarily applies to “off-cycle” technologies. If not, then the requirement to treat any innovative technology as a distinct family for certification should be removed, since it will only add to the burden and costs of the Phase 2 program with no real corresponding benefits. [EPA-HQ-OAR-2014-0827-1269-A1 p.43]

**Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 242.]

we recommend expanding the trading compliance paths for additional flexibility to allow major OEMs to take advantage of the fuel and emissions savings technologies deployed by third party up-fitters, like ourselves.

**Response:**

The agencies are continuing the Phase 1 innovative technology program, but re-designating it as an off-cycle program for Phase 2. In other words, beginning in MY 2021 technologies that are not fully accounted for in the GEM simulation tool, or by compliance dynamometer testing (for engines or chassis certified vehicles) will be considered “off-cycle”, including those technologies that may no longer be considered innovative technologies. Commenters generally supported this flexibility.

### *Eligible Technologies*

The final rules provide that in order for a manufacturer to receive these credits for Phase 2, the off-cycle technology will need to meet the following requirements:

- The technology is not represented by the applicable test procedures and simulations.
- The technology was not in common use prior to MY 2010.

Navistar commented that the 2010 restriction will become harder to implement in the future. However, we believe it is prudent to continue this requirement to avoid the potential for manufacturers to receive windfall credits for technologies that they were already using before MY 2010. We recognize that because the Phase 2 program will be implemented in MY 2021 and extend at least through MY 2027, the agencies and manufacturers may have difficulty in the future determining whether an off-cycle technology was in common use prior to MY 2010. In order to avoid this approach becoming an unnecessary hindrance to the off-cycle program, the agencies will presume that off-cycle technologies were not in common use in 2010 unless we have clear evidence to the contrary. Neither the agencies nor manufacturers will be required to demonstrate that the technology meets this 2010 criteria. Rather, the agencies will simply retain the authority to deny a request for off-cycle credits if it is clear that the technology was in common use in 2010 and thus part of the baseline.

Several commenters identified specific technologies as potential off-cycle credit technologies. It would not be appropriate for the agencies to make determinations about these technologies based on the limited information provided in the comments. Nevertheless, we recognize that many of these technologies could qualify under the program being adopted. However, Odyne is correct that hybrids would generally not qualify where they are represented by the powertrain test.

### *Test Procedures*

We do not disagree with the concern expressed by CARB about test-to-test variability confounding measurements. However, we believe that this can be addressed by proper experimental design.

Allison commented on the use of powertrain testing to demonstrate off-cycle improvements. Since improvements over the prescribed powertrain test would not be eligible for off-cycle credits (these improvements are obviously adequately measured by the applicable test procedure; this is the whole purpose of the powertrain test), we believe Allison is requesting that they be allowed to use modified versions of the powertrain procedure. We have revised the regulations to clarify that this is permissible.

### *Carryover*

Manufacturers will be able to carry over innovative technology credits from Phase 1 into Phase 2, subject to the same restrictions as other credits. Manufacturers will also be able to carry over the improvement factor (not the credit value) of a technology, if certain criteria are met. We will require preapproval prior to the first use under Phase 2, but will not require additional subsequent approval beyond the normal certification process.

### *Streamlining the Off-Cycle Approval Process*

The agencies will require documentation for all off-cycle requests similar to those required by EPA for its light-duty GHG program. Some commenters requested that the agencies develop a streamlined path for off-cycle technology approval. While we are not making fundamental changes from the proposal at this time, we remain open to working with stakeholders to look for ways to simplify the process.

Just as some technologies that were considered off-cycle for Phase 1 are being adopted as primary technologies in Phase 2, the agencies may revise the regulation in a future rulemaking to create a more direct path to recognize technologies currently considered off-cycle. For example, although we are including specific provisions to recognize certain electrified accessories, recognizing others would require the manufacturer to go through the off-cycle process. However, it is quite possible that the agencies could gather sufficient data to allow us to adopt specific provisions in a future rulemaking to recognize other accessories in a simpler manner. Because such a change would merely represent a simpler way to receive the same credit as could be obtained under the regulations being adopted today (rather than a change in stringency), it would not require us to reconsider the standards.

Some suppliers commented that the agencies should allow them to apply for off-cycle credit independent of any certifying OEMs. However, we believe it is important to include the certificate holder that would be responsible for the in-use performance of the technology.

#### *Separate Families*

EMA commented that the agencies should not require vehicles with off-cycle technologies to be certified in separate vehicle families. That was the approach adopted in the Phase 1 program, but the agencies proposed to eliminate this restriction. For the FRM, the agencies have made it clearer that we are ending this restriction.

#### *Credit for Life Cycle Reductions*

AIISI commented that the agencies should provide off-cycle credits for life cycle reductions. See Section 1.8 of this chapter for a discussion of life cycle issues

### **1.4.3 Selective enforcement audits and confirmatory testing 133**

**Organization:** American Automotive Policy Council

**In-Use Compliance and Useful Life** - AAPC agrees with continuing the 3 percent adjustment factor applied to the full useful-life certification standards for the purpose of determining in-use emissions and fuel consumption standards. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

#### **In-Use Compliance and Useful Life**

The agencies requested comment (80 Federal Register 40206) on the appropriateness of continuing the 3 percent adjustment factor applied to the full useful-life certification standards for the purpose of determining in-use emissions and fuel consumption standards. This adjustment factor was applied in Phase 1 based on the agencies' assessment of testing variability inherent in comparing results among different laboratories and different engines. AAPC supports the continuance of this allowance for in-use testing. No material advances have occurred that would result in the variability factors relevant in Phase 2 being significantly different than they were in Phase 1. Furthermore, the appropriateness of the 3% allowance has not yet been assessed against actual in-use data on 2014 MY or later vehicles and engines near their full useful lives. Absent such data, a thorough assessment of the appropriateness of this allowance cannot be made. AAPC further notes that in-use verification program limits in Light-Duty are 10% to account for in-use variations. [EPA-HQ-OAR-2014-0827-1238-A1 p.16]

**Organization:** Caterpillar Inc, et al.

There are a number of new or updated test procedures in the Phase 2 proposal including aerodynamic coast-down, fuel mapping procedure, powertrain test procedure, rear axle efficiency, Selective Enforcement Audits (SEA), and in-use chassis dyno testing. The current proposal does not include compliance margins for modified or new procedures, such as aerodynamic and engine fuel map audits. To reduce some of the variability that is inherent in the proposed test procedures, we recommend that the Agencies perform confirmatory and SEA tests using the same method and location that the manufacturer used to certify the vehicle or component. Furthermore, we have worked with the Agencies to improve the accuracy of the procedures, for example we have recommended the inclusion of the yaw angle in the coast-down procedure to reduce the impact of wind conditions. To account for the remaining variability, compliance margins must be included in the Phase 2 regulation. If not corrected, these issues will subject manufacturers to risks simply as a result of expected test variation that can only be mitigated by downgrading our declared certifications to levels significantly worse than the actual test results, so as to cover the range of production and test variability. We estimate these issues have the impact of raising the de facto targets by approximately 12.5%; that is, we need to achieve 36.5% efficiency improvement to meet the stated 24% target for high-rise sleeper tractors. [EPA-HQ-OAR-2014-0827-1215-A1 p.8] 134

**Organization:** Cummins, Inc.

*Cummins opposes using any possible vehicle configuration for an engine fuel map SEA* [EPA-HQ-OAR-2014-0827-1298-A1 p.26]

In 1036.301(b)(1), the agencies broadly define that “any applicable vehicle configuration” could be used during an engine fuel map SEA. With any vehicle configuration available for an SEA, there is no clear audit cycle on which to evaluate and optimize CO<sub>2</sub> performance. Cummins recommends the fuel map SEA uses a predefined vehicle configuration. [EPA-HQ-OAR-2014-0827-1298-A1 p.26]

**Organization:** Daimler Trucks North America LLC

The agencies must resolve problems with audit procedures and compliance margins for those audits. Although we strongly support the agencies’ use of audits to find noncompliance, the problematic procedures and margins make the rest of the agencies’ proposed standards impracticable. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

### **Audits/In-Use Testing**

Daimler Trucks North America (DTNA) starts our comments with some serious concerns about audits, before even getting to engine testing or GEM-based certification, as the manner of auditing and the compliance margins assumed for each audit have such profound impact on all other aspects of certification and compliance. There are problems with the agencies’ audit proposals, but these can easily be rectified in order to make the program workable. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

#### 1. SEAs, generally

**SEAs in § 1037.301** - The EPA should clarify that a vehicle fails an SEA only if it fails by a margin larger than the uncertainty involved in testing the component(s) that the agency audited. If an SEA shows a 1% higher emission than the manufacturer submitted to the EPA, but the uncertainty in testing components is 3%, then the 1% exceedance may be due to test variability. If, on the other hand, the agency expects that manufacturers will build into each vehicle's FEL the (say) 3% necessary to pass

SEAs, then the EPA must also include this 3% buffer in its standards (i.e., the g CO<sub>2</sub>/ton-mile numbers) given that the standards the EPA assigned lacked this buffer and therefore will not be achievable with the EPA's assumed technology mixes. [EPA-HQ-OAR-2014-0827-1164-A1 p.7]

**Suspending or revoking certificates based on SEAs, § 1037.301(f):** The agencies propose to give themselves the authority to suspend or revoke certificates based on the results of an SEA. § 1037.301(f), 80 FR 40622. If a vehicle family fails an SEA, for example for aerodynamics, then the family's aerodynamic drag values for use in GEM should be revised. But as long as the family can still meet limit values, perhaps with AB&T credits, there is no reason that the EPA should be able to suspend or revoke the family's certificate. [EPA-HQ-OAR-2014-0827-1164-A1 p.7]

## 2. GEM and Fuel Map Audits

**GEM SEA:** With the introductory text of § 1037.551 (particularly that “engine-based measurements may be used for confirmatory testing ... or for selective enforcement audits”), the agencies appear—and the text is not clear on this topic—to give themselves great flexibility in auditing, up to allowing them to audit vehicles in a manner unlike the lawful manner that the manufacturer used to certify. If that is the agencies' intention, then we disagree with this approach. The reason is that it fails to find when a manufacturer submitted bad data and instead confounds test-to-test variability into the audit process. Rather, the manner in which the EPA should audit manufacturers, whether for compliance using GEM or for anything else, is to first start with a process audit. The EPA should evaluate whether the manufacturer is following allowable procedures at each step within the certification or compliance procedure--given that there are a number of different options at many steps within the procedure and each one could cause slightly different GEM results. So for example, rather than auditing a fuel-map based GEM result using a powertrain test, the EPA should audit the fuel map, as auditing an engine fuel map result through powertrain testing confounds the differences between the tests with the test results themselves. Similarly, regarding aero SEAs, the agency should not audit a manufacturer's CFD-based aero value through coast-down and ARC; the EPA should audit the CFD result. In short, if the manufacturer chose a lawful procedure for generating GEM inputs, then the agencies would focus their analysis on the results of that lawful process and would omit any audit of what the results would be if the manufacturer had used some other (equally lawful) process. [EPA-HQ-OAR-2014-0827-1164-A1 p.8-9]

**Fuel Map SEA and Confirmatory Testing** - The EPA proposes to audit fuel maps as part of confirmatory testing (1036.235). EPA proposes to audit fuel maps on a point by point basis, including points rarely encountered in drive cycles but captured in the 143 point fuel map. Some of these points have relatively high variability of CO<sub>2</sub> emissions on a percentage basis, because of the low fuel consumption rates. Because these points are rarely encountered in drive cycles, they should not receive the same scrutiny as points that factor highly into driving operation. In turn, point by point fuel map auditing will force manufacturers to build sometimes large compliance margins (or buffers) into points within the fuel map. While this does solve the variability problem and protect against audits, it leads to the EPA receiving potentially misrepresentative fuel map information. Better would be for the EPA to remove point by point auditing so that the agency gets accurate—rather than misrepresentative—information from manufacturers. An alternative method is provided. [EPA-HQ-OAR-2014-0827-1164-A1 p.9]

Second, the EPA's proposal would confound normal engine to engine variability with GEM noncompliance, which is a vehicle-side issue. If in an SEA the EPA selects an engine with fuel consumption toward the high end of the engine family's distribution, then any GEM run using that engine's measured fuel map will indicate high fuel consumption, incorrectly indicating that the vehicle

manufacturer may have misstated GEM-based emissions. Because neither the EPA nor the vehicle manufacturer will know a priori whether the engine is at the high end of the fuel consumption distribution, any failure of a GEM audit is immediately suspect. [EPA-HQ-OAR-2014-0827-1164-A1 p.9]

Third, the EPA's proposal confounds errors of the output of GEM, which is the agency's responsibility, with errors of the input of GEM, which is the vehicle manufacturer's responsibility. In an SEA, the EPA should be concerned that a vehicle manufacturer 1) uses correct inputs to GEM and 2) uses the agency's supplied GEM. Where an input comes from a supplier other than the vehicle manufacturer, the EPA should require only that the vehicle manufacturer used that supplier's input in good faith, as the EPA currently does with tire inputs. [EPA-HQ-OAR-2014-0827-1164-A1 p.9]

The result is that the proper way to audit GEM and its inputs is: 1) require that engine manufacturers submit fuel maps and that they be held accountable for the maps' accuracy, as they currently are through SEAs that are RMC-based (an integrated, rather than point by point compliance measure) and FTP based (integrated over a test cycle); 2) do not conduct confirmatory testing of fuel maps on a point by point basis, as doing so highlights areas of variability that are unimportant yet downplays areas that are important; 3) audit vehicle manufacturers' inputs to GEM; and 4) audit that the vehicle manufacturer properly used the agency's GEM. In other words, the proper way to audit is a step by step auditing process, checking inputs individually, rather than confounding potential sources of error or, worse, highlighting errors that are unimportant. [EPA-HQ-OAR-2014-0827-1164-A1 p.9-10]

As an alternative for SEA testing, the agencies should establish regulations that recognize engine to engine variability and the need for an AQL in audits. The agencies would start by clarifying what vehicle configurations will be used for GEM inputs in fuel map audits, then test an engine or engines to generate fuel maps, use those fuel maps in GEM, and compare the results to those that the manufacturer would have gotten with its original fuel map. If the difference is above the test-to-test variability—and here we would suggest 3%, like the variability that created the FCL to FEL ratio—in a large enough number that the manufacturer did not meet an established AQL level (e.g., 40%), then and only then does the manufacturer fail the audit. This procedure is justifiable, given statistical variation, whereas the agencies' current proposal is not. [EPA-HQ-OAR-2014-0827-1164-A1 p.10]

Similarly for confirmatory testing EPA should consider evaluating a manufacturer's fuel map via GEM simulation wherein GEM results using the EPA generated fuel map are compared to results using the manufacturer's certified fuel map. Pass criteria should be established based on the certified fuel map GEM result plus the aforementioned 3% compliance margin. Should the GEM result using the EPA generated fuel map be above the pass criteria, the manufacturer should be required to accept the EPA fuel map for certification purposes. [EPA-HQ-OAR-2014-0827-1164-A1 p.10]

**Fuel map compliance (SEA and Confirmatory Testing)** - The agencies originally proposed to conduct SEA of fuel map compliance through GEM to rectify the problem that points of low fuel consumption (and hence poor signal to noise) or of infrequent applicability during driving (and hence little importance) be audited as fully as the main driving points. The agencies recognized that point-by-point compliance is even more stringent than current compliance requirements on the SET-RMC test, which is audited based on the weighted result of the thirteen points. Consequently, the agencies proposed to incorporate GEM into audits and not to overwrite individual points but to have a more statistically-based audit procedure. We applaud use of GEM for SEA audit of engine fuel map results. Further, for confirmatory testing we agree with the agencies' revised view that audit engine map differences (high only points) should be not used to modify cert fuel map. We suggest that, for both confirmatory testing and SEA, the agencies use 3% compliance margin applied to GEM output using the

certified fuel map as both a pass criteria for SEA and as the criteria for determining in confirmatory testing whether the manufacturer fuel map should be replaced by the EPA measured map (but that if the map is replaced, it be replaced in its entirety). [EPA-HQ-OAR-2014-0827-1164-A1 p.48-49]

**Organization:** International Council on Clean Transportation (ICCT)

Confirmatory testing. The U.S. EPA memo on Selective Enforcement Audit and Confirmatory Testing provides a welcome addition to the regulatory development of protocols to monitor compliance with the regulation. Previously, there were limited such details on questions about aerodynamic testing protocols, allowable measurements, thresholds, and margins, so the memo provides helpful guidance and also helps narrow the testing and compliance margins. This opens up a broader set of questions regarding how the agencies will confirm the regulatory compliance data, such as the GEM inputs for various technology-specific drop-down menus, tire low rolling resistance, etc. We would ask that the agencies consider sharing similar details in the Final Rule and/or in guidance memos on how all regulatory input data will be confirmed as valid for vehicles in real-world settings. Confirmatory testing of aerodynamics and GEM inputs, and production vehicle chassis testing, is key to ensuring CO<sub>2</sub> and fuel use reductions over the certification tests correlate with reductions in the real world (Sharpe et al, 2014; ICCT, 2015). In order for the real-world testing program to be successful, it will be critical that the emission results from the testing program are shared publicly and that the testing program starts as soon as possible (i.e., in 2016 ideally) to discern ongoing and future trends from the earliest possible time. [EPA-HQ-OAR-2014-0827-1876-A1 p.2]

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International Council on Clean Transportation (ICCT, 2015). International Council on Clean Transportation comments on United States' proposed Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles.  
<https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-1180>

Sharpe, B., Delgado, O., Muncrief, R. (2014). Comparative assessment of heavy-duty vehicle regulatory design options for U.S. greenhouse gas and efficiency regulation. <http://www.theicct.org/us-phase2-hdv-regulation-design-options>

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

Therefore OEMs would have to report worse aero performance to ensure passing an audit, with as much as 5% impact. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

No compliance margin is provided for engine fuel map audits, compared to the 3% margin allowed in Phase 1 for engine efficiency. Consequently OEMs will likely declare lower engine efficiency than their certification measurement to ensure meeting stringency. In sum, faulty assumptions driven by technology penetration rates, the absence of audit compliance margins could add as much as 17% greater reduction in fuel consumption than the proposed rule estimates. If not addressed, this could prove to be an untenable threshold and market disruptions could very possibly follow. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

**Organization:** National Association of Clean Air Agencies (NACAA)

1. February 19, 2016 EPA memorandum, *Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters for Combination Tractors and for Trailers*

On February 19, 2016, EPA issued a memorandum, *Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters for Combination Tractors and for Trailers*, discussing potential approaches to applying the longstanding principles behind selective enforcement audits and confirmatory testing for aerodynamic measurements. In our September 29, 2015 comments on the Phase 2 proposal, NACAA urged EPA “to do everything feasible to implement in-use compliance.” We believe firmly that the integrity of the Phase 2 program and achieving the associated emissions reductions rely upon strong enforcement and compliance tools and that it is imperative for EPA to finalize a program that is enforceable and auditable and includes confirmatory testing. We are, therefore, pleased that the agency has issued this memorandum to provide further insight into enforcement of and compliance with the Phase 2 program (and, potentially, the Phase 1 tractor program). [EPA-HQ-OAR-2014-0827-1890-A1 p.2]

**Organization:** Navistar, Inc.

The NPRM proposes changes in Selective Enforcement Audit (SEA) provisions in both engine and vehicle. The engine compliance margins were carried over in the engine regulation, but not included in the vehicle regulation. For instance, for the fuel map SEA the pass criteria are set at the GEM input value. The engine SEA includes a 3% margin due to variability of engines and test facilities. The SEA of the engine fuel map used in the GEM for the vehicle regulation should also include that same 3% margin. The number of runs does not effectively make up for the lack of a vehicle compliance margin because test variability arising from variations like location conditions may not change run to run. Of particular concern are the provisions that allow SEAs for each component included as a GEM input. This vastly expands the number of subsystems potentially exposed to SEA. [EPA-HQ-OAR-2014-0827-1199-A1 p.10]

The function of an SEA should be to confirm that the vehicle, as certified, achieves in-use emissions levels consistent with its certification. Necessarily, however, this must recognize the inherent variability of vehicle to vehicle performance, particularly when one is looking at one subsystem within the vehicle. Not only may there be variability vehicle to vehicle, but specific test methods with respect to particular systems may be variable as well. [EPA-HQ-OAR-2014-0827-1199-A1 p.10]

It is improper to attempt to create subcategories of features or systems subject to an audit. These functions are not subject to emissions limits in and of themselves. The vehicle or engine as a whole is subject to the emission standard, and that is what should be subject to an SEA. It is arbitrary and capricious to subject a manufacturer to liability for a system that might not meet the defined input when the vehicle as a whole may meet the emissions. This appears to be an inherent flaw in the use of the GEM model. [EPA-HQ-OAR-2014-0827-1199-A1 p.10]

Even if one were to accept that SEAs could apply to individual systems within the vehicle, we have concerns as to the proposal. The primary concern stems around whether the SEA appropriately replicates the conditions under which the certification tests were conducted. Variations between appropriately conducted certification tests and SEA methodology can create significant risks. [EPA-HQ-OAR-2014-0827-1199-A1 p.11]

In the ongoing EPA-sponsored laboratory “Round Robin” test exercise it has been demonstrated that it is unrealistic to expect repeatable CO<sub>2</sub> emissions within 3% of the average from one test facility to another. This is the case despite the application of the same cycle validation criteria noted in Table 4 of



1037.550 for each of the participating engine test facilities. This variability is also minimized through the use of the same engine and charge air coolers at each facility. The variability validates the premise that individual engine dynamometers configured with equivalent coolant and charge air cooler components can still yield statistically significant differences. The engine/dynamometer normalized test schedule accommodates the inherent variability in rotating inertia, load response and speed control to satisfy the cycle validation criteria. However, these inter-cell or intra-facility differences in dynamometer configuration and control are sufficient to yield differing results as witnessed in the Round Robin exercise. [EPA-HQ-OAR-2014-0827-1199-A1 p.11]

This is of considerable concern, since EPA has taken the position that if the agency test arrives at a different number during a confirmatory test than the number resulting from the manufacturer's test, the EPA number is substituted in the certificate of conformity. That number then becomes the official test value for that vehicle, even if all of the procedures were properly followed by the manufacturer during the initial certification test. That introduces an unacceptable amount of uncertainty into the certification process. Confirmatory tests should not be used to change a manufacturer's tested number based solely on testing variability. [EPA-HQ-OAR-2014-0827-1199-A1 p.12]

We therefore request that the Proposed Rule be modified to specifically allow a test margin for all confirmatory tests, or, at the very least, a provision that states that EPA will substitute its confirmatory number for a manufacturer's only if it identifies an error in the manufacturer's certification test procedures and identifies a different test number as a result. [EPA-HQ-OAR-2014-0827-1199-A1 p.12]

**Organization:** SmartTruck

In addition to commenting on aerodynamic testing methodology, we direct the following comments to the Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters, Docket No. EPA-HQ-OAR-2014-0827-1625. [EPA-HQ-OAR-2014-0827-1923-A1 p.3]

SmartTruck supports the EPA in its effort to provide dependable validation for aerodynamic devices and believes that a reliable testing protocol is necessary for the success of GHG Phase 2. The NPRM outlines a basic guideline for SEA and confirmatory testing structure that closely aligns with the scale and scope of tractor and trailer vehicle OEMs and provides a verification structure to ensure production vehicles conform to their certifications. [EPA-HQ-OAR-2014-0827-1923-A1 p.3-4]

In the case of trailer aerodynamics, the agencies have proposed the Aerodynamic Device Testing Alternative to allow device manufacturers to seek preliminary approval of aero-devices and supply GEM inputs to trailer OEMs. Recognizing that trailer manufacturing OEMs may have little experience with aerodynamic testing, it is likely that the majority of trailer aerodynamic testing will be performed by aerodynamic device manufacturers and provided to trailer OEMs in the form of GEM model inputs and will be subsequently used in the certification of their trailer families. We therefore seek an SEA and confirmatory testing structure that will align with the scope and size of device manufacturers in order to strengthen the GHG Phase 2 program and to utilize our experience with aerodynamic testing to expedite the certification process for both trailer OEMs and EPA. [EPA-HQ-OAR-2014-0827-1923-A1 p.4]

Although the EPA has provided SEA guidelines for trailer OEMs, the business of manufacturing a complete vehicle and manufacturing a vehicle component are fundamentally different and should be reflected in testing protocol. In aerodynamic testing, tractor and trailer OEMs use a vehicle completely manufactured or assembled by themselves whereas device manufacturers are testing a component designed to be used on a variety of vehicles, such as dry vans, refrigerated units, and partial-aero trailers, manufactured by a variety of different OEM manufacturers and a variety of different

configurations. While it makes sense to require a vehicle manufacturer to use the current model year for validation testing, it is unreasonable to require a device manufacturer to do so. For example, a device manufacturer should be able to test its model-year components on a tractor from a prior year. Especially considering that a trailer equipped with an aerodynamic device could be pulled by a tractor from any previous year. Allowing component manufacturers to test with glider kits will further ease the burden. A testing protocol specifically structured for device manufacturers would still give the EPA the right to choose the aero component to be tested but would also allow the device manufacturer greater flexibility in choosing the vehicle to be used for component testing. [EPA-HQ-OAR-2014-0827-1923-A1 p.4]

These fundamental differences are also present in relation to the size of device manufacturers compared to tractor and trailer OEMs, which greatly increase the burden on device manufacturers to comply with the proposed validation testing protocols. While vehicle OEMs have been around for several decades, the majority of aero-device manufacturers have emerged within the last ten years and are represented on just a portion of the market offered by trailer OEMs. Device manufacturers are less likely to have in-house testing facilities such as wind tunnels or test tracks and are less likely to have multiple vehicles of the current model year that can be utilized for testing. The majority of component manufacturers complete testing at third party locations which must be secured several months in advance. These factors further increase the difficulties and burden faced by device manufacturers in complying to a testing structure that is based on large vehicle manufacturers. A unique structure designated for device manufacturers should account for this by allowing device manufacturers greater flexibility in choosing testing facilities pre-approved by the EPA to ensure a greater confidence in SEA and confirmatory testing results. [EPA-HQ-OAR-2014-0827-1923-A1 p.4]

Lastly, in supporting the effort of creating a national greenhouse gas emissions program, aero-device manufacturers are in a position to work closely with the EPA to mitigate the cost and burden of compliance testing for the EPA and to provide trailer manufacturers with a confident process of compliance. By providing full disclosure of all confirmatory documentation to the component manufacturer, the EPA eases the burden by allowing component manufacturers the ability to identify possible concerns in testing results. The full disclosure of SEA and confirmatory testing criteria would also give device manufacturers the ability to mitigate validation proceedings by ensuring a greater confidence in initial certification validation. [EPA-HQ-OAR-2014-0827-1923-A1 p.5]

**Organization:** Truck & Engine Manufacturers Association (EMA)

A fourth core issue relates to the proposed requirement that engine manufacturers certify fuel maps as a part of their overall certification to the Phase 2 engine standards for reduced CO<sub>2</sub> emissions, and that they be required to provide those “certified” fuel maps to vehicle manufacturers (for their input into the updated GEM model) beginning with the 2020 model year (or even as early as 2019). Engine manufacturers would be required to use a new steady-state engine dynamometer test procedure to generate detailed fuel maps for each of their various engine families, which unique fuel maps could be input into GEM during vehicle manufacturers’ certification of their various vehicle configurations. (See Proposed § 1036.535). As a corollary enforcement mechanism, the agencies also are proposing unique selective enforcement audit (“SEA”) provisions for the manufacturer-developed fuel maps. (See Proposed § 1036.301(b)). Such SEA testing would test production engines to determine the fuel-consumption rates at each of the specified points under the engine fuel map, and then would use those SEA-measured values as inputs in GEM to generate comparisons against the manufacturer’s declared GEM results at certification. EPA would be allowed to audit and test through GEM simulations up to ten (10) unique vehicle certifications using the SEA-derived fuel map. [EPA-HQ-OAR-2014-0827-1269-A1 p.5]

There are a number of very serious issues relating to the agencies' proposed fuel-mapping and related SEA requirements. As an initial matter, the proposed engine fuel map would include 143 operating test points (13 speed points with 11 torque values at each speed point) and 4 idle test points, a very large number, which represents a dramatic increase over the Phase 1 engine testing requirements. Moreover, that testing burden would have very significant consequences, since the test results from the 143-point fuel mapping process would become the declared values that vehicle manufacturers would use for certification purposes. [EPA-HQ-OAR-2014-0827-1269-A1 p.5]

That leads to another fundamental concern. The agencies' proposed SEA testing procedure includes no margin whatsoever for the modeled GEM emission results. Under the agencies' proposal, if there is any shortfall between the GEM results using the SEA-derived fuel map (in up to 10 vehicle configurations) as compared against the GEM results reported using the engine manufacturer's original fuel map (which, in effect, creates 10 chances to "fail"), the engine manufacturer's certification could be suspended or revoked. (See Proposed § 1036.301(d)). Such a high-risk testing regime, with attendant liability, including the possible revocation of a manufacturer's engine certification, is unreasonable and would impose inherently infeasible requirements on engine manufacturers. Lab-to-lab variability, test-to-test variability, and engine-to-engine variability all need to be accounted for through the allowance of sufficient data-driven testing margins. As it stands, the agencies' proposed SEA process for the 143-point engine fuel maps is not reasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.5]

Unless EPA and NHTSA address the testing burdens and inherently infeasible SEA requirements associated with the proposed requirement for certified engine fuel maps, the Proposed Phase 2 vehicle standards could prove to be unworkable. As stated above, EMA stands ready to work with the agencies to implement the necessary revisions to the various engine-mapping issues. EMA's recommendations in that regard are set forth below. [EPA-HQ-OAR-2014-0827-1269-A1 p.5-6]

As noted above, a compliance margin is needed for the proposed "certified" fuel maps. However, proposed section 1036.301 does not include any compliance margin whatsoever for an SEA of the fuel map input into GEM, despite the inherent inaccuracies in the fuel map development procedure (see Proposed § 1036.535). Without an audit compliance margin in the rule, manufacturers would have to build a margin into their fuel maps (resulting in higher GEM inputs) to ensure passing an SEA, which would make achieving the GEM output targets significantly more challenging. The Phase 1 rule provides a 3% compliance margin for the engine certification program. For the same reasons that the margin is used in engine certification, the 3% compliance margin (at a minimum) should be implemented for the fuel-map based GEM results as well. Stated differently, a 3% compliance margin should be applied to the GEM result obtained using a certified fuel map when assessing whether an engine/vehicle passes a confirmatory or SEA test. [EPA-HQ-OAR-2014-0827-1269-A1 p.23]

Recent collaborative emissions-measurement research has demonstrated the continuing need for and suitability of a 3% compliance testing margin for GHG emissions. More specifically, EPA and EMA are currently involved in a collaborative "round-robin" engine testing program (managed by Southwest Research Institute ("SwRI")) to assess the extent of emissions-testing variability when the same test article (a heavy-duty motor vehicle engine) is tested at eight different Part-1065-compliant emissions-testing laboratories, including EPA's facilities in Ann Arbor, Michigan. The round-robin testing program has assessed the lab-to-lab variability for a number of regulated emissions, including CO<sub>2</sub>. The round-robin results for CO<sub>2</sub>, which are presented below, show that there is a 2.0% variability (as a percentage of the relevant standard) for CO<sub>2</sub> emissions assessed over the FTP test cycle. (Additional production variability, which ranges from +/- 2%, also needs to be accounted for). In light of those results, there is no basis for EPA to eliminate the 3% compliance margin that was included in the Phase 1 program. [EPA-HQ-OAR-2014-0827-1269-A1 p.23]

[Graphics, 'Round-Robin Engine Testing Results for CO2 Emissions', can be found on p.24-25]

In addition, EMA is in the process of commissioning follow-up research at SwRI to derive data to better quantify and account for the specific test-to-test and production variability relating to any subsequent audits of fuel maps. A copy of the SwRI proposal for that follow-up research is attached as Appendix "1." EPA and NHTSA should commit to co-funding and incorporating the results of that research into any final audit regulations and procedures. [EPA-HQ-OAR-2014-0827-1269-A1 p.26]

Finally, the fuel-map audit process should be more clearly defined and more predictable through the incorporation of pre-defined standard vehicle configurations for use in audit testing. [EPA-HQ-OAR-2014-0827-1269-A1 p.26]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

The Truck Trailer Manufacturers Association (TTMA) is an international trade association representing approximately 90% of the truck-pulled trailers manufactured in the United States. TTMA has a history of working closely with regulators to help them understand the unique nature of the heavy-duty trailer industry and to act as a conduit between the member companies and regulators. TTMA is offering this comment in response to the Notice of Data Availability published in the Federal Register March 2, 2016. [EPA-HQ-OAR-2014-0827-1873-A1 p.1]

Specifically, we will be commenting on the Environmental Protection Agency's Memorandum titled Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters for Combination Tractors and for Trailers (the Memo hereafter). [EPA-HQ-OAR-2014-0827-1873-A1 p.1]

As noted in the proposed rule's Preamble, there are "a large number of small businesses in this industry". The agencies recognized that performance testing requirements "would be the more challenging obstacles for this newly regulated industry." As such the agencies designed the proposed rules in such a way as to allow most trailer manufacturers to build without full testing of trailers, by passing-through tested components and using a change in CDA value, along with a discounting formula when multiple devices are used. We anticipate that if the rule advances as written, most trailer manufacturers will make use of this pass through system, with the larger manufacturers performing some of their own testing, often relying on CFD and Wind Tunnel data to contain costs in an industry the agencies admit "is very competitive". [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

As such, the sort of repetitive coast-down tests (twenty to a hundred coast-down runs per device tested) will be rarely employed by trailer manufacturers. [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

If EPA singles out a certain manufacturer for Selective Enforcement Action (SEA) and requires the manufacturer to pay for these expensive tests, we would view the SEA itself as punitive. [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

For manufacturers who are only using pass-through data, they should be immune to SEA's requiring coast-down tests in favor of investigations focusing on the supplier of the component. For those suppliers, the use of coast-down data related to the bin the eventual trailer it goes on are not properly applicable. An entirely different approach to audit a component manufacturers is called for: one that should focus on the integrity of the tests used to obtain a delta CDA or CRR (or even to verify the performance of an Automatic Tire Inflation System). [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

In the proposed rule, §1037.301(d) requires that with respect to drag area, manufactures are directed to “use the same method you used for certification” which better reflects the realities of the trailer world. The Memo’s methodology of generally allowing extra tests to be performed if early tests show unexpected results can and should be applied to all approved certification methods. [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

We thank you for this opportunity to comment on new data and remain available to answer any questions you may have. [EPA-HQ-OAR-2014-0827-1873-A1 p.2]

The assumption that there is no need to provide any compliance testing margin, SEA testing margin, engine fuel map margin, or coastdown testing margin is manifestly unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.72]

**Organization:** Volvo Group

[T]he lack of margins for aerodynamic and engine map audits would force us to understate our certified efficiency inputs to ensure passing a subsequent audit. [EPA-HQ-OAR-2014-0827-1290-A1 p.10]

Excessive stringency results in uncertainty that the proposal can be implemented, excessive cost, unreliable products, delays in new vehicle purchases, production disruption, lay-offs, and delays in achieving benefits. Volvo supports comments by EMA relative to stringencies and we elaborate on our concerns below. [EPA-HQ-OAR-2014-0827-1290-A1 p.18]

### **Engine Fuel Mapping and Audit**

As noted in EMA’s comments, at least 3% margin needs to be provided for a Selective Enforcement Audit (SEA) of the fuel map to account for production and measurement variability. Otherwise, even with 60% accepted quality level (AQL), we will be forced to downgrade our mapped efficiency due to production and test variability that is equal to, or greater than, the feasible engine improvement steps. Alternatively, the Agencies need to reduce the assumed baseline engine efficiencies and the vehicle standards that rely on engine map inputs. [EPA-HQ-OAR-2014-0827-1290-A1 p.37]

Furthermore, we cannot agree that the Agencies should be able to test the engine map over as many as 10 vehicle configurations, determined only at the time of an SEA, failure on any of which constitutes an audit failure. A single, predetermined vehicle configuration that exercises the typical range of engine operation is more than adequate. This vehicle configuration could be standardized for Class 8 tractor and vocational vehicles or could be agreed upon as part of each engine certification. [EPA-HQ-OAR-2014-0827-1290-A1 p.37]

**Organization:** Cummins, Inc.

*Cummins opposes engine-only testing for powertrain SEA* [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

As part of powertrain testing, 40 CFR 1037.550(q) requires manufacturers to record engine speed and torque over the powertrain cycles. The recorded engine speed and torque would then be used to test only the engine as part of an SEA instead of testing a complete powertrain. Cummins has concerns with this approach as a powertrain SEA surrogate. [EPA-HQ-OAR-2014-0827-1298-A1 p.39-40]

An SEA is the method EPA uses to assess a manufacturer's certified configuration against submitted test results; however, if a powertrain SEA is completed using an engine-only test, the SEA would only verify the compliance of production engines over powertrain cycles. Absent are GHG/FE impacts associated with variation in powertrain characteristics such as transmission efficiency and, most importantly, the interaction of the engine and transmission controllers. The highly complex controls of the engine and transmission actively manage, together, how the vehicle required torque is met, which is a critical part of the integration of an optimized powertrain. Not capturing these control interactions may result in elevated emissions for an engine-only test and a failed SEA. Furthermore, it is not clear how efficiency losses from the transmission would be accounted for when running an engine-only powertrain SEA. [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

For the above reasons, Cummins does not support the engine-only test as a means of a powertrain SEA. [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

**Organization:** Eaton Vehicle Group

### **Conformity testing issues**

A simple conformity testing procedure has been suggested as follows: at the time of powertrain certification, a time trace of the transmission gear and load should be recorded and then used in subsequent conformity testing actions on an engine dynamometer. Thus, conformity testing can be done in engine-only mode. However, this approach is close to the "simulated transmission" substitute for the powertrain test and we believe it cannot be applied to the highly integrated engine and transmissions. The two controllers exchange information in real time and make decisions based on each other's inputs. Thus, when the engine is exposed to a time-trace of a previous run, A) it has no transmission ECU to communicate with, and B) the any results that differ from the initial run would be inconclusive. [EPA-HQ-OAR-2014-0827-1194-A1 p.10-11]

**Recommendation:** The conformity tests for powertrains should be clarified with discussions with engine, transmission and vehicle manufactures. [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

### **Response:**

EPA requested comment on our provisions related to confirming a manufacturer's test data during certification (i.e., confirmatory testing) and verifying a manufacturer's vehicles are being produced to perform as described in the application for certification (i.e., selective enforcement audits or SEAs). The EPA confirmatory testing provisions for engines and vehicles are in 40 CFR 1036.235 and 1037.235. The SEA provisions are in 40 CFR 1036.301 and 1037.301-1037.30. The NHTSA provisions are in 49 CFR 535.9(a).

Commenters generally supported the inclusion of confirmatory and SEA testing provisions. However, as discussed below, several industry stakeholders requested changes to the proposed provisions.

ICCT requested that we include additional details in the FRM, which we have done.

### *Compliance Margins*

Some commenters suggested that the agencies should apply a compliance margin to confirmatory and SEA test results to account for test variability. However, other commenters supported following EPA's past practice, which has been to base the standards on technology projections that assume manufacturers will apply compliance margins to their test results for certification. In other words, we effectively require manufacturers to design their products to have emissions below the standards by some small margin so that test-to-test or lab-to-lab variability would not cause them to exceed any applicable standards. Consistent with this policy, EPA has typically not set standards precisely at the lowest levels achievable, but rather at slightly higher levels – expecting manufacturers to target the lower levels to provide compliance margins for themselves. As is discussed in Sections II through VI of the FRM, the agencies have applied this approach to the Phase 2 standards.

It is also important to consider the specific consequences that occur if emissions (or other measured GEM inputs) measured during confirmatory or SEA testing are worse than the declared values. If this occurs during confirmatory testing, the manufacturer simply continues on with the certification process using the new EPA values. It is not considered a violation. For SEAs, the test engine would be considered a failure, but no action would be required unless a large number of engines failed. In neither case would small variations in measured results lead to financial penalties for the manufacturer.

As discussed in Section I.C.(1)(a) of the FRM Preamble, we assume manufacturers will incorporate appropriate compliance margins for all measured GEM inputs. In other words, they will declare values slightly higher than their measured values. As discussed in Section II.D.(5) of the Preamble, compliance margins associated with fuel maps are likely to be approximately one percent. For aerodynamic inputs, we believe the bin structure will eliminate the need for CdA compliance margins for most vehicles. However, for vehicles with measured CdA values very near the upper bin boundary, manufacturers will likely choose to certify some of them to the next higher bin values (as a number of commenters noted). For tire rolling resistance, our feasibility rests on the Phase 1 standards, consistent with our expectation that manufacturers will continue to incorporate the compliance margins they considered necessary for Phase 1. With respect to optional axle and/or transmission power loss maps, we believe manufacturers will need very small compliance margins. These power loss procedures require high precision so measurement uncertainty will likely be on the order of 0.1 percent of the transmitted power. All of these margins are reflected in our projections of the emission levels that will be technologically feasible.

### *Fuel Map Confirmatory Testing*

We are making several changes to the proposed EPA confirmatory testing provisions in response to comments. First, the regulations being adopted specify that EPA will conduct triplicate tests for engine fuel maps to minimize the impact of test-to-test variability. The final regulations also state that we will consider entire fuel maps rather than individual points. Engine manufacturers objected to EPA's proposal that individual points could be replaced based on a single test, arguing that it effectively made the vehicle standards more stringent due to point-to-point and test-to-test variability. We believe that the changes being adopted largely address the concerns raised in the comments. We are also applying this approach for axle and transmission maps for similar reasons.

Manufacturers pointed to a round-robin test program showing significant variability between test sites. However, those results were not corrected for fuel properties, as is required for both Phase 1 and Phase 2 testing. Thus, they do not represent variability that would be expected to occur with EPA compliance testing. Nevertheless, the agencies do see value in working with manufacturers on the type of research project suggested by EMA.

It is worth noting that round-robin data did show that test-to-test variability within a given laboratory (where fuel properties would be constant) is on the order of one-half percent with existing equipment. It is likely that, as long as differences in fuel properties are corrected, lab-to-lab variability should be similar. Thus, we believe that overall test variability for engine testing will be about one percent in the Phase 2 time frame.

Daimler commented that EPA should evaluate the manufacturer's fuel maps using GEM for confirmatory testing. However, it is not necessary to constrain EPA testing in this manner. EPA has long treated its confirmatory results as official emission results that are fully valid.

#### *SEAs for Fuel Maps*

We have revised the SEA procedures for fuel maps in response to comments. The final provisions will evaluate fuel maps using four pre-defined GEM vehicle configurations. Volvo recommended that EPA use a single GEM configuration, but we believe this would not cover a broad enough range of the fuel map.

#### *Aerodynamic Testing*

As described in Section 4, EPA has modified the SEA regulations for verifying aerodynamic performance. These revised regulations differ somewhat from the standard SEA regulations to address the unique challenges of measuring aerodynamic drag. In particular, EPA recognizes that for coastdown testing, test-to-test variability is expected to be large relative to production variability. This differs fundamentally from traditional compliance testing, in which test-to-test variability is expected to be *small* relative to production variability. To address this difference, the modified regulations call for more repeat testing of the same vehicle, but fewer test samples.

Comments from the trailer industry supported less burdensome confirmatory and SEA procedures, even to the point of excusing manufacturers relying on supplier data from any test requirements or liability. Although, the statutes do not allow us to completely excuse certifying manufacturers in this way, we understand these concerns. Therefore, the agencies plan to work with industry to minimize compliance burdens. In particular, we plan to limit SEAs to those cases in which we have a reason to believe the products are not fully compliant with the regulations.

#### *Test Procedures*

Daimler objected to text in the proposed §1037.551 that states:

*These engine-based measurements may be used for confirmatory testing as described in §1037.235, or for selective enforcement audits as described in §1037.301, as long as the test engine's operation represents the engine operation observed in the powertrain test.*

However, Daimler does not appear to understand how this provision would be used. First, they ignore the end of the text which clearly makes it apply only where “the test engine’s operation represents the engine operation observed in the powertrain test.” Under this provision, manufacturers certifying using powertrain testing are required to measure speed and load values to allow for engine testing. Thus, testing would only occur over the manufacturer’s specified cycle. Moreover, since the manufacturers perform all SEA testing, this would be an option for the manufacturer rather than something imposed by EPA. So perhaps Daimler objects to the narrow circumstance in which EPA performs confirmatory engine testing of an engine that was certified using powertrain testing, follows the manufacturer’s



specified engine test cycle, and ensures that the test accurately represents the engine's performance during the powertrain test. However, it is not clear why this would be problematic. It is reasonable to assume that testing the engine in this way would result in equivalent emission results. Moreover, a strict requirement to require powertrain testing by EPA in such cases could lead to other problems for manufacturers. In particular, we note that in the case of an EPA confirmatory engine test indicating the manufacturer's powertrain fuel map is not accurate, the alternative would be to delay certification until EPA can perform a confirmatory test of the powertrain.

Cummins and Eaton also raised concerns about this approach. In particular, Cummins stated that not capturing control interactions could result in elevated emissions for an engine-only test. But again, a condition of this provision is that the test engine's operation must represent the engine operation observed in the powertrain test. Cummins' question about how efficiency losses from the transmission would be accounted for when running an engine-only test ignores the specification that the cycle be specified based on engine torque rather than transmission torque. To the extent Cummins concerns remain, they would be free to certify their engines based on engine-only fuel maps rather than powertrain testing.

SmartTruck commented that a device manufacturer should be able to test its model-year components on a tractor from a prior year. This is allowed. SmartTruck also commented that the agencies should allow device manufacturers greater flexibility in choosing testing facilities pre-approved by the EPA to ensure a greater confidence in SEA and confirmatory testing results. However, the program is already structured to allow manufacturers to choose any facilities for their SEAs. With respect to confirmatory testing, we note that the agencies (not the manufacturers) perform that testing.

#### *Supplier Data*

Daimler commented that for inputs from a component supplier (such as an axle manufacturer) the agencies "should require only that the vehicle manufacturer used that supplier's input in good faith" and suggested that this is the current policy for tire inputs. However, Daimler is not correct in claiming that this is the Phase 1 policy for tires. They appear to be misinterpreting text that attaches some liability for tire manufacturers to mean that there is no liability for vehicle manufacturers. In general, the certificate holder is responsible for compliance for all aspects of the vehicle covered by their certificate, even if the agencies find another manufacturer to also be responsible.

#### **1.4.4 Delegated assembly (dividing responsibility among manufacturers) 147**

**Organization:** American Automotive Policy Council

#### Vocational A/C Delegated Assembly Concerns

EPA is proposing to add vocational vehicles to the heavy-duty air conditioning leakage requirement beginning with MY2021 using the same SAE J2727 design approach used in Phase 1. While AAPC agrees that the design approach for calculating leakage is correct, we are concerned regarding responsibilities for compliance and certification. [EPA-HQ-OAR-2014-0827-1238-A1 p.20]

Currently, for non-air conditioning related system compliance, a secondary manufacturer can use the first manufacturer's Certificate of Conformity (COC) if the system is not modified and the vehicle does not exceed certain criteria such as GVWR and Frontal Area. However, for heavy-duty applications, there will be numerous cases where the second manufacturer will modify or add to the air conditioning system. In these cases it should be clear that it is the second manufacturer's responsibility for

compliance and certification of the completed air conditioning system for leakage. In such cases, the secondary manufacturer should also be responsible to attest to the durability of the complete A/C system. Once an A/C system has been modified, the integrity of the resulting system depends as much on the workmanship of the modifier as it does on the workmanship of the original manufacturer. Only the entity making the modifications can attest to durability of the final, as-modified system. Original manufacturers should not be held responsible for any alterations to the A/C system outside of their control. [EPA-HQ-OAR-2014-0827-1238-A1 p.20-21]

**Organization:** Truck & Engine Manufacturers Association (EMA)

[T]he proposed changes to the Phase 1 requirements for delegated assembly should not be finalized, as those changes also would amount to retroactive amendments to the overall stringency and cost of the Phase 1 program in violation of administrative due process and the CAA's leadtime and stability provisions. In sum, there is no reason to pull those proposed provisions forward, especially when to do so would disrupt the implementation and feasibility of Phase 1. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

**Organization:** Daimler Trucks North America LLC

**Changes to Phase 1:** There should be no changes to Phase 1. 80 FR 40519. It is too late for us to revise aero numbers or our delegated assembly procedures, given the agencies' lead time requirements, which require four years' lead time for NHTSA and require a joint program for the EPA (see *Massachusetts v. EPA* 549 U.S. 497, 532, 2007, where the Supreme Court stated that "there is no reason to think the two agencies [EPA and NHTSA] cannot both administer their obligations and yet avoid inconsistency"). We are busy working on Phase 2, to go back and adjust computer systems or delegated assembly at this point in time is too much for our limited groups. [EPA-HQ-OAR-2014-0827-1164-A1 p.111]

**Organization:** Aperia Technologies

As a prospective certifying manufacturer of automatic tire inflation systems and for the reasons below, Aperia Technologies (Burlingame, CA) supports the delegated assembly provision proposed for inclusion in 40 CFR 1037.621 providing for an 'allowance for vehicle manufacturers to sell or ship vehicles that are missing certain emission-related components if those components will be installed by a secondary vehicle manufacturer': [NHTSA-2014-0132-0104 p.1]

- Impacts on real-world operational efficiency and greenhouse gas emissions of vehicle configurations are path-independent; it doesn't matter who installs the device, just that it works. [NHTSA-2014-0132-0104 p.1]

- Such flexibility will enable faster adoption of good technology, no matter who builds it or when it gets installed. OEMs will be incented to find good technology partners, just as the market for development and commercialization of differentiated technologies by after-market manufacturers will be catalyzed toward higher competition and faster innovation. [NHTSA-2014-0132-0104 p.1]

- Certain technologies, like Aperia's Halo Tire Inflator, enable fast installation on both new and existing fleet vehicles. For such technologies, the delegated assembly provision applicable to new vehicles is likely to induce accelerated adoption among existing fleet vehicles. [NHTSA-2014-0132-0104 p.1]

We advocate the following specifically: [NHTSA-2014-0132-0104 p.1]

- We recommend that automatic tire inflation systems be added to aerodynamic devices and air conditioning systems as key aftermarket technologies. Currently, draft Phase 2 regulation does not propose to limit the use of delegated assembly to aerodynamic devices and air conditioning systems, but nonetheless focuses only on those two. [NHTSA-2014-0132-0104 p.1]

**Organization:** Association for the Work Truck Industry (NTEA)

### **Delegated Assembly**

Vehicles produced by NTEA member companies for commercial or vocational use include, but are not limited to, dump trucks, utility company vehicles, aerial bucket trucks, tow trucks, beverage delivery trucks, digger derricks, snow removal vehicles, agricultural platform and stake body trucks, fire trucks, ambulances and a host of other specialized configurations.

The typical NTEA distributor member (a FSM by NHTSA definition) is capable of producing an almost endless variety of vehicle configurations. They can mount any one of numerous body types and work equipment on a chassis of any size from any of the manufacturers. For instance, the same company may mount a utility body on a Dodge chassis one day, an aerial bucket on a Ford chassis the next day, a dump body on a Freightliner, a stake body on a GM or a telescoping crane on a Peterbilt, etc... Items such as toolboxes, winches, lift gates and ladders might also be added before the vehicle is completed.

The NTEA's Membership Roster and Product Directory lists over 129 separate body types. Each of these body types could be mounted to multiple truck chassis from multiple chassis manufacturers. In addition, multiple combinations of equipment (ladder racks, winches, snow plows, salt spreaders, light bars, towing hardware, lift gates and hundreds of other mountable components) can be added to any of the aforementioned chassis/body combinations.

In EPA's existing regulations (40 CFR 1068.261), engine manufacturers may sell or ship engines that are missing certain emission-related components if those components will be installed by the vehicle manufacturer. According to this proposal EPA would provide a similar allowance for vehicle manufacturers to sell or ship vehicles that are missing certain emission-related components if those components will be installed by a secondary vehicle manufacturer. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

The NTEA supports the EPA concept of delegated assembly. This concept could allow for greater adoption of advanced fuel savings and emission reducing technologies. Due to the nature of the manufacturing process for vocational trucks, there is little or no recognition currently for work done on a vehicle after it leaves the chassis manufacturer and before it is sold to the customer. Intermediate and final stage manufacturers can, and do, perform manufacturing operations that positively affect fuel efficiency and emissions. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

We would like to suggest that the requirement for written instructions for completion/alteration of the vehicle and/or its emissions-related components be made more flexible such that those instructions come from the most appropriate entity. For instance, if a chassis manufacturer has contracted with a hybrid drive manufacturer for installation of a hybrid drive system on the chassis manufacturer's otherwise completed chassis, the instructions for installation may best be provided by the hybrid drive manufacturer rather than the chassis manufacturer. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

The NTEA supports the concept of delegated assembly in which manufacturers involved in the production of trucks after the emissions certification process by the engine and chassis manufacturers

can contribute and be recognized for the emissions reduction their work and products creates. These intermediate and final stage manufacturers or alterers would be bound contractually, rather than by regulation to install specified products that result in specified regulatory benefits that can be used by the certifying manufacturer. [EPA-HQ-OAR-2014-0827-1187-A1 p.6]

**Organization:** California Air Resources Board (CARB)

The CARB staff supports the approach delineated in 40 CFR 1037.620-622 which defines the responsibility for each entity involved in an engine/vehicle with multiple manufacturers. This clearly defined approach will make it evident which party is responsible for every facet of the engine/vehicle. [EPA-HQ-OAR-2014-0827-1265-A1 p.190]

CARB staff further believes that 40 CFR1037.622 (page 40654 of the NPRM, paragraph (5)) should use “site” instead of “cite” (“[T]he secondary manufacturer must identify the regulatory cite site identifying the applicable exemption instead of a valid family name when ordering engines from the original vehicle manufacturer.”).[EPA-HQ-OAR-2014-0827-1265-A1 p.190]

**Organization:** CALSTART

Delegated Assembly Modification. This is salient to flexibility for the following reasons. For example, while the draft fuel economy rule does call out work site idle as part of potential “off cycle” credits, because this equipment is often added in the final stage of assembly, or even the aftermarket, it is not normally added with the involvement of or at the designation of the chassis OEM. Therefore, we are concerned that without a mechanism that matches this market structure dynamic the rule will not adequately recognize such systems that can reduce or eliminate a significant component of idling, and there will be less regulatory compliance value in supporting the development and addition of these systems. The result will be leaving significant fuel savings and emission reductions off the table. As one industry supplier noted in private comments to us, “By nature, there is usually a lot of reluctance from [an] OEM to adopt and incorporate advanced technologies, especially when it comes from second or third tier suppliers. Credits, with potential multipliers, would give OEMs incentives to adopt these technologies.” [EPA-HQ-OAR-2014-0827-1190-A1 p.6-7]

One approach we think useful to explore could be an expansion or modification of the delegated assembly provision to allow final stage or aftermarket suppliers to generate credits beyond those “delegated” by an OEM, and to be able to offer those credits back to an OEM. Ideally, the long term goal is to drive greater integration of such functions, but realistically, the innovation and installation of such systems currently takes place outside the OEM and often without the direct control or knowledge of the OEM, and the rules as drafted do not recognize this. An approach such as this could be a highly valuable design that would capture these savings and make them available to the OEM for compliance flexibility. However, as noted, such as expansion is not useful if stringency levels remain at proposed levels, as the OEM would have no need to use them. [EPA-HQ-OAR-2014-0827-1190-A1 p.7]

The introduction of the “delegated assembly” provision for vehicle manufacturers increases the flexibility for both primary and secondary manufacturers but needs further refinement, as noted earlier in our comments. While the delegated assembly provisions better reflect the work truck market, they still require that the certifying manufacturers be aware of the final state of the vehicle. This does not reflect current business practices, where chassis are up fitted before final delivery to the customer but well after point of sale from a chassis manufacturer’s perspective. [EPA-HQ-OAR-2014-0827-1190-A1 p.8-9]

In the proposal, this provision was identified as a strategy for secondary manufacturers responsible for modest alterations to the vehicle (e.g., attaching aerodynamic devices); however, it is applicable to secondary manufacturers more broadly, including manufacturers whose systems alter the powertrain on the vehicle, and we request that the agencies explicitly identify this as a pathway for advanced technologies. These mechanisms could also be used for technologies that reduce fuel use in idling. [EPA-HQ-OAR-2014-0827-1190-A1 p.9]

We also request that the agencies expand the use of the “delegated assembly” provision to Class 2b/3 complete vehicles. These changes will help increase flexibility for manufacturers and provide additional certainty around how fuel reduction solutions from secondary manufacturers can be captured by the regulatory process. [EPA-HQ-OAR-2014-0827-1190-A1 p.9]

**Organization:** Daimler Trucks North America LLC

## 10. Delegated Assembly and Body Builder Instructions

• **Delegated assembly, general comment:** We believe that the EPA should not expand its current delegated assembly procedures either in Phase 1 or in Phase 2. The current procedures require that a manufacturer ensure a vehicle is in its certified configuration by the time it reaches the ultimate purchaser. But the current regulations allow manufacturers significant leeway in doing so. For example, the current § 1037.620 allows manufacturers to ship vehicles to secondary manufacturers as long as the vehicles “will be in their certified tractor [or vocational] configuration before they reach ultimate purchasers.” This allows manufacturers to, for example, send vehicles with natural gas engines to natural gas tank installers without any unnecessary paperwork burden. The EPA does provide that “delegated assembly provisions may apply” (emphasis added), but the agency does not provide that they do. Moreover, the existing delegated assembly provisions in Part 1068 do not apply in such circumstances. We recommend that the EPA continue this approach as 1) there is no evidence that manufacturers are somehow sending to ultimate purchasers uncertified vehicles and 2) the paperwork burden presented by delegated assembly is impossibly large. Regarding the paperwork burden, unlike with delegated assembly of engines for which there are a small number of vehicle manufacturers all of which are known to the engine manufacturers, there are a large number of secondary vehicle manufacturers and primary vehicle manufacturers might not even know them or what they do—thus making it extremely difficult to require the primary manufacturers contract with them. For example, there are secondary manufacturers that add aerodynamic components, modify sleepers, add auxiliary AC components, etc. But a primary manufacturer often has no awareness that this will happen. These secondary manufacturers are required to comply with the Part 1037 regulations and ensure that the resulting vehicle complies with the regulations prior to releasing the vehicle to the ultimate purchaser; that should be enough. Requiring the primary manufacturer to police all the people who might modify the vehicles is unnecessary. So as a general comment, we recommend that the EPA stick with the minimal delegated assembly rules. [EPA-HQ-OAR-2014-0827-1164-A1 p.103]

The agencies specifically ask for comments on how the procedures should be applied more broadly or more narrowly for specific technologies. 80 FR 40328. The above statements apply to all types of technologies: as happens with incomplete vehicles under NHTSA regulations, the EPA should understand that vehicle manufacturing is a multi-stage process (regardless of the technologies on the vehicles) and that each stage of manufacturer has the incentive to properly complete manufacturing—without burdensome contracts and audits. Rather, the EPA should continue the longstanding industry practice of allowing primary manufacturers to pass incomplete vehicles with incomplete vehicle documents to secondary manufacturers who complete the installation according to 1) their normal practices (with which the primary manufacturer is often not familiar) and 2) the IVDs. No more is

necessary, nor is more necessary for certain types of technologies. [EPA-HQ-OAR-2014-0827-1164-A1 p.103]

- **Complete vehicles:** We wish to clarify the agencies' general approach, as discussed in meetings on August 25 and 26. The agencies stated that their intent with the proposed delegated assembly regulations is unclear. The agencies stated that they intend for tractors and chassis cabs to be considered complete vehicles under these regulations, so that the vehicles can be labeled as compliant and so that manufacturers need not follow any delegated assembly procedures with such vehicles. For example, the agencies stated that they do not intend to require primary vehicle manufacturers to provide components' installation instructions to body builders unless the components are emission related components described in a certificate of conformity. We agree with this approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.103-104]

- **Secondary manufacturers and delegated assembly:** it seems that the EPA has the right approach with 1037.620 and .801, where the EPA says that manufacturers only become secondary manufacturers if they put a vehicle into its final certified configuration or modify it from a certified configuration. Those are the only instances when the EPA should regulate the secondary manufacturer or the interaction between the primary and secondary manufacturers. Moreover, only when the primary manufacturer arranges for the secondary manufacturer to complete the process of getting a vehicle into its certified configuration should there be any reason to involve the primary manufacturer in delegated assembly requirements. Rather, if a primary manufacturer introduces into commerce a chassis-cab that meets the GHG regulations, that should be the end of the primary manufacturer's responsibilities; it should be between the EPA and the secondary manufacturer to ensure that the secondary manufacturer does not remove or render inoperative elements of emission control. On more minor notes: First, the EPA has a typo in 1037.621, in that the regulation references 'paragraph (f) of this section' yet the section only has paragraphs (a) and (b). Second, the EPA's addition of the provision in 1068.261(c)(7)(ii), that manufacturers add 'Del Assy' to the cert labels of incomplete vehicles, is unnecessary in many cases. Moreover it is burdensome. Labeling of vehicles is a lot more complex than labeling of engines, involving more calculations and varieties of information. In turn, it is more difficult to add text, especially if it is unnecessary. For many vehicles, like those sold without natural gas fuel systems (which the secondary manufacturers install), the vehicles cannot be driven until the secondary manufacturer completes its processes. So there is no concern about the vehicle being driven on road in a noncompliant state (except perhaps for driving as a part of manufacturing or testing). The EPA should not require additional burdensome labeling for such vehicles. 1037.650 / .621 / .801 [EPA-HQ-OAR-2014-0827-1164-A1 p.104]

- **Changes to secondary manufacturing and delegated assembly should be delayed until Phase 2, not implemented in the middle of Phase 1:** the EPA proposes to make changes to multi-stage manufacturing processes by adding the requirements of 1068.261, through 1037.621. This is a major change to the process necessary to manufacture vehicles and should not be implemented in a short time frame; manufacturers need a long time to work with their various secondary manufacturers and implement the procedures that the EPA demands (such as annual affidavits of part numbers, contractual obligations, and record keeping). While these are not huge burdens, they are new and they may involve many secondary manufacturers, including small businesses, such that implementation will take significant time and effort. Better yet, the EPA should simply regulate at the vehicles' sale to an ultimate manufacturer, not partway through the manufacturing process. Also the provisions of 1037.622(b)(5), the new (5), are unclear. Why would there be 'no valid family name' for a vehicle? When does this provision apply? 1037.621 [EPA-HQ-OAR-2014-0827-1164-A1 p.104]

**Cert labels for delegated assembly vehicles:** We agree that the EPA takes the right approach by omitting HDVs from provision § 1068.261(c)(7)(ii), which requires that manufacturers add 'Del Assy' to the cert labels of incomplete vehicles. This is burdensome and, in the case of HDVs, is unnecessary. Labeling of vehicles is a lot more complex than labeling of engines, involving more calculations and varieties of information. This complexity more difficult to add text, especially if it is unnecessary. For many vehicles, like those sold without natural gas fuel systems (which the secondary manufacturers install), the vehicles cannot be driven until the secondary manufacturer completes its processes. So there is no concern about the vehicle being driven on road in a noncompliant state (except perhaps for driving as a part of manufacturing or testing, which the agency explicitly allows). The EPA should not require additional burdensome labeling for such vehicles when there will be no benefit. [EPA-HQ-OAR-2014-0827-1164-A1 p.105]

**Delegated Assembly – Concerns with the text as written:** As the text that follows will show, we need some clarification that we have correctly understood the EPA's intent. Assembly instructions for secondary vehicle manufacturers: it seems that the EPA wants truck manufacturers to include assembly instructions with each truck sold without the body (like the box van), which is nearly all trucks. In 1037.130, the EPA proposes to require that the truck manufacturers tell those body installers how to install bodies in a manner compliant with the GHG standards. But it is not clear how things like a box van are subject to the GHG regulations or how a truck manufacturer would have any expertise in installing box vans or the variety of bodies that might get put onto a truck. We request that the EPA clarify what the agency expects truck manufacturers to tell these body installers, and we suggest that the EPA limit any such instructions to areas of truck manufacturers' expertise. In other words, manufacturers should not have to tell body installers how to mount equipment or van boxes--especially when such matters do not relate to the GHG regulations. Given all of this confusion, we wish for the EPA to clarify what the agency proposes. On a more minor note: the EPA has a typo in 1037.621, in that the regulation references 'paragraph (f) of this section' yet the section only has paragraphs (a) and (b). [EPA-HQ-OAR-2014-0827-1164-A1 p.105]

**1037.622 is improperly named:** it refers to shipping incomplete vehicles, when it should refer to partially complete vehicles, as the text is primarily focused on partially complete vehicles. The misnomer makes it unclear what we believe the EPA means: that the agency intends 1) to allow a primary vehicle manufacturer to certify an incomplete vehicle, such that the secondary manufacturer would have no need to certify the vehicle, but 2) to regulate the sale of partially complete vehicles (those not yet in their certified configuration at the time of sale to a secondary manufacturer). As written, the proposed text refers to secondary manufacturers getting certification in the case of partially complete vehicles in a section whose title refers to another type of vehicle. The EPA should clarify. [EPA-HQ-OAR-2014-0827-1164-A1 p.105]

**Organization:** Edison Electric Institute

#### **D. Delegated assembly procedures may not provide sufficient incentive for PEVs, including e-PTO systems, as well as PHEVs and BEVs**

In section V.E.2.c of the Preamble of the proposed Phase 2 Program, EPA and NHTSA also seek comment "on how the procedures should be applied more broadly or more narrowly for specific technologies."<sup>43</sup> In response, EEI offers the following comments. [EPA-HQ-OAR-2014-0827-1327-A2 p.17]

Delegated assembly procedures may not provide sufficient incentive for PEVs, including e-PTO systems, as well as PHEVs and BEVs. The proposed rule indicates that the delegated assembly

provisions “are focused on add-on features to reduce aerodynamic drag, and on air conditioning systems.” As proposed, the rule falls short in limiting the scope of the delegated assembly provisions to these technologies alone. [EPA-HQ-OAR-2014-0827-1327-A2 p.17]

End use customers, including EEI members, who wish to procure PEV technologies often turn to “upfitters” or secondary vehicle manufacturers when the product is not offered from the typical chassis manufacturers. In many cases, the chassis manufacturers or “upstream” manufacturers may not be aware of the technology being applied to their vehicles by secondary vehicle manufacturers before entering into service. Under the current structure of the proposed rule, the compliance depends entirely on the chassis manufacturers to certify the greenhouse gas performance of their vehicles. Such a focused application potentially risks ignoring major greenhouse gas reduction initiatives occurring in the regulated sector. [EPA-HQ-OAR-2014-0827-1327-A2 p.17-18]

“Upfitters,” or secondary vehicle manufacturers, should also be incentivized to deploy greenhouse gas reduction technologies as part of any final rule. One solution may be to allow secondary vehicle manufacturers to “opt-in” to the regulation. Such an option would require the secondary vehicle manufacturers to create an agreement with the otherwise regulated entity (i.e. the chassis manufacturer) to ensure the appropriate credit is apportioned between the two entities in a manner reflective of the total overall reductions. Another solution may be to create a “users’ council” that could propose to the agencies the full suite of downstream technologies being applied to upstream chassis. This users’ council could also serve to facilitate the establishment of agreements between chassis manufacturers and downstream manufacturers. [EPA-HQ-OAR-2014-0827-1327-A2 p.18]

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43 See 80 Fed. Reg. at 40,328.

**Organization:** Electric Drive Transportation Association (EDTA)

### **Delegated Assembly**

The proposed rule’s delegated assembly procedures should provide increased clarity and certainty regarding electric and plugin hybrid systems, including electric PTO systems, as all of these systems are currently developed and deployed by third-party providers to Original Equipment Manufacturers (OEMs). The emphasis of the rule should be expanded beyond aero-dynamic and air conditioning to include the spectrum of electric drive systems. [EPA-HQ-OAR-2014-0827-1217-A1 p.3]

Delegated assembly procedures should also recognize the role of up-fitters and after-market manufacturers in compliance strategies. Several options for so doing are being offered by the industry, including allowing tradeable credits between manufacturers in the chain and allowing secondary manufacturers to “opt- in” to the regulation. We support providing the pathways to incentivize the increased recognition of this segment of the manufacturing chain and would like to work with the agencies’ to identify effective and feasible mechanisms to do so. [EPA-HQ-OAR-2014-0827-1217-A1 p.3]

**Organization:** Green Truck Association (GTA)

### **Delegated Assembly**



Many of the member companies in the GTA produce products that are specifically designed to reduce fuel usage by vocational trucks. This reduction in fuel use and GHG emissions may be accomplished by advanced technologies (such as hybrid drive systems), alternative fuel conversions, reduced aerodynamic drag or use of lightweight materials. [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

In the past, many of the above mentioned products or technologies were not necessarily recognized by the regulations as they were installed after the engine and chassis had been certified. Applying the delegated assembly concept, perhaps with minor adjustments, could bring regulatory recognition of a sort to these significant fuel saving and emission reducing actions. This recognition could increase the adoption of these technologies and equipment, furthering the goals of these proposed rules. [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

In EPA's existing regulations (40 CFR 1068.261), engine manufacturers may sell or ship engines that are missing certain emission-related components if those components will be installed by the vehicle manufacturer. According to this proposal EPA would provide a similar allowance for vehicle manufacturers to sell or ship vehicles that are missing certain emission-related components if those components will be installed by a secondary vehicle manufacturer. [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

#### The GTA supports the EPA concept of delegated assembly.

While we enthusiastically support the concept of delegated assembly, we also appreciate the Agencies' willingness to consider minor modifications to the process. [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

The proposal notes, "We also request comment on any further modifications that should be made to the delegated assembly provisions to reflect the nature of manufacturing relationships or technologies that are specific to greenhouse gas standards for heavy-duty highway vehicles." [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

We would like to suggest that the requirement for written instructions for completion/alteration of the vehicle and/or its emissions-related components be made more flexible such that those instructions come from the most appropriate entity. It certainly would be appropriate for the chassis manufacturer to contractually require proper installation. However, for instance, if a chassis manufacturer has contracted with a hybrid drive manufacturer for installation of a hybrid drive system on the chassis manufacturer's otherwise completed chassis, the instructions for installation may best be provided by the hybrid drive manufacturer rather than the chassis manufacturer. [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

As such, the arrangement should allow the OEM to require proper installation of the equipment by the secondary manufacturer. The actual installation instructions should be written by the entity most qualified to do so. That may be the final stage manufacturer whose responsibility it is to mount pieces of equipment or the manufacturer of the equipment (for instance a fuel conversion kit manufacturer). [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

#### Delegated Assembly Questions

The proposed rules state that in order to utilize the proposed delegated assembly provisions, the certifying manufacturer would have "... a contractual obligation with the secondary manufacturer to complete the assembly properly and provide instructions about how to do so. Keep records to demonstrate compliance. Apply a temporary label to the incomplete vehicles. Take other reasonable

steps to ensure the assembly is completed properly. Describe in its application for certification how it will use this allowance.” [EPA-HQ-OAR-2014-0827-1188-A1 p.2]

The GTA would be interested in clarifying the scope of the delegated assembly provisions being proposed. Assuming that the procedural steps above have been taken, could the Agency provide clarification with regard to the following situations and whether or not the delegated assembly provisions could be applicable: [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

#### Scenario 1. Aerodynamic Devices

The coefficient of drag is one factor that determines the necessary horsepower, and subsequently fuel, to propel a vehicle forward. [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

A chassis manufacturer contracts with a final stage manufacturer who will be installing bodies and adding ladder racks to a significant number of identically prepared chassis to also install an aerodynamic shroud over the ladder rack. The vehicle would fall in the vocational category to be operated in the “regional” mode. The chassis manufacturer can quantify the aerodynamic improvement of the shroud. With the proper contractual arrangement, could the chassis manufacturer include the resultant reduction in emissions to their certification? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

Similarly, on a regional mode vocational truck could the installation of aerodynamic mud flaps with a specified aerodynamic profile improvement over conventional mud flaps be the subject of such a contractual arrangement between chassis manufacturer and later stage manufacturer? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

Could the chassis manufacturer and the later stage manufacturer negotiate between themselves the value attached to the later stage manufacturer’s efforts? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

#### Scenario 2. Hybrid

A chassis manufacturer delivers a completed chassis (with drivetrain) to an intermediate stage manufacturer who installs a plug-in hybrid system on the chassis and then ships the chassis to a final stage manufacturer. The chassis will be operated in the urban mode and will likely be doing a lot of start/stop and operating a power take off unit to drive equipment at a jobsite. [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

First, can the chassis manufacturer enter into a contract with the installer of the hybrid drive system for “delegated assembly” purposes? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

What information would the chassis manufacturer need in order to take advantage of the emissions improvements provided by the hybrid system over the standard (non-hybrid) chassis configuration for the certification process? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

#### Scenario 3. Alternative Fuel Conversion

Similar to Scenario 2, a chassis manufacturer sends a completed diesel powered chassis to an intermediate stage manufacturer who installs an alternative fuel conversion (liquid propane autogas, CNG). First, can the chassis manufacturer enter into a contract with the converter for “delegated assembly” purposes? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

What information would the chassis manufacturer need in order to take advantage of any emissions improvements provided by the conversion of the chassis from diesel to the alternative fuel? [EPA-HQ-OAR-2014-0827-1188-A1 p.3]

#### Scenario 4. Lightweighting

A completed chassis is delivered to a final stage manufacturer for installation of the body in order to complete the vehicle. A lightweight body (fiberglass/composite material) is specified instead of a standard body resulting in a specified reduction in vehicle weight. [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

First, can the chassis manufacturer enter into a contract with the final stage manufacturer for “delegated assembly” purposes? [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

What information would the chassis manufacturer need in order to take advantage of any emissions improvements provided by the lightweighting of the completed vehicle? [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

Could the contract be between the chassis manufacturer and the body manufacturer (whose multiple distributors could install the body in locations nationwide)? [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

#### Other

If a delegated assembly provision were to be promulgated through this rulemaking, could it be used during the Phase 1 time period? [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

#### Conclusion

The GTA supports the overall structure of the proposal as it relates to delegated assembly. This concept would allow the efforts of body and equipment, intermediate and final stage manufacturers to be recognized with regard to the fuel and emission reducing technologies they add to otherwise certified truck chassis. [EPA-HQ-OAR-2014-0827-1188-A1 p.4]

**Organization:** National Automobile Dealers Association (NADA)

Under Phase 2, vocational vehicles will continue to include what the other two motorized vehicle groupings do not. The range of Class 2b through Class 8 trucks, tractors, and buses is very wide, as is the scope of work functions and duty-cycles they engage in. Vocational vehicles often involve multi-stage manufacturing where one manufacturer builds the chassis or cab chassis and (at least) one other adds a body or other equipment to it. Often, vocational truck and tractor customers do not spec and purchase complete vehicles directly from a single manufacturer, but rather from a tractor and truck chassis dealership and a body and equipment manufacturer. The contractual arrangements involved are many. Vocational vehicle purchasers typically specify engines and other major components from a variety of suppliers with no single manufacturer having complete dominion over the finished product. Moreover, dealerships often alter or up-fit vocational vehicles prior to delivery. [EPA-HQ-OAR-2014-0827-1309-A1 p.9]

Vocational vehicle production can be both commercial (read “for stock”), or “custom” in nature. Regarding the latter, it is not at all unusual for “production” runs to involve just one vehicle. So, unlike

for most on-highway combination tractors, there are literally thousands of unique and distinct potential vehicle combinations being produced by thousands of different manufacturers and alterers, which are sold by thousands of dealerships. [EPA-HQ-OAR-2014-0827-1309-A1 p.9]

NADA/ATD does not object to making OEMs primarily responsible for any and all components, including tires, which they install in their vehicles. Dealerships selling and purchasers buying commercial vehicles should not be burdened by having to look to several different potential OEMs when an issue arises. Instead, if and when an issue arises, the truck or tractor manufacturer should be required to work things out with the suppliers whose parts or components they install. On the other hand, OEMs should not be primarily responsible for the performance of parts and components installed by a downstream manufacturer or installer where they have no control over the manufacture or installation of such those parts or components. [EPA-HQ-OAR-2014-0827-1309-A1 p.11-12]

**Organization:** Navistar, Inc.

In general, Navistar agrees with EMA's position on delegated assembly and secondary manufacturers but would like to emphasize certain points. The delegated assembly and secondary manufacturer are another area where it is useful to keep in mind the vast difference between the heavy duty commercial and light duty industries. Heavy duty vehicles, particularly vocationals, are routinely customized to an extent not seen in the light duty world. Very often this customization takes place after control of the vehicle has passed to a dealer or customer. [EPA-HQ-OAR-2014-0827-1199-A1 p.12]

The number of delegated assembly agreements required by the NPRM would be nearly unmanageable and far beyond any benefit. In the past, delegated assembly agreements typically were between an engine manufacturer and a vehicle OEM. Now, in addition to those, a vehicle manufacturer may be required to maintain agreements with air conditioner installers, idle reduction technology installers, hybrid PTO installers and aerodynamic device installers. [EPA-HQ-OAR-2014-0827-1199-A1 p.12]

The RIA states that this requirement is justified because this has worked well with engine manufacturers. We would note, however, that the number of engine manufacturers and installing vehicle manufacturers is relatively small, and that most of these entities themselves tend to be larger, more accustomed to regulatory requirements and have adequate personnel to manage complicated regulatory requirements. By contrast, installers are far more numerous, often regional and generally smaller companies.<sup>18</sup> These companies may not have the resources or infrastructure to enter into and manage numerous delegated assembly agreements. As a result, they may not be willing to enter into the agreements or may not have the resources to maintain compliance if they do enter into the agreements. This may lead to a reduced usage of the technologies or to their invisibility to the manufacturer or EPA. [EPA-HQ-OAR-2014-0827-1199-A1 p.13]

As to the latter point, we would like to highlight the possibility that this requirement could lead to the rule not capturing the benefit of many effective technologies. If the requirement of a delegated assembly agreement comes to be seen as a burden, we predict many secondary manufacturers will simply install these elements without an agreement. This means that, although the technology may be present, it would not be captured in the emission level for that vehicle. This will be an issue for both the manufacturer and the agencies. For the manufacturer, it means that a particular vehicle may be rated as having higher emission levels than is actually the case. For the agencies, they may not see all of the emission reductions that exist in the field. There should be some streamlined method of capturing the downstream installation of beneficial technologies. [EPA-HQ-OAR-2014-0827-1199-A1 p.13]

In addition, this proposal misunderstands the nature of the existing arrangements for the completion of primarily vocational, vehicles. Often items such as those described are ordered and installed either by dealers or directly by customers. Unlike with engines, vehicle manufacturers sometimes play little or no role in the installation of many of these technologies and are in no position to control their installation. There is almost always an existing contract between an engine manufacturer and a vehicle manufacturer. That contractual agreement typically does not extend between a vehicle manufacturer and an installer of, for example, a hybrid PTO. In that case, the contract is generally either between the installer and a dealer or a customer and the installer. [EPA-HQ-OAR-2014-0827-1199-A1 p.13]

Requiring a delegated assembly agreement is no way to encourage greater awareness of these technologies. The agencies should consider less intrusive and burdensome, methods of confirming the presence of these technologies. We also agree with EMA's proposed resolutions to this issue. [EPA-HQ-OAR-2014-0827-1199-A1 p.13]

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<sup>18</sup> The NTEA, representing work truck body and trailer manufacturers, has over 1,700 member companies. <https://www.ntea.com/content.aspx?id=24280>

**Organization:** Odyne Systems LLC

#### *Delegated Assembly and Regulatory Compliance*

Additionally, Odyne believes there could be a potential “chicken and egg” problem with how credits are held, if OEMs are the likely credit holder and the third party's system – potentially Odyne – needing to be certified in advance. Separately, should EPA consider expanding the delegated assembly process to include hybrid up-fitting, this could offer a potential solution to reduce regulatory burden and drive easier adoption of hybrid technology. [EPA-HQ-OAR-2014-0827-1239-A1 p.25-26]

Odyne has been working with CARB as they developed their proposed Innovative Technology Regulation (ITR) process. Since we are not an OEM and are installed on already certified vehicles we have focused on the Aftermarket process versus the New Certification process. We believe this process has appropriately accounted for nuances in the truck manufacturing process that can cloud the point at which a truck reaches certification as a new vehicle versus an aftermarket vehicle. [EPA-HQ-OAR-2014-0827-1239-A1 p.29-30]

Our understanding of current regulatory compliance and accounting proposed in Phase Two for fuel efficiency and emission benefits added through technology like Odyne's is as follows. OEMs would be required to work with third-party manufacturers, or at times called ‘up-fitters’, like Odyne to obtain credit for efficiencies made after a truck chassis is delivered, and typically already in a “certified” state. While it is theoretically possible for OEMs to delay certification, the combination of lower stringency requirements proposed in Scenario Three and extremely complex and diverse post-OEM applications for vocational trucks in particular make it difficult – and we believe too high a bar – for OEMs to seek credit for up-fitter improvements after the OEMs work is complete. In this case, should an OEM decide not to obtain credit for improvements made by up-fitters/intermediate stage manufacturers like Odyne, Odyne would not be able to become a credit holder, as the vehicle would technically be considered an aftermarket vehicle by the EPA. Even should up-fitters like Odyne be able to become a certification holder, we believe this would cause undue and unnecessary burden on small manufacturers. This would not be a preferred approach. [EPA-HQ-OAR-2014-0827-1239-A1 p.30]

We believe this lack of clarity could be a major roadblock for achieving the highest market penetrations of advanced emission and fuel saving technologies like Odyne's and others in the hybrid space. [EPA-HQ-OAR-2014-0827-1239-A1 p.30]

One potential remedy for this issue could be including a similar process to the Delegated Assembly provisions that the EPA is considering for Phase Two for hybrid systems. We understand that a number of stakeholders may be suggesting a similar approach, but remain open to EPA thinking to address this issue. [EPA-HQ-OAR-2014-0827-1239-A1 p.31]

**We highly recommend EPA convene stakeholders, including Odyne, to address what could be a major regulatory barrier for Phase Two rules in the development of final rules.** [EPA-HQ-OAR-2014-0827-1239-A1 p.31]

The CARB ITR was developed to achieve a similar purpose, with the assumption that given the highly regulated nature of the heavy duty industry, new technologies need incentive – even in small volumes – to be tested and proven, and advanced credits can serve as the catalysts to drive the development of these technologies, while also enabling the potential for earlier widespread adoption of technologies that could move the industry even beyond the emission requirements set out in this rulemaking. As noted above, any methods to streamline EPA and NHTSA rulemaking with CARB regulatory efforts would be extremely helpful to the industry. [EPA-HQ-OAR-2014-0827-1239-A1 p.31]

Odyne also believes that other aspects of certification such as warranty could be handled separately. Since the OEM is typically responsible for the main emissions related systems (engine, exhaust, etc.) and they are certifying that base configuration, they should carry the warranty for those systems. The OEM would hold the warranty, with a sub-warranty being held by Odyne for its own systems, as it is also important to point out that hybrid systems have a different life cycle than traditional powertrains. For example the battery system can vary depending on the application (load, duty cycle). Odyne currently offers a 1 year / 12,000 mile warranty and the option to purchase extended warranty up to 3 years / 36,000 miles. In our applications it is more important to focus on time/duration than mileage since the stationary/jobsite operation out weights the driving operation. [EPA-HQ-OAR-2014-0827-1239-A1 p.31-32]

Odyne understands that this is a complex issue and we applaud the EPA in its understanding that regulatory burden on small and innovative manufacturers can be detrimental to the deployment of advanced technologies, like hybrid systems. [EPA-HQ-OAR-2014-0827-1239-A1 p.32]

**Organization:** Odyne Systems LLC

As described previously, it will also be important to properly account for the benefits of various technologies in GEM model and testing. Odyne specifically supports and encourages the inclusion of PHEV systems interfaced with automatic transmissions, idle reduction systems and ePTO systems in GEM model and testing. In addition, once the technology is properly accounted for and given the credits it has earned it will be very important to provide a method like Delegated Assembly to “sell” those credits to OEM's to lower the burden on Small Companies and to recognize intermediate and final stage manufacturers that can integrate efficiency technology during the new vehicle build process to significantly reduce GHG emissions from medium and heavy duty vocational vehicles. [EPA-HQ-OAR-2014-0827-1920-A2 p.12-13]

**Organization:** PACCAR, Inc.

## **Secondary Manufacturers and Delegated Assembly Provisions**

The Agencies' proposal would impose complicated, burdensome delegated assembly requirements for secondary manufacturers. The proposed requirements are disproportional to the number of vehicles that undergo secondary manufacture and the types of alterations that are made, which have minimal effects on fuel consumption and GHG emissions. PACCAR also believes that the Agencies have significantly underestimated the number of secondary manufacturers currently operating in the heavy-duty and vocational vehicle areas, most that would be classified as small business. [EPA-HQ-OAR-2014-0827-1204-A1 p.27]

PACCAR requests that the small business exemption be carried over from Phase 1 and finalize it as a permanent flexibility, to again alleviate the potentially onerous certification and compliance requirements for these companies. This exemption would also eliminate the need for the burdensome delegated assembly requirements for OEMs and any company that cannot certify the modified vehicles with the Agencies. [EPA-HQ-OAR-2014-0827-1204-A1 p.27]

PACCAR also recommends that the Agencies clarify that any delegated assembly provisions, if finalized, do not apply to manufacturers of glider kits, nor to the dealers or others to whom the glider kits are sold. Applying delegated assembly requirements to glider assemblers could require OEMs to administer more than 200 individual contracts per year and would shift a significant portion of the compliance burden onto the OEM where the OEM has little true ability to oversee or control the process [EPA-HQ-OAR-2014-0827-1204-A1 p.27]

PACCAR requests that the Agencies consider modifying the statement regarding frontal area in §1037.622(a)(2). The intent of the provision is beneficial but sleepers added in the aftermarket and cab modifications such as those to create a crew cab generally increase the frontal area of the vehicle in either height and/or width as compared to the frontal area of the vehicle as it leaves the vehicle factory. PACCAR will work with the Agencies to modify the proposed regulatory text to accomplish the intent of this subsection. [EPA-HQ-OAR-2014-0827-1204-A1 p.27-28]

## **LNG Tank Issues**

PACCAR recognizes the importance of being able to offer our customers a natural gas powered option. In order to encourage further growth in this segment, the proposed regulation needs to be modified with regard to tank installations. PACCAR does not believe it should be responsible for LNG 5-day boil-off limits. PACCAR does not install these tanks. This is performed by secondary manufacturers who add these tanks to customer specifications. PACCAR supports the EMA comments that the proposed LNG tank requirements should apply to the tank itself and not the vehicle. [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

PACCAR should not be responsible via delegated assembly for the installation of LNG tanks. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Organization:** Truck & Engine Manufacturers Association (EMA)

## **Delegated Assembly and Secondary Manufacturers**

Under the Phase 1 program, manufacturers of “incomplete vehicles” can enter into delegated assembly agreements with secondary manufacturers (such as cab-builders, sleeper-installers, A/C installers, LNG tank installers, etc.), pursuant to which the vehicle manufacturers provide instructions regarding the installation of GHG-related components to ensure that the vehicle is “completed” in an appropriate

GHG-certified condition. This arrangement is then confirmed through an incomplete vehicle document (“IVD”) that the vehicle manufacturer submits to EPA, which satisfies the vehicle manufacturer’s responsibility for that vehicle. Consequently, in any subsequent Phase 1 audit testing, the secondary manufacturer, not the original manufacturer of the incomplete vehicle, is responsible for any emissions exceedances caused by its improper completion of a vehicle. [EPA-HQ-OAR-2014-0827-1269-A1 p.32-33]

The Agencies should not adopt any new regulations that would undercut the viability of delegated assembly, especially since the Agencies have not assessed the economic impact of a potential shutdown of that segment of the vehicle manufacturing industry. Instead, the Phase 1 provisions relating to delegated assembly should be retained. [EPA-HQ-OAR-2014-0827-1269-A1 p.33]

In that regard, EMA agrees with the provisions of proposed section 1037.801, which provides generally that manufacturers can only be deemed as secondary manufacturers if they modify a vehicle from its original certified configuration. EMA further agrees that those are the only instances when the Agencies should regulate the secondary manufacturer or the interaction between the primary and secondary manufacturers, particularly given the very large number of entities that complete but do not “modify” heavy-duty vehicles. Moreover, only when the primary manufacturer arranges for the secondary manufacturer to complete the process of putting a vehicle into its certified configuration, and only when that modification is from a previously certified configuration, should there be any reason to involve the primary manufacturer in any delegated assembly requirements. Otherwise, if a primary manufacturer introduces into commerce a chassis-cab or tractor that meets the GHG regulations, that should be the end of the primary manufacturer’s responsibilities. After that point, it should be the secondary manufacturer’s duty under the federal Clean Air Act (“CAA”) to ensure that the secondary manufacturer does not remove or render inoperative any elements of emission control, including those relating to GHG emissions. Notwithstanding the foregoing, EMA requests clarification from the Agencies regarding these issues, as the current language of the proposed regulations is not sufficiently clear on these important points. [EPA-HQ-OAR-2014-0827-1269-A1 p.33]

EMA also supports the Agencies’ proposal to exclude heavy-duty vehicles from the provisions of section 1068.261(c)(7)(ii), which require that manufacturers add 'Del Assy' to the certification labels of incomplete vehicles. Including that language would be burdensome and, in the case of heavy-duty vehicles, is unnecessary. The labeling of vehicles is much more complex than the labeling of engines, involving many more calculations and varieties of information. That complexity makes it far more difficult to add text, especially if it is unnecessary. For many heavy-duty vehicles, like those sold without natural gas fuel systems (which the secondary manufacturers install), the vehicles cannot be driven until the secondary manufacturer completes its processes. Accordingly, there is no concern about the vehicle being driven on-road in a noncompliant condition (except perhaps for some very limited driving as a part of manufacturing or testing, which the Agencies explicitly allow). Consequently, EPA should not require additional burdensome labeling for heavy-duty vehicles when there will be no benefit. [EPA-HQ-OAR-2014-0827-1269-A1 p.33]

Turning to other specifics, it appears that proposed section 1037.622 is improperly captioned: it refers to shipping incomplete vehicles, when it should refer to partially complete vehicles, as the text is primarily focused on partially complete vehicles. Moreover, the Agencies never actually define the “partially complete” vehicles that are the subject of that section. The lack of definition of this key term makes EPA’s intent unclear. In particular, it is unclear whether the Agencies intend: (i) to allow a primary vehicle manufacturer to certify an incomplete vehicle and certain partially complete vehicles as described in 1037.622(a)(1-3), such that the secondary manufacturer would have no need to certify the vehicle; or (ii) to regulate the sale of partially complete vehicles that (a) will be certified by the



secondary manufacturer, or (b) will involve the secondary manufacturer having a significant role in the vehicle design. As written, the proposed text refers to secondary manufacturers obtaining certification in the case of partially complete vehicles, an undefined type of vehicle, in a section whose title refers to another type of vehicle. The Agencies need to clarify this regulatory provision. [EPA-HQ-OAR-2014-0827-1269-A1 p.33-34]

Further, any changes to the Agencies' secondary manufacturing and delegated assembly requirements should be delayed until Phase 2, not implemented in the middle of Phase 1. This includes the proposed changes to the multi-stage manufacturing processes that would be implemented through proposed sections 1037.620 through 1037.622. Those proposed requirements amount to a major change to the process for manufacturing vehicles, and should not be implemented in a shortened time frame. Manufacturers need sufficient time to work with their various secondary manufacturers to implement the procedures that EPA seeks to impose (such as annual affidavits of part numbers, contractual obligations, and record-keeping). While those are not unmanageable burdens, they are new and may involve many secondary manufacturers, including small businesses, such that implementation will take significant time and effort. [EPA-HQ-OAR-2014-0827-1269-A1 p.34]

With respect to assembly instructions for secondary vehicle manufacturers, it seems that the Agencies are seeking to compel truck manufacturers to include assembly instructions with each truck sold without a body (like a box van), which is nearly all trucks. In proposed section 1037.130, the Agencies propose to require that the truck manufacturers instruct body-installers how to install bodies in a manner compliant with the GHG/FE standards. But it is not clear how trucks such as box vans are subject to the GHG/FE regulations, nor how a truck manufacturer would have any expertise with respect to the installation of box vans or the variety of other bodies that might get put onto a truck. Accordingly, EMA requests that the Agencies clarify what instructions they expect truck manufacturers to provide to body-installers. In that regard, EMA suggests that the Agencies limit any such instructions to topics within truck manufacturers' expertise. In other words, manufacturers should not have to instruct body-installers how to mount equipment or van boxes – especially when such matters do not relate to the GHG/FE regulations. [EPA-HQ-OAR-2014-0827-1269-A1 p.34]

In today's market, it is not uncommon for an end-user to bring a vehicle to a secondary manufacturer for post-factory modifications that can impact GHG/FE parameters, without the knowledge of the original vehicle manufacturer. Under Phase 1 of the GHG/FE regulations, any modifications made by the secondary manufacturer that could affect the GHG/FE configuration of the vehicle must be covered by a certificate of conformity ("CoC"), whether that be held by the secondary manufacturer or the original OEM. However, there are provisions that would allow for the secondary manufacturer to qualify for a small business exemption, thereby exempting the modified vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.34]

Under the Phase 2 proposal, that small business exemption would be eliminated starting in MY2022, which would add burden, or potentially restrict the ability for secondary manufacturers to maintain their business viability because they are not equipped to handle the certification, labeling, on-going compliance, and reporting for heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.34-35]

Phase 1 was only concerned with those modifications that could affect the vehicle's GHG/FE parameters. For vocational vehicles, where bodies and/or crew cabs are commonly added, this meant that the only variable of concern was a modification in tires. The Phase 2 regulations would expand this to include modification of the air conditioning system and other vehicle systems, regardless of vehicle configuration. This would add significant burden to the certification and management of vehicles in the Vocational regulatory subcategories. The original manufacturer could now become responsible for the

A/C leakage rate resulting from the secondary manufacturer's modification(s) if the secondary manufacturer did not hold a CoC for that make/model/regulatory subcategory. That is not a reasonable result. [EPA-HQ-OAR-2014-0827-1269-A1 p.35]

Additionally, for vehicles in the Tractor subcategory, modifications that affect vehicle aerodynamics are expected to continue as a major GHG/FE impact, especially in calculating roof heights for determining the appropriate regulatory subcategory and aerodynamic Bin as an input to GEM. Consequently, the original manufacturer would also have to know explicit details surrounding any down-stream modification if it affects roof height and/or aerodynamics to mitigate the risk of mislabeling or mischaracterizing the aerodynamic assessment of the vehicle. That is also problematic. [EPA-HQ-OAR-2014-0827-1269-A1 p.35]

Because it is unlikely for a secondary manufacturer to have the data or sophistication to support the many certification and compliance requirements for Phase 2, EMA recommends that the following options be added to the proposed language in the NPRM. One option for Phase 2 would be to allow specified exemptions for small businesses. In the NPRM, proposed section 1037.635(c) allows a limited exemption for small businesses that produce glider kits. EMA recommends that the Agencies provide a similar exemption for secondary manufacturers that are small businesses, subject to an annual production cap of 300 units, as specified under proposed section 1037.635(c), for both Tractor and Vocational vehicles. The exemption would apply to the vehicle-related GHG/FE requirements, other than the instruction and labeling requirements outlined in the Phase 1 regulations; the exemption would not apply to the engine-related GHG/FE requirements, or to the current criteria emission requirements. [EPA-HQ-OAR-2014-0827-1269-A1 p.35]

Another option would be to allow the vehicle to be built and labeled under the original manufacturer's CoC. The original manufacturer ("OEM") would be required to provide the maximum allowable air conditioning leakage requirements, the regulatory references, and an explanation of the potential ramifications if those requirements were not met. The same would be true for all other GHG/FE certification parts and systems. No OEM monitoring, reporting, or compliance audits would be required. For aerodynamics, due to the vast array of modifications that could affect the frontal area of the vehicle, the vehicles would have to be conservatively scored in lower aerodynamic Bins. In some cases, however, the modifications could improve the aerodynamics, so this approach may not be prudent. [EPA-HQ-OAR-2014-0827-1269-A1 p.35]

To remedy that issue, the OEM could either obtain sufficient details from the secondary manufacturer regarding the modifications impacting aerodynamics to be able to use an EPA-approved alternative aerodynamic assessment methodology, or the OEM could use an equivalent cab or sleeper profile from its product line that is certified with the Agency and then use one aerodynamic Bin lower as the GEM input (i.e., the Bin with the next higher CdA GEM input value) for determining the GHG score through GEM for the modified vehicle. No additional assessment of aerodynamics and no compliance testing would be required of the OEM. Determination of the regulatory subcategory and associated labeling would be the responsibility of the OEM. The vehicle request process from Phase 1 would still continue. [EPA-HQ-OAR-2014-0827-1269-A1 p.35-36]

In addition to implementing the other necessary revisions discussed above relating to delegated assembly and secondary manufacturers, the Agencies should implement the foregoing options to address the aerodynamic performance of vehicles completed by secondary manufacturers. [EPA-HQ-OAR-2014-0827-1269-A1 p.36]

LNG Tank Requirements

Currently, and out to the foreseeable future, LNG fuel tanks are installed outside the OEM's vehicle-manufacturing process and control. Dealers and/or customers work directly with the LNG tank manufacturer's certified installers to complete the fuel system. Under the Phase 2 proposal, the fuel system would have to meet the requirements in Section 4.2 of SAE J2343, which specify that vehicles should meet a five-day hold time after a refueling event before the fuel reaches the point of venting to relieve pressure. However, since the tanks are designed, selected, and installed outside of the OEM's manufacturing process, EMA believes that additional provisions under delegated assembly should be included that limit the OEM's role simply to informing the tank supplier of the relevant requirements, while the tank supplier is held responsible for the design and installation of the LNG tank. An alternative is to require OEM communication of the tank leakage requirement to the dealer and tank suppliers/installers. Using precedence in other regulatory areas, such as the regulations relating to fuel hoses for small SI engines, the tank manufacturer could be required to certify their tanks with EPA to a modified leakage requirement, thereby fulfilling the intent of the current language. [EPA-HQ-OAR-2014-0827-1269-A1 p.44]

**Organization:** Union of Concerned Scientists (UCS)

#### DELEGATED ASSEMBLY

The delegated assembly provision for vehicles is a significant improvement because it better reflects the way in which the work truck market functions. The agencies should also expand the use of this provision to Class 2b/3 complete vehicles—cargo vans in particular may benefit from the application of technologies from secondary manufacturers, particularly for strong hybridization, which is already being applied to aftermarket vehicles. But despite the promise of the delegated assembly provision to drive innovation, it needs further refinement. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

The delegated assembly provisions still require that the certifying manufacturers be aware of the final state of the vehicle. This does not reflect current business practices, where chassis are upfit before final delivery to the customer but well after point of sale from a chassis manufacturer's perspective. The agencies should work with secondary manufacturers to determine a way for the secondary or final stage manufacturer to "close the loop" on a vehicle's certification, provided that the vehicle is still in its certified configuration and has not been delivered to the end user. While this may add complexity to the certification process for these vehicles, this will help capture all of the technologies most applicable to the sector. This is a preferable alternative to the inclusion of aftermarket technology credits, which could undermine the efficacy of the regulations. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

**Organization:** Volvo Group

Volvo Group supports the EMA comments concerning delegated assembly provisions in their entirety except as noted in the discussion regarding Glider Kits and Small Volume Manufacturers put forth later in this document. [EPA-HQ-OAR-2014-0827-1290-A1 p.49]

Volvo Group supports the EMA comments on vehicle and engine warranty provisions of the proposed Phase 2 Rule, but requests the Agencies add manufacturers of newly regulated components to 40 CFR 1037.650 and any additionally referenced or supporting sections. [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

40 CFR 1037.650 provides that tire manufacturers choosing to provide test data and warranties to vehicle manufacturers in support of the certification and warranty requirements of the regulation are

responsible to the Agencies for meeting the requirements of the rule as they pertain to those components. Specifically, the tire manufacturer is responsible to the Agencies for the emission test data they provide and can be contractually obligated to the vehicle manufacturer to provide tire warranty and related defect tracking and reporting under the obligations of the regulation and associated parts. [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

As with tires, vehicle manufacturers typically do not see warranty claims related to many vendor supplied components such as engines, transmissions and axles since many suppliers deem this as sensitive and confidential information, especially when dealing with vertically integrated OEMs who manufacture many of the same components. Many of these components, or systems made up of these components, will now be part of the OEMs' certified vehicle configuration and some failures of these components may still allow for the vehicle's continued operation at increased emissions levels, making them warrantable emissions systems under this part. [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

Given this, Volvo Group requests that the Agencies amend 1037.650 to cover these newly regulated components and their manufacturers. Below is a list of components that Volvo Group believes should be covered under this provision; however, this list is not all inclusive, partly due to unforeseen technologies not considered in the rulemaking and unknown, future, off-cycle technology certification by Volvo Group or the suppliers. [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

Components and manufacturers proposed to be covered under 1037.650 where they are part of the certified vehicle configuration: [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

- Vendor engines
- Vendor hybrid systems
- Vendor certified powertrain systems (e.g. Cummins/Eaton alliance)
- Transmission systems (e.g. neutral at idle, shift calibration software, etc.)
- Axle systems intended to reduce emissions (e.g. part-time 6x2, low friction))
- LNG evaporative emission systems
- Auxiliary Power Units (pending inclusion as a creditable technology) [EPA-HQ-OAR-2014-0827-1290-A1 p.57]

**Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 243-244.]

While the EPA and NHTSA are regulating these primary manufacturers, we don't believe the agencies are prevented from measuring and assigning credits to third party products that produce measurable, robust, documentable savings that could then participate in a compliance credit marketplace. In XL Hybrids' current business model, our savings right now would primarily benefit just the end fleets when they could also be contributing in the phase 2 regulation goals. The benefits to the public would be a more market-driven process resulting in a faster introduction of these advanced savings technologies and the potential for achieving greater reductions and stringency. We recognize structuring such a program would be challenging, but we ask that the rules be modified to specifically allow for such a possibility so that such a program could be developed.

**Response:**

In EPA's existing regulations (40 CFR 1068.261), we allow engine manufacturers to sell or ship engines that are missing certain emission-related components if those components will be installed by the vehicle manufacturer. The Phase 1 regulations likewise state that this provision may apply to heavy duty vehicles as appropriate, and so likewise provide a similar allowance for vehicle manufacturers to sell or ship vehicles that are missing certain emission-related components if those components will be installed by a secondary vehicle manufacturer. 40 CFR 1037.621.

EPA has found this provision to work well for engine manufacturers and is finalizing a new section 40 CFR 1037.621 that formalizes this process. As conditions of this allowance, manufacturers will be required to:

- Have a contractual obligation with the secondary manufacturer to complete the assembly properly and provide instructions about how to do so
- Keep records to demonstrate compliance
- Apply a temporary label to the partially complete vehicles
- Take other reasonable steps to ensure the assembly is completed properly
- Describe in its application for certification how it will use this allowance

Under delegated assembly, it is the upstream manufacturer that holds the certificate and assumes primary responsibility for all compliance requirements. Our experience applying this approach with engines has shown that holding the upstream manufacturer responsible ensures that they will exercise due diligence throughout the process. Commenters generally supported these provisions, but as described below, several requested changes to the proposed program.

See also the initial response in Section 1.4 for a discussion of permissible modifications to certified configurations, such as potential modifications to stock vehicles at dealerships.

*Applicability*

EPA proposed to apply this new section broadly. However, commenters raised valid questions about whether it is necessary to apply this formal process as broadly as proposed. In response, we have reconsidered this proposed approach and have determined that it would be appropriate to allow a less formal process with components for which market forces will make it unlikely that a secondary manufacturer would not complete assembly properly. In those cases, the certifying manufacturers will be required to provide sufficiently detailed installation instructions to the secondary manufacturers, who would then be obligated to complete assembly properly before the vehicles are delivered to the ultimate purchasers.

One example of a case for which market forces could ensure that assembly is completed properly would be air conditioning leakage requirements. Purchasers will have the expectation that the systems will not leak, and a secondary manufacturer should have no incentive to not follow the certifying manufacturer's instructions.

As revised, §1037.621 will require the formal delegated assembly process for the following technologies if they are part of the OEM's certified configuration but are not shipped with the vehicle:

- Auxiliary power units
- Aerodynamic devices
- Hybrid components
- Natural gas fuel tanks

Certificate holders will remain responsible for other certified components, but will not automatically be required to comply with the formal delegated assembly requirements. As is currently specified in §1037.621 and §1068.261, EPA will retain the authority to apply additional necessary conditions (at the time of certification) to the allowance to delegated assembly of certified emission components to secondary manufacturers. In particular, we would likely apply such additional conditions for secondary manufacturers that we determine to have previously not completed assembly properly.

Commenters supporting the formal delegated assembly provisions urged the agencies to further specify by regulation those technologies to be included within the process. The agencies are not limiting by regulation technologies for which the certificate holders may delegate final assembly in addition to the four technologies noted above (when the components are not shipped with the vehicle to the secondary manufacturer). Manufacturers may delegate final assembly for any components for which they can demonstrate during the certification process that the vehicles will be properly assembled before reaching the ultimate purchaser. For example, we generally agree with the Aperia Technologies comment that we should allow installation of automatic tire inflation systems to be delegated to secondary manufacturers.

In response to comments, we are also extending these delegated assembly allowances for complete HD pickups and vans regulated under 40 CFR part 86.

In response to the comments requesting clarity on applicability, we note that delegated assembly would only apply where components identified as part of the certified configuration are to be installed or modified by a secondary manufacturer. Manufacturers are also correct that delegated assembly does not include unauthorized modifications to a vehicle already in its certified configuration.

PACCAR commented that the proposed requirements would impose a disproportional burden relative to the actual impacts. EMA expressed similar concerns. While we believe the changes already discussed will ameliorate some of the manufacturers' concerns, the changes do not go as far as they requested. We are not providing a blanket exclusion for small businesses, dealers, or glider vehicle assemblers that install engines into glider kits. As finalized, the regulations will allow manufacturers to work with the agencies to develop appropriate procedures to ensure that vehicles completed by such entities are in the certified configuration before reaching the ultimate purchasers.

#### *Process Issues*

NTEA commented that the requirement to provide instructions for completion of the vehicle be made more flexible such that those instructions come from someone other than the certificate holder. Such arrangements will generally be allowed under §1037.620, which provides that EPA's focus will generally be on ensuring that a requirement is met rather than on who meets it. However, that process will work slightly differently than NTEA envisioned in their comments. NTEA stated that "intermediate and final stage manufacturers or alterers would be bound contractually, rather than by regulation to install specified products that result in specified regulatory benefits that can be used by the

certifying manufacturer.” While it is true that secondary manufacturers will likely be contractually bound to complete assembly properly, they will also be required to do so by the regulations or be subject to penalties for tampering. See §1037.621(e).

It is also important to note that the regulations do not require a specific format for assembly instructions, provided the information is properly conveyed. The agencies would judge the sufficiency of the instructions by how well they ensure proper assembly. For example, detailed instructions on a website could be sufficient, as long as its location was well known to each secondary manufacturer.

EMA incorrectly stated that when final assembly is delegated, “the secondary manufacturer, not the original manufacturer of the incomplete vehicle, is responsible for any emissions exceedances caused by its improper completion of a vehicle.” Under both the existing and revised regulations, both manufacturers would be liable. Regarding downstream modifications more generally, EMA commented that the regulations would require the OEM “to know explicit details surrounding any down-stream modification if it affects roof height and/or aerodynamics to mitigate the risk of mislabeling or mischaracterizing the aerodynamic assessment of the vehicle.” However, we view the requirements as requiring the OEM to explain in the assembly instructions what modifications are not permissible.

Regarding Odyne’s comment on up-fitting a complete vehicle, the recommended paths under the regulations would be for Odyne to do one of the following:

1. Obtain its own certificate so that it would be allowed to purchase uncertified vehicles from the OEM. As the certificate holder, ODYNE would be eligible for emission credits
2. Work with the OEM to add the Odyne system to the OEM certificate.
3. Modify certified vehicles in a permissible manner that does not increase emissions. However no credits could be generated for the vehicle.

For each path, the certificate holder would be fully responsible for the warranty requirements, but could make contractual arrangements with the other manufacturer.

Daimler’s comment regarding labeling was unclear. They acknowledged that the labeling requirements in 40 CFR 1068.261(c)(7) do not apply for vehicles using delegated assembly under part 1037, and yet objected to them in a previous paragraph.

Section 1037.621(a) has been revised to eliminate the incorrect reference to paragraph (f). Section 1037.622(b)(5) has been revised to require the manufacturer to “identify the regulatory *citation*” for the applicable exemption. The title of 1037.622 has also been revised.

Volvo commented that the agencies should specify the obligations for manufacturers of the following components, similar to the existing requirements for tire manufacturers:

- Vendor engines
- Vendor hybrid systems
- Vendor certified powertrain systems (e.g. Cummins/Eaton alliance)
- Transmission systems (e.g. neutral at idle, shift calibration software, etc.)
- Axle systems intended to reduce emissions (e.g. part-time 6x2, low friction))
- LNG evaporative emission systems
- Auxiliary Power Units (pending inclusion as a creditable technology)

We have modified the regulations to reflect additional components.

#### *Custom Sleepers and Natural Gas Vehicles*

In 40 CFR 1037.622 we are allowing small businesses to modify certified tractors as long as they do not modify the front of the vehicle and so long as the sleeper compartment or natural gas tank does not exceed more than 102 inches wide or 162 inches in height. EPA is also finalizing an optional compliance path in 40 CFR 1037.150(x). This option allows small manufacturers to convert a low or mid roof tractor to a high roof configuration without recertification, provided it is for the purpose of building a custom sleeper tractor or conversion to a natural gas tractor. The allowance to convert low and mid roof tractors to high roof tractors is being adopted as an interim provision, although we have not established an end date at this time. We expect to reevaluate as manufacturers begin to make use of the provision and may decide to revise it in the future, potentially deciding to make it a permanent allowance. To be eligible for this option, the secondary manufacturer must be a small business manufacturer, and the original low or mid roof tractor must be covered by a valid certificate of conformity. The modifications may not increase the frontal area of the tractor beyond the frontal area of the equivalent high roof tractor paired with a standard box van.

Regarding evaporative emission standards for natural gas fuel tanks, we note that the regulations allow different manufacturers to hold the GHG and evaporative certificates (once again illustrating how the statute and regulations contemplate multiple manufacturers of a motor vehicle; see response in 1.3.1 above). In the circumstances identified by PACCAR, they would be allowed under §1037.622 to ship vehicles without the natural gas fuel tanks to secondary manufacturers, as long as the secondary manufacturer had a valid evaporative emission certificate for the vehicle.

The agencies received supplemental comments from American Reliance Industries recommending expansion of the allowances to also allow conversion of low-roof tractors to mid-roof configurations. We have modified the interim allowance in §1037.150 to allow this.

#### *Other Small Secondary Manufacturers*

EMA recommends the agencies provide an exemption for secondary manufacturers that are small businesses, subject to an annual production cap of 300 units. We generally do not permanently exempt small business from our regulations. We included a small business exemption in Phase 1 so that small businesses would have time to adjust to the new GHG requirements. However, Phase 2 does not start for these manufacturers until 2021. This provides more than enough time for them to become familiar with the applicable requirements.

#### *Credits for Non-Certifying Manufacturers*

Some commenters recommended that the agencies allow non-certifying secondary manufacturers to generate emission credits. However, EPA limits emission credits to certificate holders to ensure full compliance. The formal certification path includes many safeguards and procedures to ensure the vehicles are fully compliant. Without these provisions, it would be much more difficult for us to provide proper oversight. We believe the delegated assembly provisions will provide a sufficient pathway to incentivize these advanced technologies.



### *Changes to Phase 1*

Manufacturers argued that applying the proposed changes to Phase 1 vehicles would amount to a retroactive change in stringency. However, this ignores the existing text in §1037.620(a) (a Phase I provision) noting that delegated assembly may apply with regard to vehicles shipped prior to completion of assembly into their final certified configuration. Daimler acknowledged this provision but incorrectly interpreted it, reading “may” to make the provision purely advisory. This is not a correct interpretation. The provision’s plain meaning is that delegated assembly provisions may sometimes apply when partially complete vehicles are introduced into commerce but are placed in their final certified configuration by a secondary manufacturer. Thus, we do not see the proposed changes as adding fundamentally *new* requirements to the Phase 1 provisions. Also, as described below, the changes being made to the delegated assembly process lessen the likelihood that there would be any significant changes for manufacturers who were already complying with the Phase 1 requirements.

While we do not agree with the comments arguing the proposed requirements are fundamentally new, we have made two changes that avoid the problems feared by the manufacturers. First, as already noted, we are reducing the number of components that will require the formal delegated assembly process. This will limit the formal process to a small number of vehicles. Furthermore, two of these components (i.e. hybrids and natural gas fuel tanks) are not part of the primary technology basis for Phase 1 standards and so delegated assembly for these components would not arise with any frequency with respect to Phase 1 vehicles. APUs and aerodynamic technologies are part of the basis for the Phase 1 tractor standard (although not the vocational vehicle standard), and so could potentially trigger this provision in the limited instance when the APU or aerodynamic components are not attached to or otherwise shipped with the vehicle to the secondary manufacturer by the primary manufacturer. This would be an unusual circumstance, especially for aerodynamic components. In addition, for these Phase 1 components, it is unclear how the certifying manufacturer would currently be ensuring that the vehicles they certify are in the proper certified configuration without having some process substantially similar to formal delegated assembly process being finalized.

Notwithstanding, we are delaying implementation of the changes until January 1, 2018 to provide manufacturers over a year of additional lead time. EMA raised concerns about the time needed “to work with their various secondary manufacturers to implement the procedures that EPA seeks to impose (such as annual affidavits of part numbers, contractual obligations, and record-keeping).” We believe in nearly all cases, the formal delegated assembly provisions will not apply and the additional lead time will be more than enough to put appropriate processes in place. To the extent that any manufacturer is currently relying on a secondary manufacturer to complete final assembly of any of the covered components, they should already have a substantial process in place under the Phase 1 regulations. So compliance with the formal process should also be achievable by January 1, 2018.

## *Specific Scenarios*

In response to specific scenarios identified by GTA:

### Scenario 1. Aerodynamic Devices

A certifying chassis manufacturer may contract with a final stage manufacturer who will be making aerodynamic improvements, and may input the improvement into GEM for certification if the certifying manufacturer (and the secondary manufacturer) comply with the delegated assembly provisions.

### Scenario 2. Hybrids

A chassis manufacturer may contract with a hybrid installer for “delegated assembly” purposes, but the chassis manufacturer would need to test the hybrid system in order to take advantage of the emissions improvements in the certification process.

### Scenario 3. Alternative Fuel Conversion

A chassis manufacturer may also contract with an alternative fuel converter for “delegated assembly” purposes, but the chassis manufacturer would need to have a certified fuel map for the converted engine.

### Scenario 4. Light-weighting

We do not envision it to be possible for a certifying manufacturer to generate credit for lightweight body components because we cannot define the baseline configuration.

## **1.4.5 Labeling**

**Organization:** Allison Transmission, Inc.

### **EPA and NHTSA Should Explore Emission Control Labels In Separate Rulemaking**

Within the agencies discussion of emission control labels, EPA and NHTSA have requested comment on methods to provide for an electronic means to identify vehicles and access to databases that would include vehicle-specific information on the emission control system utilized in the vehicle. Currently, OEMs are required to report vehicle GHG certification level by VIN. If a vehicle had the VIN as a machine-readable code, this seems like reasonably simple technology that could be implemented without great cost to those responsible. As a component supplier, Allison believes that OEMs have the capability to configure a machine-readable code similar to the Vehicle Identification Number (VIN). It should be noted, however, that suppliers of electronic components do not always have the ability to label components prior to delivery to the vehicle OEM because vehicle OEMs program specific configurations on their assembly line. [EPA-HQ-OAR-2014-0827-1284-A1 p.48]

EPA has indicated that such electronic systems if they are considered would be subject to a separate rulemaking proceeding. Allison agrees that this would be the proper process in order to review options and receive informed comment on the benefits and costs of such systems. More broadly, in the context

of this rulemaking, if further reporting or management of GHG certification levels were to involve or otherwise obligate component suppliers, then Allison believes that a separate rulemaking is required. [EPA-HQ-OAR-2014-0827-1284-A1 p.49]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

#### Labeling

The absence of a consumer fuel efficiency label for heavy-duty pickups and vans is a serious shortcoming of the program that should be remedied as soon as possible. In response to Phase 1 comments to this effect, EPA and DOT committed to “consider this issue as we begin work on the next phase of regulations, as we recognize that a consumer label can play an important role in reducing fuel consumption and GHG emissions” (76 Fed. Reg. (Sept. 15, 2011) at 57119). A subsequent letter from NHTSA Administrator David Strickland to Senator Dianne Feinstein stated: “We are currently working to include the consideration of fuel economy labels for large pickup trucks and commercial vans as part of the second phase of fuel efficiency and greenhouse gas standards for heavy-duty vehicles.” Despite this, the agencies have not addressed this issue at all in the Phase 2 proposal. [EPA-HQ-OAR-2014-0827-1280-A1 p.25]

Any consumer product regulated for fuel efficiency should be labeled for fuel efficiency. In the case of HD pickups and vans, the success of the standards depends on manufacturers’ addition of incremental technologies to save fuel. These technologies will typically increase the cost of the vehicle, and manufacturers will need to figure out how to recover that cost. The absence of a label or any other publicly available information stating the fuel efficiency of the vehicle at the time of sale means the consumer is in effect cut out of the market for efficiency. While this might not create a problem where the standard is applied as an efficiency threshold, standards that manufacturers meet on an average basis will only work properly when coupled with a market that values efficiency and allocates efficiency based on its comparative importance relative to other vehicle requirements. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

While establishing a vehicle label is not a simple process, we believe it would be well worth the resources required. The general approach should be similar to light-duty vehicle labeling and could perhaps be carried out as a revision to that rule. While there are issues of duty cycle, test protocols, and comparability to be addressed, these are largely issues that would need to have been addressed in any case to establish a sound fuel efficiency program for these vehicles. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

Absent a consumer label, the agencies should make certification data readily available to the public. This data should be available at a single location on the internet and should be available for all vehicles prior to their availability for sale. While we understand the limitations of the certified fuel efficiency vis-à-vis performance in the real world, the certification data would at least permit comparisons of these vehicles within their regulatory class. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

*Recommendations: Labeling and data availability to the public* [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

- The final Phase 2 rule should commit the agencies to conducting a subsequent rulemaking for the labeling of heavy-duty pickups and vans and set out a timetable for the label rulemaking. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

- Prior to the implementation of a labeling requirement for HD pickups and vans, certification values should be made publicly available for any vehicle model before it can be sold. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

**Organization:** California Air Resources Board (CARB)

### **Oppose/Requested Change Comment**

#### **Comment – Requirements for emission control labels for tractors and vocational vehicles**

CARB staff has significant concerns regarding the proposed removal of the requirements directing manufacturers to list the emission control system identifiers on the emission control labels for tractors and vocational vehicles certified to the Phase 2 standards. Specifically, CARB staff recommends leaving 40 CFR 1037.135(c)(6) as it currently reads, and not including the additional statement that “Phase 2 tractors and Phase 2 vocational vehicles (other than those certified to standards for emergency vehicles) may omit this information.” Having the emission control system identifiers on the emission control label is a simple and effective way of verifying that a vehicle is in a certified configuration, and is the most commonly used method of making a compliance determination during a vehicle inspection. Relying solely on an electronic method of identifying vehicles would limit vehicle inspections to areas where a sufficient internet connection could be obtained in order to access an online database, and is therefore not the most practical and efficient way of determining a vehicle’s compliance in all situations. For these reasons, CARB staff recommends that emission control identifiers continue to be listed on the emission control labels along with an electronic method of identifying vehicles similar to the label shown in Figure 5 below. If it is not practical to require that all emission control identifiers be listed, then CARB staff recommends at a minimum requiring that all visible components be listed. CARB staff also recommends that an additional requirement be included to make labels readily visible to the average person (for example, amend 40 CFR 1037.135(b) to include: “Attached in a location where the label will be readily visible to the average person after the vehicle manufacture is complete.”) [EPA-HQ-OAR-2014-0827-1265-A1 p.110-111]

[Figure 5 can be found on p.111 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

#### **Comment – Consumer label requirements for pickups and vans**

In 2011, U.S. EPA and NHTSA signed a final rule on requirements for window labels for new MY 2013 and later light-duty vehicles sold in the U.S. Such window labels provide fuel efficiency and environmental impact information to vehicle buyers, enabling them to make more informed choices and potentially buy more fuel efficient, lower GHG emitting vehicles. On page 57119 of the Phase 1 rule,<sup>45</sup> U.S. EPA and NHTSA committed to consider requiring similar window labels for heavy-duty pickups and vans (Class 2b and 3 vehicles) as part of the Phase 2 proposal. However, the NPRM does not include such window label requirements. [EPA-HQ-OAR-2014-0827-1265-A1 p.112]

CARB staff encourages U.S. EPA and NHTSA to develop consumer label requirements for pickup and vans in Phase 2. Having window labels for heavy pickup and vans would give buyers of such vehicles better, more complete information to consider when purchasing new vehicles. It would also increase the likelihood that the more efficient, lower GHG emitting vehicles required by the proposed Phase 2 standards are embraced by consumers. [EPA-HQ-OAR-2014-0827-1265-A1 p.112]

<sup>45</sup> Page 57119 of the Phase 1 Rule “As we did not propose a consumer label for heavy-duty pickups and vans in this action and have not appropriately engaged the public in developing such a label, we are not prepared to finalize a consumer-based label in this action. However, we do intend to consider this issue as we begin work on the next phase of regulations, as we recognize that a consumer label can play an important role in reducing fuel consumption and GHG emissions.” (Federal Register / Vol. 76, No. 179, Sept. 15, 2011).

**Organization:** Daimler Trucks North America LLC

## 12. Labels

### i. Emission Control Identifiers

- **Label changes:** We agree with the EPA's approach of removing from labels the emission control identifiers, given that 1) those identifiers do not help demonstrate compliance and 2) there are far too many elements involved in compliance to track on a label, especially starting in Phase 2 when so many factors become relevant for GEM. A better approach, as the agency seems to recognize, for ensuring a vehicle is compliant is for manufacturers to store the vehicle's GEM inputs by VIN and to have the VIN on the certification label, such that a vehicle inspector could ask the manufacturer what items are on the vehicle. The EPA's Phase 2 approach does just this. So we agree with the changes. [EPA-HQ-OAR-2014-0827-1164-A1 p.108]

- **Vehicle build information versus electronic labels and database access** – The agencies comment on their need to get “detailed build information for a specific vehicle upon [an agency’s] request.” The agencies cite a need for same day response or within 24 hours at most. 80 FR 40251. We agree with the agencies’ concern and can generally provide that a response within one working day (obviously not one day response on weekends or holidays, because our Compliance staff is not a 24/7/365 operation, as the agencies understand). We think that such a turn-around is sufficient and that such rapid turn-around means it is not necessary to go through the cost and effort of developing and maintaining an electronic database with readable barcodes that could provide immediate access to such information, as the agencies suggest on the same page. That is, we agree with the agencies’ concern that there would be a tremendous level of effort required. Moreover, we have a concern about privacy and data security, for example if would-be thieves could learn that a vehicle had a particular vehicle speed limiter or idle shutdown feature. (Cargo theft is a very significant concern, so we do not want to create any avenues to increase such theft). In short, we think that our one-by-one responses to agencies’ requests should be the best balance of speed and safety. [EPA-HQ-OAR-2014-0827-1164-A1 p.108-109]

- **Emission Control Labels** - The agencies, recognizing the large number of inputs that go into certification and compliance compared to the small number of items that can reasonably be represented on an emission control label, propose to eliminate emission control identifiers from labels. We agree that this is the correct approach. It has never been appropriate, for example, to list certain components like 'ATS' (aerodynamic fuel tank side skirt) as a proxy for the coefficient of aerodynamic drag; the former is not regulated and the latter is. Plus so many vehicle components and their shapes and placements affect Cd that no small listing of parts will satisfactorily describe the regulated coefficient of drag. So we agree with the agency's approach of not requiring that we list items on the label that are not directly regulated. Moreover, as we discuss elsewhere, the agencies should follow this approach for all vehicles, not making specific exceptions for emergency vehicles. The emission control identifiers are irrelevant for all vehicles. Although the agencies state a desire to have available information with which to do inspections, in order to check that vehicle owners have not tampered with or rendered inoperative

emission controls, we think that if the emission controls offer the fuel savings that the agencies say they do, then there will be no reason for customers to tamper with them, thus making the tampering issue moot. [EPA-HQ-OAR-2014-0827-1164-A1 p.109]

ii. Emergency Vehicles

**Emergency Vehicle Labels** - The agencies propose to require unique vehicle labels for emergency vehicles. Such labels would contain emission control identifiers when no other vehicles' labels do. We think this is 1) unnecessary for the reasons described above and 2) extremely problematic as we cannot create separate labeling computer systems within the one computer system that we have for all labels. Rather, we recommend that the agencies use the same approach for labeling of emergency vehicles as for all other vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.109]

**Organization:** Environmental Defense Fund (EDF)

**Transparency of emissions and fuel economy for consumers through labeling and online resources is critical**

When faced with the decision of which new light-duty vehicle to buy, consumers are provided with valuable information including city and highway fuel economy, GHG rating, average annual cost and estimated cost savings over an average vehicle. This information is posted on the window of all new light-duty vehicles sold, and additional information is readily available from EPA's Fuel Economy Guide and other online tools. In contrast, consumers of medium-duty pickup trucks and utility vans are not offered any information on fuel economy, emissions or relative costs. [EPA-HQ-OAR-2014-0827-1312-A1 p.46]

As discussed above, one of the many market barriers to the purchase of more efficient trucks is the lack of access to complete and reliable information. The agencies state in the Preamble that, "One common theme that emerges from these [barrier] studies is the inability of HDV buyers to obtain reliable information about the fuel savings, reliability, and maintenance costs of technologies that improve fuel efficiency."<sup>204</sup> Yet the Agencies have yet to provide this information to consumers, despite repeated commitments to do so. [EPA-HQ-OAR-2014-0827-1312-A1 p.46]

Indeed, in the Phase 1 rulemaking, the Agencies committed to consider window labels for pickups and vans in Phase 2 – "we do intend to consider this issue as we begin work on the next phase of regulations, as we recognize that a consumer label can play an important role in reducing fuel consumption and GHG emissions." And this commitment was reiterated and reinforced by NHTSA in a letter to Senator Diane Feinstein last year, stating, [EPA-HQ-OAR-2014-0827-1312-A1 p.46]

"NHTSA supports the concept that providing information to consumers on energy use and emissions can play an important role in raising awareness, improving transparency, and ultimately, reducing fuel consumption and greenhouse gas emissions through informed decision-making...NHTSA recognizes the importance of this issue and we currently believe that we could best and most thoroughly address all of these issues by conducting rulemaking for fuel economy labels, in collaboration with EPA, as part of the second phase of fuel efficiency and greenhouse gas standards for heavy-duty vehicles."<sup>206</sup> (Attachment 3) [EPA-HQ-OAR-2014-0827-1312-A1 p.46-47]

Despite these commitments, there is no mention of window labels in the proposed rulemaking. [EPA-HQ-OAR-2014-0827-1312-A1 p.47]

Improving the fuel consumption information on 2b and 3 vehicles would significantly foster the deployment of cost-effective efficiency technologies, leveraging the standards being finalized in this rulemaking. EDF urges the Agencies to conduct label design and education outreach for Class 2b and 3 vehicles, similar to that conducted as part of the light-duty labeling rule. We also request that EPA and DOT finalize comparable window label requirements for all new 2b and 3 vehicles and provide online information for buyers of all classes of heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.47]

#### **A. Large population, annual sales and miles travelled of Class 2b and 3 vehicles call for informing consumer choice**

While their CO<sub>2</sub> emissions are lower per vehicle than vocational trucks and tractor trailers, Class 2b and 3 pickup trucks and vans have the highest sales volumes in the heavy duty market and account for about 15-20 percent of all fuel use and GHG emissions in the truck market. In the Phase 1 RIA, EPA estimated 2b and 3 sales were 580,000 per year in 2010 and projected they would increase to between 700,000 and 800,000 per year for 2014-2021.<sup>207</sup> However, a recent report by ICCT found the number of new registered 2b and 3 vehicles was about 450,000 in 2010, and increased to 1 million in 2012 and 1.2 million vehicles per year in 2013, concluding that, “the sales are increasing at a significantly greater rate than the agencies had projected.”<sup>208</sup> DOT estimates that 2b and 3 vehicles travel about 35 percent of total medium- and heavy-duty vehicle annual miles. [EPA-HQ-OAR-2014-0827-1312-A1 p.47]

Because of their large population and large annual sales volume, providing window labels on 2b and 3 vehicles provides an important opportunity to reach a large portion of heavy-duty consumers. Providing these consumers with transparent information about efficiency, fuel savings and air pollution will help them make informed decisions. And because of the high number of miles traveled annually by 2b and 3 vehicles, when informed consumers buy more efficient vehicles, additional emissions reductions can be achieved, leveraging the standards being finalized under the fuel economy and GHG rulemaking. [EPA-HQ-OAR-2014-0827-1312-A1 p.47-48]

#### **B. Similar use and configuration to their light-duty counterparts make labels feasible**

Despite the definition and regulatory split between light-duty trucks and 2b and 3 trucks, they are very similar in use patterns as well as engine and transmission configurations and emissions control technology. EPA regulates criteria emissions from 2b and 3 vehicles under the light-duty Tier 3 rulemakings because, “Most are built by companies with even larger light-duty truck markets, and as such they frequently share major design characteristics and potential emissions control technologies with their LDT counterparts.”<sup>209</sup> In fact, many 2b trucks are simply larger versions of a manufacturer’s 2a model with engines and transmissions that can be nearly identical in configuration. Like light-duty trucks, more than 90 percent of 2b and 3 vehicles are sold as ‘complete’ vehicles, as defined by EPA.<sup>210</sup> EPA also confirms that the “Often, the technologies available to reduce fuel consumption and GHG emissions from this segment are similar to the technologies used for the same purpose on light-duty pickup trucks and vans, including both engine efficiency improvements (for gasoline and diesel engines) and vehicle efficiency improvements.”<sup>211</sup> These technologies include, but are not limited to, engine improvements such as friction reduction, cylinder deactivation, cam phasing, and gasoline direct injection; aerodynamic improvements; low rolling resistance tires; and transmission improvements. In addition to the same efficiency technologies, Class 2a and 2b trucks are both certified with chassis dynamometer testing. [EPA-HQ-OAR-2014-0827-1312-A1 p.48]

The use of class 2b and 3 vehicles can vary widely but many of the uses are the same as light-duty trucks: they can be strictly personal-use vehicles, vehicles that double for both work and personal use, or vehicles that are used solely for commercial purposes (cargo vans). Many are purchased to perform a

certain work function, necessitating a specific workload and towing capacity. However, despite varying workloads and towing capacities of 2b trucks, their similarities outweigh their differences. [EPA-HQ-OAR-2014-0827-1312-A1 p.48]

Based on these similarities, EPA and NHTSA should develop window labels for 2b and 3 vehicles that provide comparable information afforded to consumers of light-duty cars and trucks. Given that these vehicles are often purchased to perform a certain work function, it may also be appropriate to provide payload and towing capacity on the label to allow for easy cross-vehicle comparisons in combination with fuel efficiency information. [EPA-HQ-OAR-2014-0827-1312-A1 p.48-49]

### **C. Agencies should immediately begin rulemaking process for labels**

The updated light-duty labeling rule was finalized with updated fuel economy and GHG standards for light-duty vehicles. That provided EPA and DOT the opportunity to develop labels that would reflect the increased fuel economy and cost savings from advanced technologies like plug-in hybrids and electric vehicles. It also allowed manufacturers to harmonize the development and roll out of new vehicles and new labels at the same time. EPA should similarly develop window labels for 2b and 3 vehicles with the finalization of the Phase 2 fuel economy and GHG rule. This would provide manufacturers of 2b and 3 vehicles with integrated planning, similar to the issuance of light-duty labels and emissions standards, and provide important transparency for consumers. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

### **D. Consider carrying out an expert assessment to inform 2b/3 label design and rely on pertinent findings from the development of light-duty labels**

EISA 2007 required DOT and EPA to update light-duty label designs and include GHG information. It also required the Agencies conduct consumer education outreach. The label redesign process included the following: [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

- Literature review –examining vehicle buying process, information sources used by consumers as they shop for vehicles, the factors that influence consumer vehicle purchasing decisions, and the impact of the increasing availability of more efficient and lower emitting vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

- Focus groups (in 3 phases) – 4 cities over 4 months, 32 focus groups including 257 people. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

- Expert panel – included executives from Zappos, Unilever, Pandora, Craigslist, and Gates Foundation. It was an intensive one-day workshop to elicit ideas. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

- National level online survey of new vehicle buyers – an Internet survey designed to elicit responses about new label ideas. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

- The innovative ideas and information collected from the redesign process resulted in consumer-friendly window labels that reduce the market barrier to purchasing cleaner, more efficient light-duty vehicles. We recommend the agencies consider the pertinent findings from the light-duty process and engage in consumer and expert outreach to inform label design for 2b and 3 vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.49]

### **E. Develop an online tool for all medium and heavy-duty vehicles**



In addition to the label redesign, the Agencies launched an online education campaign for light-duty vehicles. Window labels direct buyers to the EPA website [www.fueleconomy.gov](http://www.fueleconomy.gov) to see the full Fuel Economy Guide. The website also allows a user to personalize their fuel economy information by inputting their specific driving habits and fuel prices and tells the buyer the cost to fill the tank, or the volume of the fuel tank, or how many miles could be driven on a tank. The information such as the miles per tank can be personalized to reflect a person's relative amount of city and highway driving. This information is helpful to a potential consumer, as more consumers are starting their buying research online. [EPA-HQ-OAR-2014-0827-1312-A1 p.49-50]

Similar information could be provided to consumers of all types of medium- and heavy-duty vehicles. In addition to the labels, the Agencies could provide the same personalized online information for 2b and 3 consumers as the light-duty online tool. [EPA-HQ-OAR-2014-0827-1312-A1 p.50]

For vehicle classes 4-8, EDF encourages EPA to use the data and information collected during the development of the Phase 2 rule to develop a user-friendly online calculator or tool that would allow consumers to conduct personalized research of various vehicle configurations. The tool would produce average fuel economy over select duty cycles. This tool would provide rigorous, reliable information on vehicle efficiency and emissions performance to inform consumer choices. [EPA-HQ-OAR-2014-0827-1312-A1 p.50]

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204 Preamble at 40436.

206 Letter from NHTSA Administrator David Strickland to Senator Diane Feinstein (date unknown). See Attachment 3.

207 EPA, Process for Determining the Standards for Class 2b and 3 Trucks, 2008 model year pickup data submitted to 2010 HD rule docket, (2008), available at <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2010-0162-033>.

208 ICCT, Regulatory Considerations for Advancing Commercial Pickup and Van Efficiency Technology in the United States, (April 2015).

209 79 Fed. Reg. 23414, Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards (April 28, 2014).

210 A 'complete vehicle' can be a chassis-cab (engine, chassis, wheels, and cab) or a rolling-chassis (engine, chassis and wheels), while an 'incomplete-chassis' could be sold as an engine and chassis only, without wheels. Final RIA, Page 1-9. Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards; Proposed Rule, 78 Fed. Reg. 29,816 (May 21, 2013) at 29874.

**Organization:** Institute for Policy Integrity at NYU School of Law

**Consumer Labels:** In our comments on the Phase 1 standards for heavy-duty vehicles, Policy Integrity explained why informational failures justify some additional labeling requirements for heavy-duty vehicles. EPA and NHTSA have developed sophisticated labels for light-duty vehicles to help consumers directly and easily compare vehicle options by their fuel efficiency, estimated fuel costs, and estimated emissions. No such labels exist for heavy-duty vehicles. While many consumers of heavy-

duty vehicles are commercial actors that, compared to average individuals, might have better access to information and more time and resources to make informed choices on their own, at least some heavy-duty vehicles are purchased by individuals (certain pickups, vans, mobile homes, and recreational vehicles). Moreover, there is no reason to assume that many government entities, non-profit entities, small businesses, and other commercial actors that purchase heavy-duty vehicles would not also benefit from easier access to clearer information. [EPA-HQ-OAR-2014-0827-1195-A1 p.1]

Policy Integrity was not alone in suggesting improved consumer labels during the Phase 1 rulemaking. A group of 18 U.S. Senators, New York State, and NACAA, as well as ACEEE, the American Lung Association, the Clean Air Task Force, EDF, the International Council on Clean Transportation, Sierra Club, and the Union of Concerned Scientists, all supported consumer labels. In response, they agencies noted that they “agreed” with the recommendation, but insisted that a label would be “too complicated” to finish during the Phase 1 rulemaking. They promised to “consider a consumer label in the context of our efforts with stakeholders to begin work on a second phase of this regulation.”<sup>2</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.1-2]

Contrary to this promise, there is no discussion of a consumer label in the Phase 2 proposed rulemaking. Instead, EPA proposes scaling back the emission-control labels (which contain some limited information helpful for monitoring and enforcement, but are not designed to inform consumer comparisons of vehicle efficiency or emissions). Instead, the agencies should follow through on their promise to consider more informative consumer labels. If labels cannot be designed without delaying the final Phase 2 rule, the agencies should initiate a separate rulemaking specifically on labels. For more on the agencies’ statutory authority to create such labels and suggestions on the design of such labels, see our 2011 comments.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.2]

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2 Accord. 76 Fed. Reg. 57,106, 57,119 (Sept. 15, 2011); see EPA Response to Comments Document for Joint Rulemaking <http://www3.epa.gov/otaq/climate/documents/420r11004.pdf>, at 3-13 to 3-15 (2011) (exact quote above).

3 [http://policyintegrity.org/files/publications/2211\\_Regulatory\\_Report\\_2011\\_Heavy\\_Trucks\\_Rule.pdf](http://policyintegrity.org/files/publications/2211_Regulatory_Report_2011_Heavy_Trucks_Rule.pdf)

**Organization:** Navistar, Inc.

The NPRM proposes to maintain the requirement for emergency vehicles. Navistar opposes maintaining the emission control label requirement for emergency vehicles. The vehicle labels are all printed from the same system so maintaining the requirement for emergency vehicles eliminates much of the benefit from the proposed change. As the NPRM states, the list of control technologies for Phase 2 is much larger than in Phase 1 so determining compliance by merely looking at the label is not practical, limiting the utility of the label as a source of information for purchasers. Therefore, removing the emission control information requirement on the label for all vehicles is the best solution. EPA also asks for comment on maintaining some label content for selected technologies. Navistar opposes any requirement for even limited emission control information content on the vehicle label. Again, even limited content requires more complex labeling systems with no actual benefit. [EPA-HQ-OAR-2014-0827-1199-A1 p.19]

As an additional improvement and as part of the proposed model year mismatch solution, Navistar agrees with EMA that the Agencies should eliminate the requirement for model year information on the vehicle label. In addition, Navistar does not support the proposal for electronic, scannable labels to the

extent such a program would require manufacturers to develop and build new websites dedicated solely to the Phase 2 GHG/FE program. [EPA-HQ-OAR-2014-0827-1199-A1 p.19]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The proposed Phase 2 regulations also include an unnecessary labeling requirement in section 1037.103(f). Since the venting controls are completely contained on LNG tanks, it makes no sense for the vehicle manufacturer to specify the maximum fuel tank capacity for the vehicle. If the tank is certified to the evaporative emission requirements itself, its venting controls will be adequate and nothing on the vehicle will affect that performance. Accordingly, the vehicle labeling requirement set out in proposed section 1037.103(f) should be deleted since it serves no reasonable purpose. [EPA-HQ-OAR-2014-0827-1269-A1 p.45]

#### Electronic Vehicle Labeling

EMA supports the Agencies' intent to minimize and simplify the information required on engine and vehicle labels. The amount of required information is already at the limit of what can fit and be accounted for on a label. Accordingly, and among other things, EMA believes that only one engine label and one vehicle label should be required and that, to facilitate such a uniform label, the Agencies should eliminate the requirement for model year information. That said, EMA does not support a requirement for electronic, scannable labels at this time to the extent such a program would require manufacturers to develop and build new websites dedicated solely to the Phase 2 GHG/FE program. [EPA-HQ-OAR-2014-0827-1269-A1 p.45]

#### General Comments Regarding Emission Labels

As mentioned above, the specific information that should be on the emission control information label is a long-standing concern. EMA, along with other engine manufacturers associations from around the world, have been working on a project to develop a new approach to providing emission control information. This industry effort appears to be quite similar to that discussed by the Agency in Paragraph III.E.(2)(f) of the Preamble entitled "Emission Control Labels," which reads: [EPA-HQ-OAR-2014-0827-1269-A1 p.81]

We also request comment on approaches that would minimize burden for manufacturers to respond to requests for vehicle build information and would expedite an authorized compliance inspector's visual inspection. For example, the agencies have started to explore ideas that would provide inspectors with an electronic method to identify vehicles and access on-line databases that would list all of the engine-specific and vehicle-specific emissions control system information. We believe that electronic and Internet technology exists today for using scan tools to read a bar code or radio frequency identification tag affixed to a vehicle that would then lead to secure on-line access to a database of manufacturers' detailed vehicle and engine build information. Our exploratory work on these ideas has raised questions about the level of effort that would be required to develop, implement and maintain an information technology system to provide inspectors real-time access to this information. We have also considered questions about privacy and data security. We request comment on the concept of electronic labels and database access, including any available information on similar systems that exist today and on burden estimates and approaches that could address concerns about privacy and data security. Based on new information that we receive, we may consider initiating a separate rulemaking effort to propose and request comment on implementing such an approach. [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

Over the ensuing years, EMA would like to see such a system developed. In that regard, EMA would support using such a system on a global basis for all regulatory categories. That would alleviate the types of issues being addressed through the proposed change to Part 1039.135(d). [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

**Organization:** Volvo Group

### **Electronic Database**

The Agencies have requested comment on the implementation of instantly accessible electronic databases for in-use audits, possibly in conjunction with scan-able bar code or RFID vehicle and engine labels. Currently, the Agencies must request certified configuration information for a specific vehicle or engine from the vehicle manufacturer, who then has 24 hours to respond. Volvo Group is not aware of any issues that have arisen from this method. Volvo Group's concerns regarding this type of instantly accessible database lie in the development and maintenance burden, as well as information security. [EPA-HQ-OAR-2014-0827-1290-A1 p.42]

Given no notice from the Agencies regarding problematic issues with the current system, it is unclear what challenges they are attempting to resolve, but it is clear that the costs associated with development and maintenance of such a system would be substantial. First, a system to print a unique bar code would need to be developed and validated, or a commercially available system would need to be integrated into Volvo Group's IT systems. Second, the bar code would then need to be linked to a secure web-based database, which itself would require substantial development and integration. This database would need to contain eight years of production information due to the Agencies' requirements on the retention period of engine and vehicle GHG records. [EPA-HQ-OAR-2014-0827-1290-A1 p.42]

For other Volvo Group business units with regulated sales in the U.S. and Canada (specifically Volvo Powertrain, Volvo Bus, Nova Bus, and Prevost Motorcoach) these systems would need to be developed from the ground up to be incorporated into the overall database, as these systems are not on the same platform as Volvo Group Trucks and were excluded from the automated systems developed for Phase 1. This decision was taken in Phase 1 due to the bus and coach divisions' limited volumes and/or limited certification data and configurations and resultant low benefit of an automated system versus the cost of development of such a system that could then be integrated across platforms to the Truck Group's system. [EPA-HQ-OAR-2014-0827-1290-A1 p.42]

The Volvo Group spent nearly \$2 million (2012\$) dollars on the automated integration of the Phase 1 GEM and storage of the calculated vehicle data. Given that all of the previously mentioned additional systems will still be on multiple platforms when the Phase 2 regulation is implemented, it is likely that the development of an integrated and fully automated instantly accessible database and labeling system would require on the magnitude of \$10 million dollars for Phase 2. This estimate does not account for any maintenance or additional security required, nor does it include any costs associated with an RFID chip in each engine and vehicle emissions label, nor the costs associated with end of line programming and validation of the data on the chip. Given that there is no vehicle customer benefit from this system, it would not be possible to increase pricing to cover the investment and cost of capital, especially given the cost increases already associated with the engine and vehicle technologies necessary to meet the GHG stringencies as set by the regulation. [EPA-HQ-OAR-2014-0827-1290-A1 p.42-43]

Given the latitude that the Agencies have in the data they can request and the fact that this data is considered commercially sensitive and proprietary in nature Volvo Group has serious concerns about security of a web based database for any purpose. This concern would be greatly increased by the

significant increase in certification data for both engines and vehicles, such as engine fuel maps, powertrain maps, axle efficiency maps, etc. [EPA-HQ-OAR-2014-0827-1290-A1 p.43]

Concerning RFID chips embedded in engine and vehicle labels, Volvo Group is concerned that this would enable tampering in that a chip could be potentially reprogrammed, erased, or intentionally damaged. Volvo Group is also concerned with the long-term survivability of an RFID chip in a HHD engine compartment. [EPA-HQ-OAR-2014-0827-1290-A1 p.43]

As a result of these concerns, Volvo Group does not support the implementation of such a strategy and further believes that the development of any such system that may be requested by the Agencies should be voluntary and open to further discussion on structural design. In addition, given the probable low number of in-use audits the Agency has the capacity to perform compared to the annual HHD production volumes for the N.A. market, it is not expected that these additional costs and security concerns are justified. [EPA-HQ-OAR-2014-0827-1290-A1 p.43]

**Organization:** Wabash National Corporation

### **Labeling**

EPA has historically required that certified vehicles have a permanent emission control label affixed to the vehicle. For the Phase 2 trailer program, EPA is proposing that the label include the manufacturer, a trailer identifier such as the Vehicle Identification Number, the trailer family and regulatory subcategory, the date of manufacture, and compliance statements. EPA is also proposing that the label include emission control system identifiers, and that manufacturers would be required to maintain records that would allow EPA to verify that an individual trailer is in its certified configuration. [EPA-HQ-OAR-2014-0827-1242-A2 p.17]

As described above, trailers are highly customized and built to customers' specifications, resulting in an endless array of potential configurations. Requiring the creation of custom labels to identify the exact devices on each trailer would be extremely burdensome. Instead, EPA should incorporate labeling requirements similar to those promulgated by the DOT on tank trailers, which require the manufacturer simply to certify that the trailer complies with applicable regulations at the time of manufacture. This approach would be much less burdensome and yet would accomplish the same goal of alerting an inspector whether a trailer should or should not include an aerodynamic device at the time of inspection. [EPA-HQ-OAR-2014-0827-1242-A2 p.17]

### **Response:**

EPA proposed to largely continue the Phase 1 engine and vehicle labeling requirements, but to eliminate the requirement for tractor and vocational vehicle manufacturers to list emission control on the label. The agencies consider it crucial that authorized compliance inspectors are able to identify whether a vehicle is certified, and if so whether it is in its certified condition. To facilitate this identification in Phase 1, EPA adopted labeling provisions for tractors that included several items. The Phase 1 tractor label must include the manufacturer, vehicle identifier such as the Vehicle Identification Number (VIN), vehicle family, regulatory subcategory, date of manufacture, compliance statements, and emission control system identifiers (see 40 CFR 1037.135). EPA proposed to apply parallel requirements for trailers.

In Phase 1, the emission control system identifiers are limited to vehicle speed limiters, idle reduction technology, tire rolling resistance, some aerodynamic components, and other innovative and advanced

technologies. However, the number of emission control systems for greenhouse gas emissions in Phase 2 has increased significantly for tractors and vocational vehicles. For example, all aspects of the engine transmission and drive axle; accessories; tire radius and rolling resistance; wind averaged drag; predictive cruise control; idle reduction technologies; and automatic tire inflation systems are controls which can be evaluated on-cycle in Phase 2 (i.e. these technologies' performance can now be input to GEM), but could not be in Phase 1. Due to the complexity in determining greenhouse gas emissions in Phase 2, the agencies do not believe that we can unambiguously determine whether or not a vehicle is in a certified condition through simply comparing information that could be made available on an emission control label with the components installed on a vehicle. Therefore, EPA proposed to remove the requirement to include the emission control system identifiers required in 40 CFR 1037.135(c)(6) and in Appendix III to 40 CFR part 1037 from the emission control labels for vehicles certified to the Phase 2 standards. Manufacturers generally supported the elimination of the emission control information from the vehicle GHG label, while CARB opposed it. We continue to believe these details are unnecessary.

Some commenters opposed the separate labeling requirements for custom chassis vehicles, but we believe it important for the labels to identify the standards to which each vehicle is certified.

### *Electronic Labeling*

Although we are largely finalizing the proposed labeling requirements, we remain interested in finding a better approach for labeling. Under the agencies' existing authorities, manufacturers must provide detailed build information for a specific vehicle upon our request. Our expectation is that this information should be available to us via e-mail or other similar electronic communication on a same-day basis, or within 24 hours of a request at the latest. The agencies have started to explore ideas that would provide inspectors with an electronic method to identify vehicles and access on-line databases that would list all of the engine-specific and vehicle-specific emissions control system information. We believe that electronic and Internet technology exists today for using scan tools to read a bar code or radio frequency identification tag affixed to a vehicle that could then lead to secure on-line access to a database of manufacturers' detailed vehicle and engine build information. Our exploratory work on these ideas has raised questions about the level of effort that would be required to develop, implement and maintain an information technology system to provide inspectors real-time access to this information. We have also considered questions about privacy and data security. We requested comment on the concept of electronic labels and database access, including any available information on similar systems that exist today and on burden estimates and approaches that could address concerns about privacy and data security.

Manufacturers expressed some support for the goal of electronic labeling, they also agreed that any such changes should be considered in a separate rulemaking. Although we are not finalizing such a program in this rulemaking, we remain very interested in the use of electronic labels that could be used by the agencies to access vehicle information and may pursue these in a future rulemaking. Such a rulemaking would likely consider the feasibility of accessing dynamic link libraries in real-time to view each manufacturer's build records (and perhaps pending orders). The agencies envision that this could be very useful for our inspectors by providing them access to the build information by VIN to confirm that each vehicle has the proper emission control features.

### *Consumer Labels*

Several commenters expressed support for consumer fuel economy labels for heavy-duty vehicles. However, we did not propose such provisions, and consider the issue to be outside the scope of this rulemaking.

## 1.4.6 CBI and Compliance Data

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Absent a consumer label, the agencies should make certification data readily available to the public. This data should be available at a single location on the internet and should be available for all vehicles prior to their availability for sale. While we understand the limitations of the certified fuel efficiency vis-à-vis performance in the real world, the certification data would at least permit comparisons of these vehicles within their regulatory class. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

Sound practices for the collection and dissemination of data are essential to the effective evaluation of the heavy-duty vehicle fuel efficiency and greenhouse gas emissions program. Data from the program should also greatly enhance understanding of heavy-duty vehicles and vehicle markets in the U.S. The lack of specifications of engine and transmission associated with a given vehicle, which is major gap in data collection in Phase 1, will be filled in Phase 2, now that vehicle certification uses actual power train specifications rather than default values as inputs to GEM. It is important that this information, along with all other GEM inputs and outputs, be made available to the public.

The agencies should make available in a timely fashion other data and information arising from the program as well, relating to individual vehicle and engine model certification, manufacturer compliance, and performance of the industry as a whole. Key information would include the contents of certification applications for engines and vehicles, and annual compliance reports showing each manufacturer's status and usage of special credit provisions and credit balances. In the final rule, the agencies should commit to regular publications summarizing trends in the heavy-duty vehicle market, as EPA stated it would "make every effort to do" in its response to comments on the Phase 1 rule.<sup>27</sup> A 2013 ACEEE working paper on heavy-duty vehicle fuel efficiency data<sup>28</sup> set out in detail our concerns and recommendations in this area. Many remain relevant to the current proposal and are reiterated in the recommendations that follow.

### CAFE data collection

NHTSA proposes (p.40540) changes to the way that manufacturers report CAFE data to the agency. NHTSA should take this opportunity to add the footprint of each vehicle to the model-by-model information required of the manufacturers. Moreover, footprint data together with fuel economy data for each model should be publically available. Given that footprint is the attribute on which the light-duty CAFE standards are based, analysts and others seeking to understand how the standards are working need this detailed information. Moreover, it is hard understand how the agencies could directly verify the accuracy of manufacturers' calculations of their fleets' compliance without having footprint data for individual models.

### *Recommendations: Data collection and dissemination*

- Post all data collected in rule implementation that is not Confidential Business Information on the web in a timely fashion and in a form conducive to analysis. Posted data should include the information in certification applications for engines and vehicles and include all GEM inputs and outputs. The data should be made available in a database that is updated frequently so that key properties of engines and vehicles can be referenced as these products enter the market. Sales volumes at the most disaggregate level available should be added to the database as early as possible.

- In annual compliance reports for the heavy-duty rule, report on each manufacturer's use of special provisions (e.g., early credits, alternative engine certification, advanced and innovative technology credits), application of credit carry-forward/carry-back, and credit balance. Understanding the details of how manufacturers are complying with the standards, including their use of rule flexibilities, will provide insight into how the rule may be influencing the vehicle market and how rule design might be improved.
- Produce an annual report on trends in heavy-duty vehicle technology, carbon dioxide emissions, and fuel economy. An annual heavy-duty vehicle trends report is necessary to track the directions of a rapidly evolving market for fuel efficiency technology. The report should present the agencies' findings regarding the key fuel efficiency trends in the heavy-duty vehicle market with respect to vehicle and engine types, technologies, and manufacturers. Where relevant data on individual models or manufacturers is unavailable in the public online database, present that information in the least aggregated form compatible with CBI policy.
- Consolidate analysis and reporting of data on heavy-duty pickups and vans with light-duty reporting. Include these vehicles in the agencies' light-duty databases and in EPA's annual Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends report.
- (CAFE) Require manufacturers to include model-by-model footprint data when submitting fuel economy information for CAFE compliance. This model-level data should be made available to the public along with fuel economy and vehicle specifications, as well as sales volumes.

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27 Environmental Protection Agency. 2011a. Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles: EPA Response to Comments Document for Joint Rulemaking. EPA-420-R-11-004. August.

28 Langer, T. 2013. "Heavy-Duty Vehicle Fuel Efficiency Data in the United States." ACEEE. <http://aceee.org/white-paper/heavy-duty-data>.

**Organization:** California Air Resources Board (CARB)

Additionally, the NPRM requests comment on whether the Phase 2 full vehicle simulation proposal, which potentially requires engine manufacturers to disclose proprietary engine performance information to vehicle manufacturers long before production, would enable the "reverse engineering" of engine manufacturers' intellectual property, and if so, what steps U.S. EPA and NHTSA could take to address this issue. While CARB staff recognizes that this proposed approach will likely require engine manufacturers to disclose more detailed engine design and performance information early in production cycles, certainly earlier than currently occurs, CARB staff believes this will be a positive development that will facilitate better engine, component, and vehicle integration necessary for achieving maximum, cost-effective fuel efficiency improvements and GHG benefits. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]186

**Organization:** Daimler Trucks North America LLC

Refuting the idea that a fuel map can be used to 'reverse engineer' engine manufacturers' IP - The agencies question whether fuel maps that engine manufacturers pass to vehicle manufacturers could be



used to 'reverse engineer' intellectual property related to the proprietary design of engines, and the agencies request comment on what steps the agencies could take to address this. 80 FR 40181. We request comment on whether or not such information could be used to “reverse engineer” intellectual property related to the proprietary design of engines, and what steps the agencies could take to address this. Based on experience in benchmarking and investigation of competitive products over many generations of technologies, DTNA believes such concerns to be unfounded. The fuel map of an engine is an end result of the performance and integration of multiple design features that can be combined in different ways to arrive at the same result. To illustrate, the fuel efficiency at a given operating point is a function of turbocharger performance, injection control, timing of valve events, EGR flow, air system pumping losses, application of intake throttling, thermal losses from the combustion chamber, energy losses to bearings and ancillaries, and characteristics of lubricants. To reverse engineer an engine's system by only evaluating the end result is essentially impossible. To effectively reverse engineer an engine's systems requires actual operation of an engine in an appropriate test environment where multiple temperatures, pressures, flows, electronic control inputs and outputs, and emissions outputs from both the engine and the aftertreatment can be measured and recorded. Such detail measurements are required, for example, to determine if the fuel efficiency at a given condition is the result of combustion system optimization at high NOx levels in combination with highly efficient NOx aftertreatment, or by less optimized combustion and aftertreatment combined with efficiencies gained by other means such as lower pumping and friction. [EPA-HQ-OAR-2014-0827-1164-A1 p.13-14] After the engine testing, one would need to test and examine multiple engine components to understand component contributions. For example, to determine actual power losses to an engine pump that may contribute or degrade performance would require measurements on a bench test. Detail examination, performance testing, and metallurgical analysis of multiple components is often necessary for complete understanding. [EPA-HQ-OAR-2014-0827-1164-A1 p.14]

Once a product is understood to the extent possible from these examinations, the processes to duplicate and produce the actual critical designs, if not patent protected, requires additional resources and time. One can easily conclude that a view of an engine fuel map reveals is essentially an insignificant first step that in itself reveals little or nothing of the design content necessary to get to the end result. [EPA-HQ-OAR-2014-0827-1164-A1 p.14]

Moreover, vehicle manufacturers could theoretically derive a competitor's engine fuel map soon after an engine begins production. That said, it would require each vehicle manufacturer to put each engine on a test stand and run a battery of tests, just to replicate information that the engine manufacturer already has—a great waste of time and resources. In short, vehicle manufacturers could generate fuel maps if there were IP in those maps, but we agree with the agencies' proposal to require engine manufacturers to create the maps. [EPA-HQ-OAR-2014-0827-1164-A1 p.14]

That said, if the engine manufacturer has concerns about IP before their engine is launched into production, there are steps the engine manufacturer could take. The fuel map provided to the manufacturer does not need to be the exact fuel map measured in the test cell. The fuel map provided to the manufacturer needs only to not be lower than the actual measured fuel map. As is the case with other emissions levels submitted to the agencies and which could be tested in a compliance audit, the levels established by the engine manufacture in the fuel map would presumably be raised slightly for compliance margin. Additionally the compliance margin may vary across the fuel map, for example, be set higher in regions of the map that are seldom or not at all encountered in the vehicle simulation. To a certain extent, the contours and levels of the actual fuel map can be masked by these and other even more sophisticated approaches. [EPA-HQ-OAR-2014-0827-1164-A1 p.14]

Even if it were the case that a certification fuel map contained IP (which it does not), DTNA has proposed solutions to avoid passing IP. For example, data encryption techniques can be used, as these are readily available in the Matlab Simulink environment. Or the engine manufacturer could keep its fuel map and run GEM for vehicle manufacturers. Or the EPA could store the fuel map on a server, from which GEM would grab it during execution. Finally, in early stages of development with a vehicle manufacturer, an engine manufacturer can provide a fuel map that is an approximation of the actual fuel map which provides a similar GEM cycle result as the map that is ultimately provided which may be long after vehicle production begins, since actual credit calculations using final maps are not required until months after start of production. Any of these techniques would provide protection of the fuel map and any associated IP (if there were any) to the same level, if not better than, the idea of the cycle averaged mapping approach that the agencies propose in the NPRM. In conclusion, the agencies' proposal for manufacturers to provide fuel map information to vehicle manufacturers need not be a concern and is in fact a necessary ingredient for a successful Phase 2 program. [EPA-HQ-OAR-2014-0827-1164-A1 p.14-15]

**CBI of the GEM inputs:** The EPA proposes to open GEM inputs up to FOIA inquiries rather than protect the inputs as CBI. While we appreciate the responsibility the agency has for disclosure of relevant emissions data to the public, we disagree with the agency on the idea of making public GEM inputs which are not emission results and should not be treated as such. Fuel economy is and has been one of the key concerns for our customers and one on which we compete with other manufacturers in the market. The advances made in technology over the past decades and those future advances on which the agencies are basing this rule on are a result of this competitive market. By declaring that information on the inputs that go into the GEM model are no longer confidential, the agencies will damage the market by sharing trade secrets and eliminating competitive advantages companies develop as soon as this technology is produced in a vehicle. Companies cannot invest millions of dollars to develop an advantage that the agencies will hand over to their competitors as soon as it is produced and sold. Much as the agencies have estimated "payback" time for customers purchasing technologies, companies must also be able to recuperate the costs of research and development of new technologies in order to justify the expenditures. By limiting this payback time to one year or less, the agencies are essentially limiting the ability of companies to invest and innovate. In Section IX-I of the Preamble, the agencies point out that: "Executive Order 13563 (January 18, 2011) directs federal agencies to consider regulatory impacts on, among other criteria, job creation. According to the Executive Order 'Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation.'" The agencies should be mindful of the risk to job creation they may cause. [EPA-HQ-OAR-2014-0827-1164-A1 p.43-44]

Unlike with criteria pollutant certification data, which will generally not affect the market, the EPA's proposal to open manufacturers' highly competitive greenhouse gas and fuel economy data to FOIA disclosures could also distort the market in unexpected, unintended ways. For example, when fleets see that one manufacturer has better aerodynamics than a second one, the fleets could demand that the first make aero improvements; this could be problematic if the second manufacturer optimizes its vehicles not using aerodynamics but using hybrids or waste heat recovery—both of which compromise aerodynamics (as demonstrated by our Super Truck vehicle). In other words, individual GEM inputs can be meaningless or indeed misleading. The agency's proposal is also problematic for those cases where the GEM model is misaligned with real-world FE reductions, for example where the generic regulatory drive cycles differ from actual ones; we would not want HDV purchasers misled by GEM information. In addition, the multiple methods the agencies have proposed to calculate inputs (e.g. powertrain testing and alternative testing) work against this data being of actual use to the public, as the confusion these inputs would generate far outweighs the data's ability to be useful and meaningful to the public as opposed to just making the GEM output available. Even if the test procedures were all the same, the GEM inputs can be misleading, given that manufacturers often put in different safety margins against

selective enforcement audits, such that inputs such as aerodynamics may not be comparable, or may be misleading, from manufacturer to manufacturer. In summary, we think that if the agencies reverse course by removing CBI protection for GEM inputs, they risk skewing our market for the worse, improperly sharing the IP that companies develop and rely on, confusing rather clarifying fuel efficiency. [EPA-HQ-OAR-2014-0827-1164-A1 p.44]

**Difficulty of reverse engineering** - EPA requests comment an engine manufacturer concern that providing an engines fuel map to other manufacturers introduces a risk of lost intellectual property. 80 FR 40181. Based on experience in benchmarking and investigation of competitive products over many generations of technologies, DTNA believes such concerns to be unfounded. The fuel map of an engine is an end result of the performance and integration of multiple design features that can be combined in different ways to arrive at the same result. To illustrate, the fuel efficiency at a given operating point is a function of turbocharger performance, injection control, timing of valve events, EGR flow, air system pumping losses, application of intake throttling, thermal losses from the combustion chamber, energy losses to bearings and ancillaries, and characteristics of lubricants. To reverse engineer an engines system by only evaluating the end result is essentially impossible. Rather, reverse engineering an engine's systems requires actual operation of an engine in an appropriate test environment where multiple temperatures, pressures, flows, electronic control inputs and outputs, and emissions outputs from both the engine and the aftertreatment can be measured and recorded. Such detailed measurements are required, for example, to determine if the fuel efficiency at a given condition is the result of combustion system optimization at high NOx levels in combination with highly efficient NOx aftertreatment, or by less optimized combustion and aftertreatment combined with efficiencies gained by other means such as lower pumping and friction. [EPA-HQ-OAR-2014-0827-1164-A1 p.46-47]

Beyond engine testing, one must examine and test multiple engine components to understand component contributions. For example, to determine actual power losses to an engine pump that may contribute or degrade performance would require measurements on a bench test. Detailed examination, performance testing, and metallurgical analysis of multiple components is often necessary for complete understanding. Once a product is understood to the extent possible from these examinations, the processes to duplicate and produce the actual critical designs (if they are not patent protected), requires additional resources and time. One can easily conclude that a view of an engine fuel map reveals is essentially an minor first step that in itself reveals little or nothing of the design content necessary to get to the end result. [EPA-HQ-OAR-2014-0827-1164-A1 p.47]

Moreover, the fuel map provided to the manufacturer may not even be the fuel map measured in the test cell. The fuel map provided to the manufacturer needs only to not be lower than the actual measured fuel map. As is the case with other emissions levels submitted to the agencies and which could be tested in a compliance audit, the levels established by the engine manufacture in the fuel map would presumably be raised slightly for compliance margin. Additionally the compliance margin may vary across the fuel map, for example, be set higher in regions of the map that are seldom or not at all encountered in the vehicle simulation. The contours and levels of the actual fuel map can be masked by these and other even more sophisticated approaches. [EPA-HQ-OAR-2014-0827-1164-A1 p.47]

Further, if IP were actually a concern, passing the fuel map could involve data encryption techniques like those internal to Matlab Simulink. Moreover, if IP were a concern, then in early stages of development with a vehicle manufacturer, an engine manufacturer can provide a fuel map that is an approximation of the actual fuel map which provides a similar GEM cycle result as the map that is ultimately provided which may be long after vehicle production begins, since actual credit calculations using final maps are not required until months after start of production. In short, manufacturers learn little about a competitor's engine from the fuel map. The fuel map does not contain IP. And it can be

measured, once an engine is available, although doing such measurement would be a large expense for little value. For these reasons, DTNA agrees with agencies' proposal that the Phase 2 program require engine manufacturers communicate fuel maps to vehicle manufacturers for use in GEM, either unprotected or encrypted. We agree with the agencies that the regulations should not require vehicle manufacturers to measure their own fuel maps (to be used for GEM input) for engines they do not manufacturer. Definition of the engine fuel map should be the sole responsibility of the engine manufacturer. DTNA concludes that EPA's proposal for engine manufacturers to provide fuel map information to vehicle manufacturers need not be a concern and is in fact a necessary ingredient for a successful Phase 2 program.[EPA-HQ-OAR-2014-0827-1164-A1 p.47]

**CBI of tire data: we request that the agencies develop a SmartWay-like page with or information about tires' relative performances, perhaps on a green yellow red basis (unlike today, which is essentially a green or nothing basis). This would help HDV owners and buyers determine what the appropriate tires are. We as vehicle manufacturers cannot develop such a page because of limitations on our use of tire manufacturers' data. 80 FR 40216. [EPA-HQ-OAR-2014-0827-1164-A1 p.79]**

**Organization:** International Council on Clean Transportation (ICCT)

*Compliance data sharing.* We would also like to take this opportunity to express how the data sharing about compliance of regulated vehicles does not appear to be nearly as detailed or as regular as that of the regulatory development data availability as indicated in this NODA. As stated in our previous comments, we recommend that the agencies make all GEM inputs and outputs fully available to the public. Just as actual emission certification results are made public, these GEM data are the certification compliance data and therefore should be made publicly available. Making the full certification database publicly available is critical to let truck fleets who purchase the technologies, fleet consultants who advise on the technology purchases, researchers, and citizen groups transparently see what otherwise only is available to a select few government officials. In addition, we ask that the agencies include data on the sales (or production volume) by model year of each certified engine and vehicle, as regulatory compliance is based on a sales-weighted average of the results, and sales is a critical compliance determinant and a missing link to see industry and within-segment average CO2 and efficiency performance. [EPA-HQ-OAR-2014-0827-1876-A1 p.2-3]

We especially point out this compliance data question because the EPA began a process to be more forthcoming about the compliance data (US EPA, 2014). The ICCT and other stakeholders provided detailed comments (e.g., see ICCT, 2014). This process has apparently been halted. To date, compliance data for model year 2014 (i.e., "Phase 1") heavy-duty vehicles' GEM inputs, CO2 outputs, and critically the production volume of all the vehicles and engines, has not been made available, when it would be key in allowing stakeholders to understand the ongoing Phase 2 analysis. Similarly, in other compliance areas, full data availability has been lacking. For example, light-duty vehicle CO2 emissions are based on vehicle model-specific CO2 emissions, footprint, off-cycle credits, and production volume of vehicles; however, EPA only shares parts of this data without allowing stakeholders to see or understand all the compliance calculations. In addition, to our knowledge EPA has not shared the data to demonstrate heavy-duty diesel in-use compliance (e.g., Portable Emissions Measurement System data) for model year 2010- through 2014-compliant vehicles. [EPA-HQ-OAR-2014-0827-1876-A1 p.3]

We understand that this NODA is about Phase 2 regulatory development data. Nonetheless, we think data availability on compliance is at least as important as regulatory development data to ensure there is follow-through on the commitments and expectations put forth within each rulemaking. As a result, a full reporting of all model year 2014 vehicle and engine simulation input, testing, and output data needed to determine companies' compliance standing, within the 2016 heavy-duty vehicle Phase 2 final rulemaking release, would clearly seem warranted. Clear statements in the 2016 Final Rule about the timeline and details for future year (i.e., model year 2015-2027) public compliance data availability would also seem appropriate. [EPA-HQ-OAR-2014-0827-1876-A1 p.3]

**Organization:** Natural Resources Defense Council (NRDC)

Implement requirements to collect and disseminate data to the public on real-world technology adoption and performance to ensure that standards are leading to needed reductions in fuel use and carbon pollution. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

### **C. Collect and Disseminate Performance Data**

NRDC believes that the agencies should design and implement programs to verify that improvements required under the standards are resulting in the expected fuel consumption and emissions reductions in real-world driving. Improvements included in Phase 2 GEM and the addition of new drive cycles with vocational vehicles signal a significant transition toward compliance that accounts for more fuel efficient technology across the vehicle. To ensure that new technologies are being applied in the market and delivering real-world savings, the agencies should develop a program to collect and publicly disseminate existing vehicle performance data and data generated in future model years. The agencies should also establish procedures to demonstrate progress and to enhance the program transparency. [EPA-HQ-OAR-2014-0827-1220-A1 p.7]

The agencies should collect and publicly disseminate vehicle configuration and performance data from new vehicle sales and, to the degree possible, for the existing on-road fleet. Requirements for public data are intended to accomplish three goals: [EPA-HQ-OAR-2014-0827-1220-A1 p.7]

- (a) Establish a broad technical database to support transition from Phase 1 to Phase 2 GEM simulation that is validated by on-road measurements,
- (b) Enhance public understanding of actual technology adoption, and
- (c) Track actual on-road emissions and fuel consumption performance of new vehicles and the full on-road fleet.

The following recommendations are intended to address these goals. [EPA-HQ-OAR-2014-0827-1220-A1 p.7]

#### **i. Collect In-use Testing and Full Vehicle Testing Data and Make Data Publically Available**

EPA and NHTSA should build a public database of chassis and full-vehicle testing performed by manufacturers and the federal agencies. The agencies should expand its on-road testing to validate current compliance models and encourage manufacturers to provide more data. The agencies should make data available to the public to improve understanding of technology performance; where necessary, data can be aggregated to protect confidential business information. [EPA-HQ-OAR-2014-0827-1220-A1 p.8]

#### **ii. Build a Truck Market Database for Public Use and Evaluation**

Tracking fleetwide emissions is critical to understanding if improvements in per-truck emissions required under the standards are actually resulting in reductions of emissions from the entire on-road fleet. A future fleet of cleaner trucks could emit more carbon pollution than today's fleet if the future fleet has a larger population or travels more miles. [EPA-HQ-OAR-2014-0827-1220-A1 p.8]

EPA and NHTSA should aggressively support federal efforts to reinstate surveys to collect truck market data. Such surveys should provide a description of the truck fleet population and its operating characteristics. A description of the existing fleet has been provided publically in the past through the discontinued U.S. Census Vehicle Inventory and Use Survey (VIUS). The VIUS classified truck data by various characteristics including physical configuration (age, size, weight, body type, engine size, and mechanical equipment), operational uses (business purpose, range, efficiency, and geography) and fuel type. EPA and NHTSA should create a public database that includes current data from at least the same fields of the VIUS but also allows organization of data consistent with the subcategories used in the truck emissions and fuel economy compliance regime. [EPA-HQ-OAR-2014-0827-1220-A1 p.8]

**iii. Publish an Annual Report Describing New and On-Road Fleet Performance** EPA and NHTSA should annually release a report that describes the emissions and fuel consumption performance of the current and past model year fleets and the overall on-road fleet. For new vehicles, the report should contain data similar to EPA's annual publication of "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends". The report should be expanded to cover performance and summary characteristics of the existing fleet (from the market database described above) so an overall picture of medium- and heavy-duty truck emissions and fuel consumption progress is clear. [EPA-HQ-OAR-2014-0827-1220-A1 p.8]

**iv. Publish an Annual Report Describing Manufacturer Credit Balances and the Use of Any Credit Flexibility Mechanisms**

EPA and NHTSA should annually release a report that describes the manufacturer credit balances within each compliance category. The report should also include the generation of credits under all allowed flexibility provisions. [EPA-HQ-OAR-2014-0827-1220-A1 p.8]

**Organization:** Rubber Manufacturers Association (RMA)

**EPA Should Not Make Rolling Resistance Data Public, but Should Develop a Rating System for Medium and Heavy Truck Tires, to Include Replacement Tires.** Without an accurate and up to date rating system, publishing rolling resistance measurements could be counterproductive for operators. [EPA-HQ-OAR-2014-0827-1304-A1 p.2]

**The Agencies Should Not Publish Tire Rolling Resistance Measurements**

The NPRM correctly states that tire manufacturers consider rolling resistance test data to be proprietary. The NPRM continues to state that per EPA policy, "tire rolling resistance measurements are not considered to be CBI and can be released to the public after the introduction into commerce date identified by the manufacturer." The NPRM continues by requesting comment on whether "EPA should release such data on a regular basis to make it easier for operators to find proper replacement tires for their vehicles." While RMA appreciates the interest EPA expresses in educating vehicle operators about tire rolling resistance in order to provide information about appropriate replacement tires, releasing rolling resistance measurements would not contribute to this goal. RMA therefore recommends that the Agencies not publish tire rolling resistance measurements and instead consider a more thoughtful approach to providing tire rolling resistance ratings to replacement tire purchasers. [EPA-HQ-OAR-2014-0827-1304-A1 p.12-13]

More importantly, publishing test data would only serve to confuse the constituency the Agencies intend to assist. Rolling resistance test data submitted to an original equipment manufacturer (OEM) per this regulation would reflect test data from three tires, tested pursuant to the conditions specified in this

regulation. The test data would not provide any guidance about how to understand whether differences among these test data represent meaningful distinctions, from a fuel economy or greenhouse gas emissions standpoint, nor would it provide any information about test variability. Further, the test data would not provide any information about how the difference in rolling resistance between two tire models would translate to fuel savings on their specific type of vehicle. [EPA-HQ-OAR-2014-0827-1304-A1 p.13]

The challenges associated with publishing rolling resistance test data submitted pursuant to compliance with this regulation are heightened by the lack of a reference machine or alignment procedure. The alignment procedure developed in ISO 28580 was designed specifically for the purpose of facilitating meaningful comparisons among test data generated on different rolling resistance test machines. Without an alignment procedure, as RMA cited in its comments on the Phase 1 NPRM, differences in rolling resistance measurements of up to 20 percent can be seen in data generated on different well-controlled machines. Without limiting this source of variation and without explaining this statistical uncertainty, tire purchasers may make inaccurate assumptions about the granularity of the data published that could lead to inappropriate tire purchases. [EPA-HQ-OAR-2014-0827-1304-A1 p.13]

Even more compelling, if rolling resistance data were made available, it would not be actionable on the part of a truck or fleet operator, since similar information is not widely available for replacement tires. Providing rolling resistance data to the public only for tires sold as original equipment would disadvantage tires sold only as replacement tires, because information for those tires would not be similarly available on a government website. RMA does not oppose the concept of providing meaningful tire rolling resistance performance information to tire purchasers, if provided in an actionable, easy to understand format. In fact, today many RMA members provide fuel economy calculators for their truck tire customers freely on their websites. In addition, RMA has long supported providing tire rolling resistance consumer information (“tire efficiency” information) to consumers at point of sale for consumer vehicles. [EPA-HQ-OAR-2014-0827-1304-A1 p.13-14]

If the Agencies are serious about educating the replacement tire marketplace about rolling resistance performance of medium- and heavy-duty truck tires, RMA recommends that the Agencies develop a mandatory rating system for these products, applicable to tires used in original equipment fitments and those available in the replacement market. NHTSA is in the final stages of developing such a rating system for passenger car tires. In addition, the European Union has developed and implemented a similar rating system for tires sold in the EU. Information about the EU rating program is available at <http://ec.europa.eu/energy/en/topics/energy-efficient-products-and-labels/tyres>. If the Agencies were to develop such a rating system in the United States, it should include other important tire performance information, such as traction performance, to assure that tire purchasers make selections truly appropriate for their vehicle and driving needs. In addition, a tire should always match the vehicle and tire information placards’ specifications for tire and vehicle load ranges and speed ratings. [EPA-HQ-OAR-2014-0827-1304-A1 p.14]

In addition to providing tire replacement rolling resistance ratings for new tires, the Agencies should consider providing information to replacement tire purchasers about the benefits of retreaded tires, in terms of resource conservation as well as tire rolling resistance. Today, about 40 to 50 percent of the truck tires in service on America’s roads and highways are retreaded tires. EPA has recognized the significant role retreaded tires play in the truck tire market by including retreaded tires in the SmartWay™ Partnership technologies program. As EPA states on its SmartWay™ verified technologies website, “the EPA demonstrated that certain low rolling resistance retread products can reduce NOx emissions and fuel use of long haul class 8 tractor-trailers by 3 percent or more, relative to other popular high rolling resistance retread products.” The SmartWay™ verified technologies list

includes low rolling resistance treads (procure and mold cure) for retreaded tires that are at or below the target thresholds established for the treads of retreaded tires for drive and trailer use. [EPA-HQ-OAR-2014-0827-1304-A1 p.14]

**Rolling Resistance Machine Alignment.** RMA renews its call for the Agencies to establish a reference laboratory for use in correlating rolling resistance data generated in support of this rule and to provide a clear and unambiguous guide to the compliance tests that the Agencies may conduct to enforce this regulation. [EPA-HQ-OAR-2014-0827-1304-A1 p.35]

**EPA Should Not Make Rolling Resistance Data Public, but Should Develop a Rating System for Medium and Heavy Truck Tires, Including Replacement Tires.** Without an accurate and up to date rating system, publishing rolling resistance measurements could be counterproductive for operators. [EPA-HQ-OAR-2014-0827-1304-A1 p.35]

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### GEM Inputs and Fuel Map CBI Issues

The proposed fuel-map requirements raise significant issues for some manufacturers relating to the disclosure of confidential business information (“CBI”). Compelling engine manufacturers to provide 143-point fuel maps to third-party vehicle manufacturers (including in-advance of the production availability of the engines at issue) and to the public could result in the disclosure of engine manufacturers’ highly proprietary engine designs and fuel efficiency strategies, resulting in potentially significant adverse competitive effects. While encryption programs may be available to alleviate those concerns, those programs, as well as their potential integration into GEM, have not been assessed or finalized. [EPA-HQ-OAR-2014-0827-1269-A1 p.26]

Moreover, the Agencies are proposing to make GEM inputs subject to FOIA inquiries rather than to protect those inputs as CBI. That is not appropriate, and EMA objects to this aspect of the Proposed Phase 2 Standards. GEM inputs are not emission results and should be treated as CBI. It is not sufficient for the Agencies to safeguard this information only until the vehicle/engine is introduced into commerce. The GEM-input information goes to the core of market competition, and the Agencies must recognize that. Unlike the case with respect to criteria pollutant certification data, which will generally not affect the market, the Agencies’ proposal to open manufacturers’ highly competitive GHG/FE data to FOIA disclosures could distort the market in unexpected ways. For example, if fleets perceive that one manufacturer has better aerodynamics than another, the fleets could demand that the second manufacturer make aerodynamic improvements. This could be problematic if the first manufacturer optimizes its vehicles using technologies that actually compromise aerodynamics. The bottom line from this example is that the only thing that matters is on-road fuel efficiency or, as a surrogate, GEM results - the outputs, not the inputs. Moreover, the GEM inputs can be misleading, given that manufacturers often put in different compliance margins to better insure against SEAs, with the result that inputs such as aerodynamics may not be comparable, or may be misleading, from manufacturer-to-manufacturer. The concerns relating to engine fuel map data are just as significant, as noted above. In summary, the Agencies risk skewing the market for the worse if they reverse course by removing CBI protection for GEM inputs. [EPA-HQ-OAR-2014-0827-1269-A1 p.26-27]

EPA is also seeking comment on whether the Agency should consider notch-specific engine/alternator efficiencies to be confidential business information. Under the current “*Class Determination 1-13, Confidentiality of Business Information Submitted in Certification Applications for 2013 and subsequent model year Vehicles, Engines and Equipment,*” there are three possible ways such information could be



treated: 1) as information not entitled to confidential treatment; 2) as information entitled to confidential treatment until introduction into commerce; or 3) information entitled to confidential treatment. The “Class Determination” document, authored by EPA’s Office of General, provides guidance as to how to determine which of these three treatment options is appropriate for various types of information. [EPA-HQ-OAR-2014-0827-1269-A1 p.75][This section can also be found in section 14.4.12 of this comment summary]

The following table, taken from the Class Determination document, lists the information that can be entitled to confidential treatment. [EPA-HQ-OAR-2014-0827-1269-A1 p.75][This section can also be found in section 14.4.12 of this comment summary]

[Table 3, 'Manufacturer Information Entitled to Confidential Treatment', can be found on p.76 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

In accordance with EPA regulations at 40 C.F.R. sections 2.204 and 2.205, information will be entitled to confidential treatment if the manufacturer (1) asserts that the information is entitled to confidential treatment, and (2) has not waived or withdrawn that assertion. Inherent in assertion (1) are the following representations by the manufacturer: (a) they have maintained the information in confidence, (b) the information cannot be readily obtained by other legitimate means, and (c) disclosure of the information to the public both before and after model introduction would be likely to cause substantial harm to the manufacturer’s competitive position. [EPA-HQ-OAR-2014-0827-1269-A1 p.76][This section can also be found in section 14.4.12 of this comment summary]

EPA provides two alternative methods to certify engines used in locomotive applications. Such engines can be certified on an engine dynamometer or alternatively in the locomotive. In the latter case, it is necessary to know the notch-specific engine/alternator efficiencies to ensure that the engine is tested at the appropriate speed and load conditions. [EPA-HQ-OAR-2014-0827-1269-A1 p.76][This section can also be found in section 14.4.12 of this comment summary]

EMA believes that notch-specific engine/alternator efficiency clearly fits within the category “Technical Description Information” on Table 3 above. Accordingly, EMA believes that notch-specific engine/alternator efficiencies readily meets the criteria set forth in 40 CFR 2.204 and 2.205 and should be treated as confidential business information. [EPA-HQ-OAR-2014-0827-1269-A1 p.77][This section can also be found in section 14.4.12 of this comment summary]

**Organization:** Truck Renting and Leasing Association

We also are concerned that the Proposed Standards do not go far enough in protecting company proprietary information which could discourage innovation. Fuels maps and related data-rich information are closely held within our industry, yet the Proposed Standards seem to envision that such information will be made available to parties outside of the requisite company. [EPA-HQ-OAR-2014-0827-1140-A1 p.4-5]

**Organization:** Volvo Group

### **GEM Inputs Should be maintained as Confidential Business Information**

As noted in the EMA comments, Volvo Group is concerned with proprietary data considered Confidential Business Information (CBI) becoming public domain if used in the certification of engines

and vehicles. Fuel mapping strategies, transmission shift strategies, and other features that Volvo Group views as proprietary and confidential, and as providing a competitive edge in the constant race to lead the HHD market in fuel economy, would become available to competitors not only once that technology is released into production, but in the case of a competitor to whom we are also a supplier that information would need to be made available prior to their vehicle model year certification. Furthermore, since GEM inputs are not “emissions data”, they are not automatically subject to disclosure under CAA § 208(c), 42 U.S.C. § 7524(c). [EPA-HQ-OAR-2014-0827-1290-A1 p.32]

We do, however, recognize that it will be necessary for vehicle manufacturers to have access to required GEM inputs from suppliers, including engines, transmissions, axles, and tires. We believe such data, if considered proprietary, could be encrypted so that it could be read into the GEM tool without direct access to vehicle manufacturers who may also be competitors to these suppliers. Such encrypted data could be restricted only to OEM certification personnel via a confidentiality agreement. Another alternative is to use a third party contractor to run GEM simulations for vendor supplied engines so that fuel maps could be maintained as confidential. We also believe that data for tire rolling resistance should be publicly available so that vehicle owners can know which replacement tires will maintain the vehicle in its certified configuration. [EPA-HQ-OAR-2014-0827-1290-A1 p.32]

In addition, given the complexity of the Phase 2 rule making there is concern over this information being provided openly to a public that is not familiar with the technologies and derivation of the GEM inputs employed to certify to the Phase 2 regulation, as well as the data being misrepresented to competitively target customers with the same limited knowledge. [EPA-HQ-OAR-2014-0827-1290-A1 p.32]

For these reasons Volvo Group is requesting the Agencies consider this data as confidential business information, and treat it accordingly. [EPA-HQ-OAR-2014-0827-1290-A1 p.32]

**Response:**

The agencies received mixed comments regarding the question of whether GEM inputs should be made available to public. Some commenters supported making this information available, while others thought it should be protected as confidential business information (CBI). In accordance with Federal statutes, EPA does not release information from certification applications (or other compliance reports) that we determine to be CBI under 40 CFR part 2. Consistent with section 114 (c) of the CAA, EPA does not consider emission test results to be CBI after introduction into commerce of the certified engine or vehicle. (However, we have generally treated test results as protected before the introduction into commerce date). EPA has not yet made a final determination for Phase 1 or Phase 2 certification test results or other GEM inputs. Nevertheless, at this time we expect to continue this policy and consider it likely that we would not treat any test results or other GEM inputs as CBI after the introduction into commerce date as identified by the manufacturer.

In a broader context, the agencies agree with the principle that it would be helpful to make available to the public data and information that would enable the public to track trends in technology sales over time, as well as track company-specific compliance data. As described in the FRM Preamble, one approach would be to publish an annual compliance report for the Heavy-duty Phase 2 program. In the context of the light-duty vehicle GHG standards, EPA has already published four annual compliance reports which has made available to the public detailed information regarding both how individual light-

duty vehicle companies have been meeting their compliance obligations, as well as summary information at the light-duty fleet level. NHTSA makes information on the light-duty fuel economy program available through its CAFE Public Information Center ([http://www.nhtsa.gov/CAFE\\_PIC/CAFE\\_PIC\\_Home.htm](http://www.nhtsa.gov/CAFE_PIC/CAFE_PIC_Home.htm)). Information includes manufacturer and overall fleet standards and CAFE performance, credit status, and civil penalty status. This information has been helpful to increase transparency to all stakeholders and to allow the public to see how companies are progressing from one year to the next with respect to their compliance requirements. Prior to issuing such compliance reports, EPA and NHTSA will work with regulated manufacturers to reconcile concerns over the release of claimed confidential business information, consistent with 40 CFR Part 2 and 49 CFR 512.

#### **1.4.7 General ABT issues 197**

**Organization:** American Automotive Policy Council

##### Credit Transfers

In the Preamble of the Phase 1 Heavy-Duty rule (76 Federal Register 57106, 57127-28) NHTSA stated that it was implementing “Program Flexibilities” in the form of different kinds of CAFE credits, and averaging, banking and trading (ABT) provisions. NHTSA also said that it’s important for manufacturers to plan for compliance using a multi-year time frame, consistent with normal business practice. NHTSA decided that it was prudent to start with a five-year carry-forward and three-year carry-back approach to credit usage, but in doing so NHTSA would have time thereafter “to learn about technical and other issues that can inform future rulemakings[, and that i]n the future, [NHTSA] intend[s] to consider whether additional cost savings could be realized through broader trading provisions and whether such provisions could be designed so as to address any other relevant concerns.” [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

As raised during the interagency EO12866 review, AAPC agrees that the ability to transfer credits between fleets can offer a cost effective way to meet multiple regulatory compliance challenges. With limited product offerings and smaller fleet volumes, manufacturers of heavy-duty vehicles and engines have unique limitations compared to manufacturers of light-duty vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

AAPC requests that the Agencies provide heavy-duty manufacturers with all reasonable mechanisms to manage their fleet compliance. Current allowances for averaging, banking and trading that allow trading only between narrowly defined averaging sets are overly restrictive, providing very limited flexibility to large manufacturers and no flexibility to manufacturers who may only have a single product in a given averaging set. [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

AAPC strongly encourages the Agencies to remove the restrictions for credit trading between engine and vehicle averaging sets as well as to allow for trading of credits between Class 2b/3 trucks and vans with vocational vehicles and engines on a “Megagrams of CO<sub>2</sub>” and “gallons” basis. [EPA-HQ-OAR-2014-0827-1238-A1 p.16]

Specifically, AAPC proposes trading across all medium- and heavy-duty compliance categories and light duty fleets and would work with the Agencies to define necessary adjustment factors to get all units into equivalent megagrams\*. [EPA-HQ-OAR-2014-0827-1238-A1 p.16]

[Figure of vehicle adjustment factors can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

**Organization:** California Air Resources Board (CARB)

**Oppose/Comment on Topic Where NPRM Requests Comment**

**Comment – Use of banked Phase 1 credits in Phase 2 program / Credit adjustment factors**

The NPRM indicates that “positive market reception to Phase 1 technologies could lead to manufacturers accumulating credit surpluses that could be quite large at the beginning of the Phase 2 program” (pages 40157 and 40251 of the NPRM). The NPRM does not attempt to quantify the level of projected banked credits that could be available at the end of Phase 1. However, U.S. EPA and NHTSA believe, even at this early stage of Phase 1 implementation, that substantial credits will be available that will impact Phase 2 cost, technology readiness, and other key variables. The NPRM provides almost no analysis of, nor accounting for, the potential implications of a large number of banked Phase 1 credits. A large number of Phase 1 credits means that manufacturers have adopted CO<sub>2</sub> reducing technologies much faster than originally anticipated. However, the NPRM baseline scenarios do not recognize that a large number of banked credits reflect technology advancement beyond Phase 1 standards: [EPA-HQ-OAR-2014-0827-1265-A1 p.78-79]

“In each of these proposed baseline configurations, the agencies have not applied any vehicle-level fuel saving or emission reduction technology beyond what is required to meet the Phase 1 standards. NHTSA and EPA reviewed available information regarding the likelihood that manufacturers of vocational vehicles would apply technology beyond what is required for Phase 1, and we concluded that the best approach was to analyze a reference case that maintains technology performance at the Phase 1 level.” (page 2-113 of the RIA). [EPA-HQ-OAR-2014-0827-1265-A1 p.79]

U.S. EPA and NHTSA propose that these credits be fully carried over into the Phase 2 regulations, without discounting. CARB staff has several concerns with this approach: [EPA-HQ-OAR-2014-0827-1265-A1 p.79]

1) Allowing banked Phase 1 credits in the Phase 2 program reduces the efficacy of the Phase 2 program and delays technology development progress. Generation of large volumes of credits in the Phase 1 program indicates that technology has progressed faster than anticipated during the Phase 1 rulemaking. This faster Phase 1 progress should not justify reduced progress during Phase 2. CARB staff believes sunsetting these credits with the Phase 1 program would still provide manufacturers the opportunity to utilize these credits during Phase 1 (although some manufacturers may not), while maintaining the technological momentum needed to cost-effectively meet more aggressive Phase 2 standards. CARB staff believes that, at most, the life of remaining Phase 1 credits should be limited to no more than three years or with MY 2020, whichever is sooner, such that they would be sunsetted after MY 2020. [EPA-HQ-OAR-2014-0827-1265-A1 p.79]

2) The cost and benefit assessments in the NPRM did not account for the potential of large quantities of banked Phase 1 credits in either of the “baseline” scenarios. If manufacturers have banked large numbers of credits at the beginning of the Phase 2 program, this suggests that the baseline for purposes of cost-benefit and feasibility analysis at the beginning of Phase 2 should reflect Phase 1 plus the technology advancement associated with the large numbers of banked credits. A large number of credits at the end of Phase 1 suggests the trajectory of technology advancement may be more rapid than utilized

for baseline scenario modeling, and a more dynamic baseline may be appropriate. [EPA-HQ-OAR-2014-0827-1265-A1 p.79]

3) Not only does the NPRM not discount the Phase 1 credits when carrying them over into Phase 2, it actually adjusts these credits upwards, reflecting an increase in the proposed useful life definition. CARB staff recommends against use of these proposed adjustment factors. U.S. EPA and NHTSA base the calculation of credits on factors such as the emission level compared to the standard and the useful life. Some of the useful life values in Phase 1 were substantially shorter than the actual typical useful life; U.S. EPA and NHTSA have proposed to increase the useful life period for these classes of vehicles. As a consequence of this increase, U.S. EPA and NHTSA propose to apply an adjustment factor relating the old useful life to the new useful life. U.S. EPA and NHTSA assert that CO<sub>2</sub> deterioration is relatively flat and thus, one can presume that the certified CO<sub>2</sub> levels will indeed continue to be met over the longer useful life. While CARB staff agrees that it is appropriate to adjust the useful life upwards to more closely represent the actual useful life, if the credit is multiplied by the ratio of new “actual” useful life to Phase 1 (shorter) useful life, an additional fractional credit will be generated for a benefit that already exists. Because this change in the useful life reflects a recognition of the actual useful life, rather than an increase in the anticipated useful life, CARB staff believes that it is not appropriate to apply a credit adjustment factor to these credits. Allowing the Phase 1 credits to be adjusted upward based on a new extended useful life, as proposed, would take benefits achieved by the Phase 1 program and -- instead of allowing them to benefit the environment -- would allow them to be used to reduce the potential benefits of the proposed Phase 2 program. [EPA-HQ-OAR-2014-0827-1265-A1 p.80]

CARB supports the use of ABT to enable manufacturers to meet Phase 1 and Phase 2 standards in the most efficient and cost-effective way. However, allowing excess Phase 1 credits into the Phase 2 program could result in slower technology advances than anticipated in the NPRM. CARB encourages U.S. EPA and NHTSA to consider sunsetting banked Phase 1 credits in the Phase 2 program to lock in the faster than anticipated technology adoption anticipated from Phase 1. CARB staff specifically suggests that the Phase 1 credits, which currently expire after 5 years, be set to expire in three years or with MY 2020, whichever is sooner. CARB staff further recommends that Phase 1 credits not be adjusted upwards to reflect the change in the useful life to more properly approximate actual useful life. Finally, CARB staff suggests a more dynamic baseline than U.S. EPA and NHTSA are proposing may be appropriate if U.S. EPA and NHTSA are correct in presuming the accumulation of large numbers of Phase 1 credits. [EPA-HQ-OAR-2014-0827-1265-A1 p.80]

Manufacturers are demonstrating their ability to utilize ABT to cost-effectively meet and exceed existing GHG standards. If U.S. EPA disagrees with CARB’s recommendation and maintains its proposal to allow Phase 1 credits in Phase 2, a significant number of Phase 1 credits in the early years of Phase 2 provides greater justification for adopting Alternative 4 over Alternative 3 (as is CARB staff’s recommendation discussed elsewhere in this comment package). [EPA-HQ-OAR-2014-0827-1265-A1 p.81]

### **Oppose/Requested Change Comment**

#### **Comment – Retirement of emission reduction credits**

CARB staff recommends U.S. EPA and NHTSA consider the inclusion of a mechanism within the proposed Phase 2 rulemaking for manufacturers to quantify and then voluntarily forego/retire emission reduction credits (particularly for hybrid heavy-duty engines) in a way that is simple, real, transparent, and enforceable. CARB staff is currently developing innovative technology regulatory requirements that

could allow hybrid engine, vehicle and/or driveline manufacturers to meet more flexible CARB OBD and other certification requirements to facilitate market launch of key hybrid truck and bus technologies. The innovative technology regulations could also provide more limited certification flexibility for other innovative engine technologies, such as WHR, that have the ability to achieve even greater CO2 emission reductions. CARB staff anticipates that the innovative technology regulations could require manufacturers opting to receive this flexibility to demonstrate that the applicable hybrid or other innovative technology be surplus to all applicable rules, regulations, or other requirements. Further detailed discussion on these issues follows. [EPA-HQ-OAR-2014-0827-1265-A1 p.86]

CARB staff is exploring how a potential innovative technology surplus emission reduction compliance demonstration might be conducted in a transparent and efficient way. One potential approach might be to allow manufacturers to generate emission reduction credits from the hybrid or other innovative technology as part of their federal Phase 2 compliance demonstration, and then require the manufacturer to forego/retire these credits as part of their possible Phase 2 ABT reporting. This report would then be shared with CARB as part of the demonstration that the hybrid technology receiving certification flexibility via the innovative technology regulation is surplus to any Phase 2 requirement. The accounting involved with generation, quantification, and retirement of the applicable emission reduction credits would be critical for CARB to determine that the hybrid engines opting to participate in the innovative technology regulation are surplus to Phase 2. Such a mechanism could mirror the approach taken in the NPRM, 40 CFR 1039.710(h), which allows for quantification and retirement of emission reduction credits generated by off-road engines. We believe credit for hybrid engines not participating in the Innovative Technology Regulation should continue to be allowed. [EPA-HQ-OAR-2014-0827-1265-A1 p.86-87]

Another potential approach might be to allow manufacturers to voluntarily designate their credits to a third party, such as CARB (or other public agencies). Such an approach would provide CARB staff with assurance that a banked credit is permanently retired. [EPA-HQ-OAR-2014-0827-1265-A1 p.87]

Without a reporting mechanism to ensure a technology is (and remains) surplus to the proposed Phase 2 requirements in each compliance MY, a potential Innovative Technology Regulation may need to require manufacturers to supplement any adopted federal Phase 2 compliance demonstrations with a California-specific Phase 2 compliance demonstration (with and without the hybrid or other technology, weighted as appropriate by its anticipated California sales volume). Even in such circumstances, however, it may be challenging for CARB staff to track whether a manufacturer utilizes the “surplus” reduction associated with the hybrid or other technology in future year federal compliance demonstrations. A formal mechanism for manufacturers to demonstrate compliance with any adopted federal Phase 2 standard, generate the appropriate emission reduction credits associated with a specific technology, and then permanently forego/retire those credits could help align a potential CARB Innovative Technology Regulation with any adopted federal Phase 2 program, and provide a simple, real, transparent and enforceable mechanism to encourage key technologies in California that go beyond proposed Phase 2 standards. CARB staff looks forward to discussing such a potential approach with U.S. EPA and NHTSA over the coming months as CARB, U.S. EPA and NHTSA consider the adoption of these potential rulemakings. [EPA-HQ-OAR-2014-0827-1265-A1 p.87]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Foregoing emission credits; Expiration of credits**

CARB staff fully supports the provisions in 40 CFR 1039.701(h) that allow manufacturers to voluntarily waive their rights to use banked emission credits. CARB staff’s only recommendation for amending this

proposal is that U.S. EPA and NHTSA should clarify that manufacturers choosing not to generate credits for an engine family certified to a FEL more stringent than the applicable standard, as described in 40 CFR 1039.701(h)(2), are permanently bound by that choice and cannot later decide to claim credits for that engine family retroactively in a subsequent MY. [EPA-HQ-OAR-2014-0827-1265-A1 p.128]

On a separate but related topic, CARB staff recommends that U.S. EPA and NHTSA adopt provisions to set a reasonable timeframe for the compulsory expiration of Tier 4 non-road compression ignition emission credits, and codify the terms for expiration in 40 CFR 1039.740. California is a participant in the federal ABT program and is therefore dependent on U.S. EPA and NHTSA for action regarding this request. Our concern is the delay in the full implementation of engines in California equipped with advanced exhaust aftertreatment controls for both PM and NOx. More manufacturers than anticipated are certifying off-road compression ignition engine families in California to Tier 4 final standards without simultaneously employing both PM and NOx aftertreatment devices, and this is due in part, we believe, to manufacturers' use of banked emission credits. We recognize that other factors may contribute to this situation as well, but addressing the expiration of emission credits would help California to more quickly achieve its much needed PM and NOx emission reduction goals. [EPA-HQ-OAR-2014-0827-1265-A1 p.128]

**Organization:** Cummins, Inc.

Cummins supports inclusion of ABT provisions in the Phase 2 GHG/FE regulation [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

Cummins considers ABT to be an important and necessary part of any regulatory program. ABT encourages earlier implementation of new technologies, allows manufacturers flexibility in planning their investments and managing product costs and provides relief for technical and lead-time issues. All contribute to the development of reliable products that meet the needs of customers. We support the inclusion of ABT provisions in this rulemaking. As described below, Cummins agrees with many aspects of the proposed Phase 2 ABT program for GHG/FE that assist in a successful implementation of the program without sacrificing the sought after environmental and fuel-saving benefits. [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

*Cummins supports maintaining the Phase 1 ABT averaging set restrictions* [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

In the Preamble (80 FR 40157), the Agencies are proposing to continue the Phase 1 averaging sets and restrictions in Phase 2. Cummins agrees with maintaining the Phase 1 averaging set and restrictions such as: [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

- No credit exchange between gasoline, light heavy-duty (LHD), medium heavy-duty (MHD) and heavy heavy-duty (HHD) engines. [EPA-HQ-OAR-2014-0827-1298-A1 p.30]
- Credit exchange allowed between vocational and tractor engines within a service class. [EPA-HQ-OAR-2014-0827-1298-A1 p.30]
- No credit exchange between engines and vehicles. [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

*Cummins supports continuing the use of CO<sub>2</sub>-equivalent credits to comply with nitrous oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>) standards* [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

The Agencies are proposing the continued use of CO<sub>2</sub>-equivalent credits to comply with N<sub>2</sub>O and CH<sub>4</sub> standards. Continuing this provision is appropriate in Phase 2, and Cummins supports it. The specified Global Warming Potentials (GWP) of N<sub>2</sub>O and CH<sub>4</sub> are used to account for the equivalent CO<sub>2</sub> credits needed to offset any standards exceedance. This flexibility has been applied by various manufacturers in Phase 1 and is necessary for Phase 2. [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

*Cummins opposes a 90-day final reporting deadline for ABT* [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

Cummins urges the Agencies to maintain Phase 1 ABT reporting deadlines where the final ABT report is due at 270 days after the end of the model year. Many engine/vehicle first point of sale information is not known for well over 90 days after the model year is over. Thus, without that location information the credits from those engines would not be allowed if the first point of sale was in the US and occurred on day 91. This is an unreasonable and punitive proposal due to the fact that the markets and customer demand fluctuates and not all first point of sales will occur within 90 days at the end of the model year. The current final reporting using first point of sale information up to 270 days needs to be maintained. [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

**Organization:** Daimler Trucks North America LLC

· **Averaging, Banking & Trading (80 FR 40387 et seq.)** - The agencies propose to retain the 5-year carry-forward rule for all heavy-duty sectors. The agencies should instead allow a credit carry-forward period of more than 5 years, allowing Phase 1 credits generated in the model years 2014 to 2019 to be used in later model years up to 2027. EPA included a similar provision in the light-duty vehicle regulations. This provision would assist manufacturers in retaining their usual heavy-duty vehicle lifecycles (much longer than 10 years) and gaining additional compliance flexibility. By including such a provision, the agencies would allow an appropriate lead time that will enable the industry to comply with the Phase 2 regulations. As the costs for fuel-saving technologies are likely to decrease over time, future vehicle generations can be equipped with future technologies at lower costs. [EPA-HQ-OAR-2014-0827-1164-A1 p.113-114]

· **Credit Transfer Between Class 2b-3 Medium-Duty and Light-Duty Programs** Daimler encourages EPA and NHTSA to allow the transfer of credits between the medium-duty truck and van (Class 2b-3) program and the light-duty vehicle program. As EPA recognized in responding to similar comments made by Daimler on the light-duty Phase 2 proposed rule, EPA is authorized under the Clean Air Act to allow such transfer. See EPA Response to Comments, 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, at 10-13 (Aug. 2012). Previously, EPA indicated that such a step would require careful analysis and notice and comment, see 77 FR 62789 (Oct. 15, 2012), and committed to making such a proposal for broader credit transfers, including transfers between light- and heavy-duty vehicles, in the second phase of its heavy-duty GHG rulemaking. See 76 FR 57128 (Sept. 15, 2011) (“Through this public process, emphasizing the Administration’s strong preference for flexible approaches and maximizing the use of market tools, the agencies intend to fully consider whether broader credit trading is more appropriate in developing the next phase of heavy-duty regulations.”). Although the heavy-duty Phase 2 proposed rule has not specifically proposed allowing such a credit transfer, as the agencies committed, the agencies have requested comment on all aspects of their proposed medium-duty truck and van standards and on all aspects of their proposed Averaging, Banking, and Trading program. [EPA-HQ-OAR-2014-0827-1164-A1 p.114]

The agencies purposely structured the medium-duty truck and van program to be akin to the light-duty program. The program is attribute-based with the standards set pursuant to a mathematical function.



While the agencies added elements to the footprint-based attribute to account for the functionality of these vehicles, the agencies also made clear that the measured performance values for CO<sub>2</sub> are generally equivalent to fuel consumption. Compliance with the light-duty and medium-duty standards is measured through similar dynamometer light-duty program. The agencies recognize all of these commonalities in the heavy-duty Phase 2 proposed rule. See 80 FR 40148 (recognizing similarities between medium-duty trucks and vans and light-duty vehicles), 40175 (same chassis dynamometer test procedure), 40331-32 (comparable weight range, manufacturing, and GHG/fuel economy technologies), 40365 (recognizing technology sharing and requesting comment on agency plans to analyze light-duty and medium-duty trucks and vans jointly). [EPA-HQ-OAR-2014-0827-1164-A1 p.114]

Daimler considers the standards established for medium-duty trucks and vans to be challenging and aggressive. For example, compliance with the Phase 1 standards required that many 6- cylinder diesel engines be downsized to 4-cylinder diesel engines. Far from creating “windfall” credits to apply to the light-duty program, any credits earned with regard to Class 2b-3 vehicle represent substantial emissions improvements, as well as real and measurable reductions in CO<sub>2</sub>. [EPA-HQ-OAR-2014-0827-1164-A1 p.114-115]

In the medium- and heavy-duty Phase 1 rule, the agencies effectively created three separate programs: one for tractor/trailers, one for vocational vehicles, and one for medium- and heavy-duty trucks and vans. While the first two programs involve vehicles where emissions regulation has in the past been focused exclusively on engines, the third program is vehicle- based—just as with the light duty GHG program—and in fact involves vehicles in the same weight ranges but subject to different use. Vehicles that meet certain criteria designed to identify “work trucks” are placed with the medium-duty truck and van program, while vehicles meeting certain criteria designed to identify “medium duty passenger vehicles” are placed within the light-duty program. Allowing credit transfers in this class between the light-duty and light heavy-duty vehicle fleets is consistent with the agency’s general structure to treat like vehicles alike. The basic programs categorize vehicles by general type, construction, and use. The ABT program recognizes that similarly weighted vehicles are likely to utilize the same engine, transmission, and after-treatment technologies to reach and exceed compliance. EPA established a system whereby similar vehicles using similar technologies could share credits across the various programs. Nothing in the Clean Air Act prohibits the agency from using its discretion to harmonize and promote its greenhouse gas program across similar vehicles and to promote more broadly the application of emissions reducing technology. EPA should exercise this discretion in a limited fashion to allow credits earned on Class 2b-3 vehicles in the medium-duty truck and van program to be applied in the light-duty program as well. [EPA-HQ-OAR-2014-0827-1164-A1 p.115]

NHTSA also has the legal authority to apply credits developed in its medium- and heavy-duty fuel consumption program. Although the legislation mandating NHTSA’s program did not expressly authorize a credit program, NHTSA nonetheless exercised its discretion in the heavy-duty Phase 1 rulemaking to adopt one and to harmonize its program with the EPA program. NHTSA also noted in the program that it has considerably more leeway within the medium- and heavy-duty program to establish flexibilities and to include consideration of credits within its standard setting than it does under the light-duty program. Allowing the transfer of Class 2b-3 vehicle credits between the medium-duty program and the light-duty program is an extension of the same discretion that led and authorized NHTSA to develop the medium-duty credit program initially. Daimler urges NHTSA to use the same authority to extend the credits in a limited fashion, and along the same lines as EPA, to allow credits generated on Class 2b-3 medium-duty trucks and vans to be applied in the light-duty CAFE program. [EPA-HQ-OAR- 2014-0827-1164-A1 p.115]

**Technology neutral standards:** The EPA proposes technology neutral standards. We agree that this is the right approach. Prescribing technology to vehicle manufacturers is not the right role for the EPA. That said, the agencies should recognize that—although they purport to create technology neutral standards—in creating a separate engine standard alongside a vehicle standard, the agencies depart from technology neutrality, forcing technology onto the engine even if the same net emissions impact on-road could be achieved through vehicle-side technologies. We recommend that, upon a showing from a manufacturer that a vehicle-side technology creates extra emission reductions beyond those necessary for vehicle-side compliance, that the manufacturer be able to convert those extra emission reductions into an engine-side credit (and vice versa). Only with such an allowance will the agencies truly achieve the technology neutrality that they claim their regulations have. [EPA-HQ-OAR-2014-0827-1164-A1 p.116]

**Erroneous reference:** in ABT provisions, the EPA requires that a manufacturer account for a credit limitation at 1037.40(c), yet there is no such provision. The agency needs to clarify. 1037.40(c) [EPA-HQ-OAR-2014-0827-1164-A1 p.117]

**Organization:** Eaton Vehicle Group

The EPA requested comments on the life of Phase 1 credits in 2021. We are working with some OEMs to produce Phase 1 credits with advanced technology in the market today and are accelerating advanced technology development and deployment. Should Phase 1 credits carry over toward 2021 compliance, we would be further incentivized to accelerate new fuel saving technology as it would also generate compliance value and flexibility for our customers. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 103.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 121-122.]

We have also had favorable experience with the extended carry forward time allowed in the light duty regulation, which has resulted in manufacturers achieving greater improvements sooner based on the understanding that they will not waste through expiration the surplus credits that they have earned through their early actions. This concept could also be applied to the medium and heavy duty segments.

**Organization:** Gentherm, Inc.

**Comment #1. Treat Tractor emissions at the Tractor level; provide a transparent mechanism for efficiency improvements trades between Powertrain and Engine technology areas.** [EPA-HQ-OAR-2014-0827-1133-A1 p.1]

### **Background from Draft**

“We also propose not to allow trading between engines and chassis, even within the same vehicle class. Such trading would essentially result in double counting of emission credits, because the same engine technology would likely generate credits relative to both standards.” [EPA-HQ-OAR-2014-0827-1133-A1 p.1-2]

In the proposed draft the target for improvements of CO2 emissions for Engines is listed as 4% for diesel engines and 0% for gasoline engines. At the same time, the expected CO2 emission reduction resulting from powertrain improvements are listed at 24%. [EPA-HQ-OAR-2014-0827-1133-A1 p.2]

**Proposed change:** Gentherm recommends allowing for a mechanism to trade emission reductions between engine and chassis. In other words, we are proposing an implementation of mechanism which would encourage engine manufacturers to adopt advanced technologies which would reduce CO2 emissions beyond the level defined in this ruling. To achieve this we are proposing an ability to apply additional improvements at the tractor level. As an example, if an engine improvement in a gasoline engine (and associated technologies such as Waste Heat Recovery) of Class 7 vehicle can contribute to CO2 emissions reduction, this could be accounted towards the overall goal of efficiency improvement. Another example would be a case where improvement of diesel engine emission exceeds the stipulated 4%. The proposal would be to allow the improvements above the stipulated numbers to count towards overall tractor improvement efficiency, effectively allowing trading between the improvements from Engines and Powertrain. Instead of the concern of double-counting the credits, as indicated in the draft of the rule today, the allowance of trading would stimulate industry cooperation between engine and chassis/powertrain makers. [EPA-HQ-OAR-2014-0827-1133-A1 p.2]

**Organization:** National Automobile Dealers Association (NADA)

NADA/ATD fully supports the proposals allowance for averaging, banking, and trading, for small business accommodations, and for other flexibilities designed to enhance compliance and program effectiveness. [EPA-HQ-OAR-2014-0827-1309-A1 p.11]

**Organization:** Navistar, Inc.

Sections 1036.730 and 1037.730 of the NPRM propose to set the deadline for filing final ABT reports to March 31<sup>st</sup> following the model year, thus reducing total the period for filing final ABT reports. This is a significant reduction in the filing time frame from that in the current rule requirements of 90 days for an end of the year report and 270 days for a final report. Navistar opposes the reduced time frame for the final report. The rules as they exist already constitute a significant burden. This change also appears to reduce the time frame to correct errors, since the rules currently allow all errors to be corrected by the final report. The proposal effectively only allows the correction of an error if it works against the manufacturer by reducing the number of credits. There is no reasonable basis for this change. Given the complexity of the rules, manufacturers ought to be able to correct any errors within 270 days as is presently the case. In addition, this proposed change coupled with significant cutting of the final report deadline will have an unnecessary and unwarranted effect of increasing the burden on the manufacturer. We also note that the 90 / 270 day timeframe has been in place for many years for other types of emissions such as NOx, and will remain in effect in that context. There is no reason a dual time frame should exist. Navistar would be in favor of eliminating the first report at March 31 as part of an alternative approach that allows a single report, but provides sufficient time in which to create that report. We also note, in this regard, that the Proposed Rule potentially significantly expands the number of separate families that must be tracked for ABT purposes. This only increases the burden and argues directly feasibility of allowing less time for report filing than is the case today. [EPA-HQ-OAR-2014-0827-1199-A1 p.14]

**Organization:** PACCAR, Inc.

**Retain the Existing ABT End of Year 270-day Reporting**

The proposal to reduce the time for end of year reporting for Averaging, Banking, and Trading (ABT) and for production volumes to 90 days after the end of the calendar year named in the model year is overly restrictive. This proposal comes too soon after production periods are completed and will add an unnecessary burden onto manufacturers as well as preventing EPA and NHTSA from receiving the most complete and thus more accurate data on the vehicle and engine configurations that are entering into operation. PACCAR recommends retaining the current 270 days from the end of the calendar year that is named in the model year for report submission. [EPA-HQ-OAR-2014-0827-1204-A1 p.29]

**Organization:** Tiffin Motorhomes, Inc.

IV. Compliance with the proposed regulations using ABT is not possible or feasible for Tiffin

After a studied reading of the proposed regulations, it is not possible or feasible for Tiffin to meet the proposed 2021, 2024 and 2027 standards using ABT. [NHTSA-2014-0132-0099-A1 p.3]

The ABT provisions are not a viable alternative for Tiffin for two reasons. First and foremost, Tiffin currently manufactures only two chassis models, one classified as a MHO, the other as an HHD. These chassis are produced only for motorhomes, and exclusively for Tiffin. This narrow range of products along with the low production volume provide a much lower level of compliance flexibility under the ABT provisions. The annual production volumes for these chassis are; MHO 300-500 units per year, and HHD 500-700 units per year. [NHTSA-2014-0132-0099-A1 p.3-4]

**Organization:** Truck & Engine Manufacturers Association (EMA)

AB&T Credit Life and Averaging

Allowing Phase 1 credits to carry-over into the Phase 2 program is critical to the feasibility and cost-effectiveness of the Proposed Phase 2 Standards for medium-duty and heavy-duty vehicles. Simply stated, if Phase 1 credits were to expire at the end of the Phase 1 program, the Phase 2 program, as proposed, would not be feasible for heavy-duty vehicles. In addition, the Agencies should clarify that manufacturers are not required to use current-year excess credits to balance a prior-year's deficit. [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

In particular, the Agencies will need to change the wording of proposed sections 1036.745(c) and 1037.745(c), which are carry-overs from the Phase 1 program. Currently, those provisions state as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

(c) You may apply only surplus credits to your deficit. You may not apply credits to a deficit from an earlier model year if they were generated in a model year for which any of your engine families for that averaging set had an end-of-year credit deficit. (Emphasis added) [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

While the Agencies' intent in proposing this language may be to require manufacturers to reconcile an aggregate deficit within a given model year before carrying credits over to off-set a deficit in a different model year – with the net effect that only “surplus” credits from a model year can be used – the current regulatory language is not so limited. Manufacturers necessarily will have engine and vehicle families in a given model year that have deficit balances even though there is a net positive balance for the entire averaging set. That is the whole point of “averaging.” Consequently, the Agencies should revise the proposed regulatory sections at issue to state as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

(c) You may apply only surplus credits to your deficit. You may not apply credits to a deficit from an earlier model year if they were generated in a model year for which your averaging set had an end-of-year credit deficit. (Emphasis added) [EPA-HQ-OAR-2014-0827-1269-A1 p.48]

#### End-Of-Year Reporting

EMA supports the Agencies' proposal to have manufacturers submit one report at the end of the model year to track compliance with the Proposed Phase 2 Standards. However, given the time that it takes for many engines and vehicles (most especially from the most recent model year) to reach their final configuration and point of sale, the deadline for the submission of that one end-of-year report should be 270 days (not 90 days) after the close of the calendar year named in the model year. [EPA-HQ-OAR-2014-0827-1269-A1 p.48]

**Organization:** Volvo Group

#### Engine Efficiency

Recognizing that the Agencies have chosen to include a separate engine efficiency regulation, we encourage them not to increase stringency beyond the proposed levels. Maintaining engine stringency at these levels pushes the envelope of engine technology without forcing the many negative consequences we have outlined in these comments. Furthermore, we are very concerned that an engine manufacturer could generate significant credits (for example by selling alternatively fueled engines) so that they could avoid selling undesirable, complex, expensive engine technology, while competitors, lacking such credits, would be pushed out of the market. [EPA-HQ-OAR-2014-0827-1290-A1 p.19-20]

#### **Response:**

The Phase 1 ABT provisions were patterned on established EPA ABT programs that have proven to work well. In Phase 1, the agencies determined this flexibility would provide an opportunity for manufacturers to make necessary technological improvements and reduce the overall cost of the program without compromising overall environmental and fuel economy objectives. Commenters generally supported this approach for engines, pickups/vans, tractors, and vocational vehicles. Thus, we are generally continuing this Phase 1 approach with few revisions to the engine and vehicle segments. However, as described in Section 5, we are finalizing a much more limited averaging program for trailers that will not go into effect until 2027. The agencies see the overall ABT program as playing an important role in making the technology-advancing standards feasible, by helping to address many issues of technological challenges in the context of lead time and costs. It provides manufacturers flexibilities that assist the efficient development and implementation of new technologies and therefore enable new technologies to be implemented at a more aggressive pace than without ABT.

#### *Relation of ABT to Stringency*

Volvo commented that the ABT program should not be used to justify more stringent standards. However, ABT programs are more than just add-on provisions included to help reduce costs. They can be, as in EPA's Title II programs generally, an integral part of the standard setting itself. A well-designed ABT program can also provide important environmental and energy security benefits by increasing the speed at which new technologies can be implemented (which means that more benefits accrue over time than with later-commencing standards) and at the same time increase flexibility for, and reduce costs to, the regulated industry and ultimately consumers. Without ABT provisions (and other related flexibilities), standards would typically have to be numerically less stringent since the

numerical standard would have to be adjusted to accommodate issues of feasibility and available lead time. See 75 FR 25412-25413. By offering ABT credits and additional flexibilities the agencies can offer progressively more stringent standards that help meet our fuel consumption reduction and GHG emission goals at a faster and more cost-effective pace.<sup>22</sup>

Volvo's comments seemed to be primarily addressing the proposed vocational vehicle standards. They argued that "it is completely unacceptable that the Agencies promulgate a regulation where an entire class (regulatory subcategory) of vehicles is known and intentionally targeted beforehand to be incapable of meeting the standard for that subcategory when utilizing the full technology package and the expected penetration rates used to set the standard." However, that is not what is being done in the final rule for vocational vehicles. As explained in Preamble Section V.C.(2) and RIA Chapter 2.9, the vocational vehicle standards for each of the subcategories (Regional, Multi-Purpose, Urban powered by LHD, MHD, and HHD engines) were developed as are all the other standards in the rule: reflecting achievable reductions based on the technology packages and penetration rates in the agencies' designated potential compliance pathways. In particular, the agencies are not basing any of the vocational vehicle standards on either normalization of the baseline, or equalization of the standard stringencies. The standards being adopted thus would be achievable without averaging.

#### *Carryover of Phase 1 Credits and Credit Life*

The agencies proposed to continue the five-year credit life provisions from Phase 1, and not to adopt any general restriction on the use of banked Phase 1 credits in Phase 2. In other words, Phase 1 credits in MY2019 could be used in Phase 1 or in Phase 2 in MYs 2021-2024. CARB commented in support of a more restrictive approach for Phase 1 credits, based on the potential for manufacturers to delay implementation of technology in Phase 2 by using credits generated under Phase 1. We also received comments asking the agencies to provide a path for manufacturers to generate credits for applying technologies not explicitly included in the Phase 1 program. In response to these comments, the agencies have analyzed the potential impacts of Phase 1 credits on the Phase 2 program for each sector and made appropriate adjustments in the program. For example, as described in Section II of the FRM preamble, the agencies are adopting some restrictions on the carryover of windfall Phase 1 engine credits that result from certain test procedure aspects of the Phase 1 vocational engine standards. Also, as described in Section III of the FRM, the agencies are projecting that Phase 1 credit balances for tractor manufacturers will enable them to meet more stringent standards for MY2021-2023, so the agencies have increased the stringency of these standards accordingly.

In particular, CARB argued that the agencies had not analyzed the impacts of allowing carryover of Phase 1 credits into Phase 2. However, we have analyzed such impacts and have adjusted the MY 2021 tractor standard to be one percent more stringent based on projected Phase 1 credit balances for tractor manufacturers.<sup>23</sup> Although not explicitly quantified in other cases, the likelihood of manufacturers having significant Phase 1 credits available in the Phase 2 timeframe has allowed us to be less conservative in our projections of the availability and effectiveness of technologies. Just as important, CARB appears to be overlooking a very important benefit of allowing manufacturers to bank credits. It provides an incentive for manufacturers to develop new technologies and introduce them into the market as soon as possible. The effect of CARB changes would be to reduce this incentive, which appears to conflict with their comments regarding advanced technologies.

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<sup>22</sup> See *NRDC v. Thomas*, 805 F. 2d 410, 425 (D.C. Cir. 1986) (upholding averaging as a reasonable and permissible means of implementing a statutory provision requiring technology-forcing standards).

<sup>23</sup> Memo to Docket, Phase 1 Credit Balance Analysis, August 2016.

Although, as we have already noted, the numerical values of Phase 2 standards are not directly comparable in an absolute sense to the existing Phase 1 standards (in other words, a given vehicle would have a different g/ton-mile emission rate when evaluated using Phase 1 GEM than it would when evaluated using Phase 2 GEM), we believe that the Phase 1 and Phase 2 credits are largely equivalent. Because the standards and emission levels are included in a relative sense (as a difference), it is not necessary for the Phase 1 and Phase 2 standards to be directly equivalent in an absolute sense in order for the credits to be equivalent.

This is best understood by examining the way in which credits are calculated. For example, the credit equations in 40 CFR 1037.705 and 49 CFR 535.7 calculate credits as the product of the difference between the standard and the vehicle's emission level (g/ton-mile or gallon/1,000 ton-mile), the regulatory payload (tons), production volume, and regulatory useful life (miles). The Phase 2 payloads, production volumes, and useful lives for tractors, medium and heavy heavy-duty engines, or medium and heavy heavy-duty vocational vehicles are equivalent to those of Phase 1. However, EPA is changing the regulatory useful lives of HD pickups and vans, light heavy-duty vocational vehicles, spark-ignited engines, and light heavy-duty compression-ignition engines. Because useful life is a factor in determining the value of a credit, the agencies proposed to apply interim adjustment factors to ensure banked credits maintain their value in the transition from Phase 1 to Phase 2.

For Phase 1, EPA aligned the useful life for GHG emissions with the useful life already in place for criteria pollutants. After the Phase 1 rules were finalized, EPA updated the useful life for criteria pollutants as part of the Tier 3 rulemaking. The new useful life implemented for Tier 3 is 150,000 miles or 15 years, whichever occurs first. This same useful life is being adopted in Phase 2 for HD pickups and vans, light heavy-duty vocational vehicles, spark-ignited engines, and light heavy-duty compression-ignition engines. The numeric value of the adjustment factor for each of these regulatory categories depends on the Phase 1 useful life. These are described in detail in Sections II, V, and VI of the Preamble. Without these adjustment factors the changes in useful life would effectively result in a discount of banked credits that are carried forward from Phase 1 to Phase 2, which is not the intent of the changes in the useful life. With the relatively flat deterioration generally associated with CO<sub>2</sub>, EPA does not believe the changes in useful life will significantly affect the feasibility of the Phase 2 standards. CARB's opposition to this adjustment appears to be the result of either its general opposition to allowing Phase 1 credits into Phase 2, or a mistaken belief that there will be an actual in-use difference between usage patterns for Phase 1 and Phase 2 vehicles. To the extent their comment reflects the former, we do not believe it would be appropriate to use this useful life difference to discount Phase 1 credits. If it is the latter, we do not believe there will be an in-use durability difference for vehicles at the end of Phase 1 (e.g. MY2020) and vehicles at the start of Phase 2 (e.g. MY 2021).

We note that the primary purpose of allowing manufacturers to bank credits is to provide flexibility in managing transitions to new standards. The five-year credit life is substantial, and allows credits generated in either Phase 1 or early in Phase 2 to be used for the intended purpose. However, we believe that limited ability manufacturers have had to generate Phase 1 credits for Class 2b through 7 vocational vehicles, along with the sometimes narrow product line for some manufacturers, makes it more likely that the five-year credit life would be too short for these vocational vehicles. As described in Section I.C.(1)(b)(i) of the FRM Preamble, the agencies are extending the credit life for the Light and Medium heavy-duty vehicle averaging sets (typically vehicles in Classes 2b through 7) so that all credits generated in 2018 and later will last at least until 2027.

For other engines and vehicles, the agencies believe a credit life longer than five years is unnecessary to accomplish this transition. Restrictions on credit life serve to reduce the likelihood that any manufacturer will be able to use banked credits to disrupt the heavy-duty vehicle market in any given

year by effectively limiting the amount of credits that can be held. Without this limit, or other constraints, one manufacturer that saved enough credits over many years could achieve a significant cost advantage by using all the credits in a single year. The agencies believe that allowing a five-year credit life for all credits, and as a consequence allowing use of Phase 1 credits in Phase 2, creates appropriate flexibility and appropriately facilitates a smooth transition to each new level of standards.

#### *Averaging Sets*

EPA has historically restricted averaging to some extent for its HD emission standards to avoid creating unfair competitive advantages or environmental risks due to credits being inconsistent. It also helps to ensure a robust and manageable compliance program. Under Phase 1, averaging, banking and trading can only occur within and between specified “averaging sets” (with the exception of credits generated through use of specified advanced technologies). We proposed to continue this regime in Phase 2, retaining the existing vehicle and engine averaging sets, and creating new trailer averaging sets.

Comments were mixed, with some supporting the proposed restrictions, and others supporting relaxation of the restrictions.

We are not allowing trading between engines and chassis, even within the same vehicle class. Such trading would essentially result in double counting of emission credits, because the same engine technology would likely generate credits relative to both standards (and indeed, certain engine improvements are reflected exclusively in the vehicle standards the agencies are adopting). With respect to Gentherm’s comment, we believe the inclusion of fuel maps in GEM will provide sufficient additional incentive for engine improvements.

The agencies continue to believe that maintaining trading to be only within the classes listed above will provide adequate opportunities for manufacturers to make necessary technological improvements and to reduce the overall cost of the program without compromising overall environmental and fuel efficiency objectives, and it is therefore appropriate and reasonable to allow under the agencies’ respective statutory authorities. We do not expect emissions from engines and vehicles – when restricted by weight class – to be dissimilar. Similarly we expect complete HD pickups and vans to be more similar to one another than to other Class 2b-5 vehicles or to light-duty vehicles. We therefore expect that the lifetime vehicle performance and emissions levels will be very similar across these defined categories, and the credit calculations will fairly ensure the expected fuel consumption and GHG emission reductions.

These restrictions have generally worked well for Phase 1, and we continue to believe that these averaging sets create flexibility without creating an unfair advantage for manufacturers with erratically integrated portfolios, including engines and vehicles. See 76 FR 57240.

#### *Credit Deficits*

The Phase 1 regulations allow manufacturers to carry-forward deficits for up to three years. This is an important flexibility because the program is designed to address the diversity of the heavy-duty industry by allowing manufacturers to sell a mix of engines or vehicles that have very different emission levels and fuel efficiencies. Under this construct, manufacturers can offset sales of engines or vehicles not meeting the standards by selling others (within the same averaging set) that better than the standards. However, in any given year it is possible that the actual sales mix will not balance out, and the manufacturer may be short of credits for that model year. The three-year provision allows for this possibility and creates additional compliance flexibility to accommodate it.



EMA comments that “manufacturers necessarily will have engine and vehicle families in a given model year that have deficit balances even though there is a net positive balance for the entire averaging set.” However, EMA misunderstands what it means for a family to have an end-of-year deficit. An engine family is not actually considered to have an end-of-year deficit if the manufacturer has sufficient credits to achieve a zero-balance in the end-of-year report.

#### *Voluntary Retirement of Credits*

CARB recommended that the agencies include a mechanism within the proposed Phase 2 rulemaking for manufacturers to quantify and then voluntarily forego/retire emission reduction credits. The agencies proposed such a program and are finalizing it. See 40 CFR 1036.701(e) and 1037.701(e).

#### *Reporting Requirements*

Several commenters opposed the proposed change to the reporting deadlines and supported maintaining the Phase 1 ABT reporting deadlines where the final ABT report is due at 270 days after the end of the model year. Some noted that the required information may not be known for well over 90 days after the model year is over. The agencies have decided to not finalize the proposed changes and instead to largely continue the Phase 1 approach. However, we are changing the reporting deadlines slightly to make them dates certain rather than a number of days after the model year ends. Reports will now be due on March 31 and September 30. These are essentially the same deadlines, but will be easier to implement because neither manufacturers nor the agencies will be required to track small changes to the end dates of model years.

#### *Other Issues*

Daimler identified an incorrect reference a nonexistent §1037.40(c) in the proposed 40CFR 1037.730. This has been revised to refer to 1037.740(c)

### **1.4.8 Global Warming Potential Comments**

**Organization:** American Automotive Policy Council

- **Global Warming Potential (GWP) change for non-CO2 GHGs** - EPA should refrain from having different GWP based on vehicle classifications. If EPA chooses to lower the N<sub>2</sub>O GWP from 298 to 268 and increase CH<sub>4</sub> from 25 to 36 based on latest IPCC report, the cost-benefit analysis needs to be clearly outlined in the final RIA inclusive of the impact on flex fuel vehicle and CNG products. In addition, the effective impact on greenhouse gas stringency associated with offsetting exceedances of the N<sub>2</sub>O and CH<sub>4</sub> cap standards must be evaluated. Furthermore, the draft RIA should also include a detailed analysis of the merits of using Global Temperature Potential (GTP) values in lieu of GWP for both N<sub>2</sub>O and CH<sub>4</sub>. As stated above, this change should be consistent across all vehicle classes, as well as, all regulations under EPA and NHTSA authority. [EPA-HQ-OAR-2014-0827-1238-A1 p.11]

**Organization:** American Gas Association (AGA) et al.

**We Strongly Support Maintaining the Agency-wide Use of the 100-year Global Warming Potential of 25 for Methane that Was Established in the IPCC’s AR4**

Establishing a global warming potential (GWP) is a critical issue in any GHG program. EPA has wisely adopted a single GWP that it uses consistently in all of its programs and reporting obligations. More specifically, EPA consistently uses a 100-year GWP of 25 for methane. This GWP was established in the IPCC's Fourth Assessment Report (AR4), which was published in 2007.<sup>4</sup> We strongly support maintaining this approach for the Phase 2 Rule. [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

Examples of EPA's use of the AR4 GWP include:[EPA-HQ-OAR-2014-0827-1223-A1 p.2]

- The LD Phase 1 Rule, the LD Phase 2 Rule, and the HD Phase 1 Rule;<sup>5,6,7</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.2]
- EPA's Emissions Factors for Greenhouse Gas Inventories;<sup>8</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.3]
- The recently-announced strategy to reduce methane from the oil and natural gas industry;<sup>9</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.3]
- The Greenhouse Gas Reporting Rule;<sup>10</sup> and [EPA-HQ-OAR-2014-0827-1223-A1 p.3]
- The national inventory of GHG emissions and sinks.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

In addition to ensuring internal consistency among EPA's many greenhouse gas programs, maintaining the use of the AR4 GWP also enables EPA to coordinate its data with the data collected by EPA pursuant to its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). Doing so "improves EPA's ability to analyze corporate, national, and sub-national GHG data consistently, enhances communication of GHG information between programs, and gives outside stakeholders a consistent, predictable set of GWPs to avoid confusion and additional burden."<sup>12</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

We strongly support the continued use of the AR4 GWP in this Proposal. Furthermore, we believe that changing the GWP should be an agency-wide decision, and not an outcome of any particular sector-specific rule. Anything else could result in a patchwork of inconsistent metrics being used across the array of EPA programs. [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

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4 P. Forster and V. Ramaswamy. "Changes in Atmospheric Constituents and in Radiative Forcing". Chapter 2 of the IPCC's Fourth Assessment Report, page 212. <http://www.ipcc.ch/publicationsanddata/ar4/wg1/en/ch2s2-10-2.html>.

5 HD Phase 1 Rule, page 57188.

6 "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule." Federal Register, May 7, 2010. <http://www.gpo.gov/fdsys/pkg/FR-2010-05-07/pdf/2010-8159.pdf>, page 25421. (Hereafter cited as "LD Phase 1 Rule")

7 "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule." Federal Register, October 15, 2012. <http://www.gpo.gov/fdsys/pkg/FR-2010-05-07/pdf/2010-8159.pdf>, page 62667. (Hereafter cited as "LD Phase 2 Rule").

8 "Emission Factors for Greenhouse Gas Inventories". Environmental Protection Agency, April 4, 2014. <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>, Table 9.

9 “Fact Sheet: EPA’s Strategy for Reducing Methane and Ozone-Forming Pollution from the Oil and Natural Gas Industry”. Environmental Protection Agency, January 14, 2015. <http://www.epa.gov/airquality/oilandgas/pdfs/20150114fs.pdf>.

10 “2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determinations for New or Substantially Revised Data Elements”. Environmental Protection Agency, 40 CFR Part 98, EPA-HQ-OAR-2012-0934; FRL-9902-95-OAR, RIN 2060-AR52, page 21, November 15, 2013. <http://www.epa.gov/ghgreporting/documents/pdf/2013/documents/2013-data-elements.pdf>.

11 “Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Potential Revisions to Liquids Unloading Methodology for Natural Gas Systems”. Environmental Protection Agency, page 2, December 2014. <http://www.epa.gov/climate/climatechange/pdfs/Potential%20Revisions%20to%20Liquids%20Unloading%20Emissions%20Estimate%2012.11.pdf>.

12 “Emission Factors for Greenhouse Gas Inventories”. Environmental Protection Agency, April 4, 2014. <http://www.epa.gov/climateleadership/documents/emission-factors.pdf>, Table 9.

**Organization:** Center for Biological Diversity

### **The Methane GWP Used for Analysis and Trading Must be the 20-year GWP from AR5**

The EPA has requested input regarding what methane global warming potential (“GWP”) is appropriate for the purposes of these standards. As we have strenuously urged in previous comments to the EPA, the only reasonable source is the Intergovernmental Panel on Climate Change (“IPCC”) most recent assessment. At present, this is the Fifth Assessment Report (“AR5”), but GWP values should be updated each time a new Assessment Report becomes available. [EPA-HQ-OAR-2014-0827-1460-A1 p.16-17]

As noted in the call for comments within the Proposed Rule, there are several GWP values from which to choose, depending on both carbon cycle feedbacks and time frame for climate impacts. With regard to carbon cycle feedbacks, it is essential to employ the GWP that includes carbon cycle feedbacks. The groundbreaking realization by the contributors to AR5 was that carbon cycle feedbacks are an inherent part of the warming caused by CO<sub>2</sub>. Yet, until the most recent Assessment, they were omitted from GWP values for other greenhouse gases. Thus, until AR5, the GWP conversion was actually comparing apples to oranges. The only way to accurately compare among greenhouse gases – the entire purpose of a GWP – is to include carbon cycle feedbacks. This amounts to a 100-year methane GWP of 36. [EPA-HQ-OAR-2014-0827-1460-A1 p.17]

The second choice with regard to the GWP for methane is time horizon: 20 years or 100 years. We urge the EPA to analyze the effects of the rule using both, but to use the 20-year GWP for trading purposes as this is the most accurate reflection of the time scale for this rule.<sup>84</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.17]

The selection of a particular time horizon for GWPs influences the policy focus because the analysis and comparison occurs only at the selected time frame. Many policy analysts and decision makers, believe that a 100-year focus is important for long-term climate stabilization, while a near-term (20 years or less) focus is equally crucial because the next few decades will determine whether catastrophic and irreversible damage can be avoided before tipping points are crossed. Decision makers and the public should be presented with the 20-year effects of greenhouse gases to focus attention on short-term

solutions that may abate immediate harm sufficiently to allow us to reach climate stability on a 100-year and beyond time scale. [EPA-HQ-OAR-2014-0827-1460-A1 p.17]

The time-based distinction between GWPs is of key importance for a greenhouse gas such as methane. Methane is a short-lived greenhouse gas that remains in the atmosphere a little over a decade; by contrast, CO<sub>2</sub> has an atmospheric lifetime of a century and beyond. Methane has exerted the second largest warming influence since the Industrial Revolution, behind only CO<sub>2</sub>.<sup>85</sup> And crucially, *the AR5 value for its 20-year GWP (87) is nearly 2.5 times higher than its 100-year GWP (36)*. The implications of this difference for responsive action are enormous. [EPA-HQ-OAR-2014-0827-1460-A1 p.17]

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<sup>84</sup> See Morgan R. Edwards & Jessika E. Trancik, *Climate impacts of energy technologies depend on emissions timing*, 4 NATURE CLIMATE CHANGE 347 (2014).

<sup>85</sup> Myhre 2013, *supra* note 69, IPCC Figure 8.17 at 69.

**Organization:** Clean Energy

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 248-249, 250-251.]

Specifically, we appreciate the continued allowance of cross-pollutant trading of CH<sub>4</sub>, N<sub>2</sub>O, and CO<sub>2</sub>.

The rule also provides consistency. Continued utilization of the 100-year global warming potential of 25 for CH<sub>4</sub> provides a standard metric across the full array of light-, medium-, and heavy-duty vehicles as well as other agency rules governing greenhouse gas emissions.

**Organization:** NGVAmerica

**J. GWP Values for Methane (CH<sub>4</sub>) and N<sub>2</sub>O. EPA has proposed using the GWP values identified in the IPCC Fourth Assessment** [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

NGVAmerica strongly supports the continued use of the GWP values used under the Phase 1 rules. These GWP values have long-standing acceptance and are used for purposes of the greenhouse gas regulations covering light and medium duty passenger cars, and also for numerous other EPA rules. Using these values provides consistency and uniformity across a number of regulatory programs and allows efficient comparisons across these regulatory programs. Therefore, we strongly urge EPA to continue to use the GWP values adopted under Phase 1. [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

**Organization:** Optimus Technologies

**GWP Values for CH<sub>4</sub> and N<sub>2</sub>O**

Concerning the Request for Comment on Changing Global Warming Potential Values in the Credit Program for CH<sub>4</sub> and N<sub>2</sub>O at 80 FR 40206 (Column 1, Paragraphs 1-2): “Therefore, we not only request comment on whether to update the GWP for methane and nitrous oxide to that of the Fifth Assessment Report, but also on which value to use from this report.” The IPCC states on page 44 of its Synthesis Report<sup>1</sup> that global concentrations of N<sub>2</sub>O (as well as CO<sub>2</sub> and CH<sub>4</sub>) have been steadily

increasing despite efforts and regulations to curb and decrease its concentration. As such, Optimus Technologies believes the higher value for nitrous oxide should be used. In regards to methane, Optimus Technologies believes the EPA should consider using the 20-year GWP value, stated in the report as 86, given the shorter lifetime of methane. The harmful effects of methane should be mitigated by increasing the GWP of methane (and thus reducing the number of vehicles/engines with excess methane emissions on the road). Methane emissions are especially prevalent with natural gas (CNG or LNG) vehicles. In a recent Pennsylvania State University Study<sup>2</sup>, researchers state that “the CH<sub>4</sub> emissions are nearly 100 times higher for CNG” and that the “CH<sub>4</sub> emissions from the CNG vehicle lead to CO<sub>2</sub> equivalent emissions of 1890 g/mi, compared to the 1785 g/mi of CO<sub>2</sub> emitted by the diesel vehicle.” [EPA-HQ-OAR-2014-0827-1276-A1 p.1]

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1 [https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5 SYR FINAL All Topics.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_All_Topics.pdf)

2 <http://www.research.psu.edu/events/expired-events/naturalgas/documents/trans-fuels-position-paper.pdf>

**Organization:** Securing America's Future Energy

We support maintaining key structural components established in the Phase 1 Rule, which provide for a fair and consistent Phase 2 Proposal. Specifically, SAFE is agrees with the continuance of the compliance pathway flexibility for cross-pollutant trading of methane and the 100-year global warming potential factor for methane. [EPA-HQ-OAR-2014-0827-1462-A1 p.2]

SAFE supports the continuation of the compliance pathway flexibility for cross-pollutant trading of methane and using 100-year global warming potential of 25 for methane. [EPA-HQ-OAR-2014-0827-1462-A1 p.4]

**Response:**

The Phase 1 GHG rule included a compliance alternative allowing heavy-duty manufacturers and conversion companies to comply with the respective methane or nitrous oxide standards by means of over-complying with CO<sub>2</sub> standards (40 CFR 85.525). More specially, EPA allows manufacturers to use CO<sub>2</sub> credits (generated from the same averaging set) to comply with the methane and nitrous oxide requirements after adjusting the CO<sub>2</sub> emission credits based on the relative GHG equivalents. To establish the GHG equivalents used by the CO<sub>2</sub> credits program, the Phase 1 heavy-duty vehicle rulemaking incorporated the IPCC Fourth Assessment Report GWP values of 25 for CH<sub>4</sub> and 298 for N<sub>2</sub>O, which are assessed over a 100 year lifetime. EPA is largely continuing this allowance for Phase 2.

Since the Phase 1 rule was finalized, a new IPCC report has been released with new GWP estimates. EPA asked for comment on whether the methane GWP used to establish the GHG equivalency value for the CO<sub>2</sub> Credit program should be updated to those established by IPCC in its Fifth Assessment Report (AR5). The IPCC AR5 presents four different potential values for the GWP of methane over a 100 year lifetime, ranging from 28 to 36. These values are the result of slightly different calculation methods. Therefore, we not only requested comment on whether to update the GWP for methane to that of the AR5, but also on which value to use from this report. The GWPs of 28 and 30 are both a result of using a carbon cycle approach consistent with that used in the Fourth Assessment Report. This carbon cycle approach included a climate-carbon feedback when calculating the lifetime of a pulse of carbon dioxide emissions, but did not include any climate-carbon feedback when calculating the impacts of a pulse of non-CO<sub>2</sub> greenhouse gas emissions. As the GWP is the ratio of the impact of a pulse of non-CO<sub>2</sub> GHG

emissions relative to a pulse of carbon dioxide emissions, a second approach was presented where the non-CO<sub>2</sub> GHG pulse also included climate-carbon feedbacks. This second approach yields GWP values of 34 or 36. For the purposes of this rule, EPA is choosing the approach that includes climate-carbon feedbacks for both non-CO<sub>2</sub> and CO<sub>2</sub> pulses, as the agency considers this the approach most likely to be adopted by the international scientific community in future assessments on the timescale of this rule. The IPCC presents the value of 34 as the default value for the methane GWP, but also reports a value of 36 for “fossil” methane to take into account the atmospheric CO<sub>2</sub> that would result from the oxidation of methane in the atmosphere.

We received a number of comments on this issue. For the most part, the environmental community favored using the more recent GWP value and even some commented that EPA should use a methane GWP based on a 20 year timeframe. On the other hand, the natural gas industry and natural gas truck manufacturers commented that EPA should not update to the newer GWP values but continue to use the methane GWP value from the AR4 IPCC report because EPA is still using the methane GWP from the AR4 today in other contexts. Although EPA is currently using AR4 values in other contexts, it is unlikely that EPA will still be using AR4 values in 2021 when the Phase 2 requirements begin. Thus, commenters opposing the use the methane GWP from the later IPCC report are not persuasive. EPA will continue to base the credit adjustment on a 100 year timescale because it seems to best balance short-term versus long-term effects of climate change.

Of the possible 100 year methane GWP values presented in the IPCC AR5 report, EPA is choosing to use the value of 34 because it is the primary value presented by the IPCC and because the approach of not accounting for the CO<sub>2</sub> oxidation product within the GWP for methane is consistent with prior IPCC practice.<sup>24</sup> The use of this GWP for credit adjustments will not begin until 2021, when the Phase 2 engine standards go into effect. The choice of this GWP value for future rules on this timescale does not prejudice the choice of other GWP values for use in regulations and other purposes in the near term.

## 1.5 Lead Time 216

**Organization:** Advanced Engine System Institute (AESI)

There appears to be ample evidence to indicate that, of the options considered by the agencies, Alternative 4's timeline comes closest to striking the right balance though it does appear greater reductions than the 4.2% in the proposal could well be feasible now and still be quite cost-effective. There are now a multitude of technologies, including waste heat recovery, turbo-compounding, advanced downspeeding, hybridization, etc. that can be ready to deploy in the Alternative 4 timeframe or sooner at still reasonable cost, provided the right policy or market signal and some combination of incentives or credits. EPA may want to consider whether such incentives or credits, particularly in an era of low fuel prices, might expedite the development and commercialization of these technologies and promote earlier and more cost-effective achievement of the program goals. If the Agency chooses not to adopt a technology-driving engine standard in this rulemaking cycle, it may make sense to incorporate a Mid-term Review or evaluation of engine related technologies in the not too distant future so the standards can be adjusted and updated to keep pace with innovation and the growing need to reduce carbon emissions. [EPA-HQ-OAR-2014-0827-1152-A1 p.2 [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.290-291.]]

**Organization:** American Bus Association et al.

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<sup>24</sup> The corresponding N<sub>2</sub>O value from the AR5 report is 298, which is the same as the value used in Phase 1.

We, the 16 undersigned trade associations, represent a diverse cross-section of industries that have a strong interest in the joint U.S. Environmental Protection Agency and National Highway Traffic Safety Administration proposed rule “Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2.” Our combined 240,000 members rely on a strong, vibrant U.S. commercial motor vehicle industry to safely and cost-effectively transport goods and people, provide high quality direct and indirect job opportunities, and make meaningful contributions to cleaner air and safer roads. Given we are already very concerned over the proposed Phase 2 “Alternative 3” efficiency targets, we ask EPA and NHTSA to reject what is defined in the NPRM as “Alternative 4” to avoid serious negative economic implications for fleets, truck manufacturers, suppliers, dealers, and the nation’s economy as a whole. [EPA-HQ-OAR-2014-0827-1293-A1 p.1]

Equipment acquisition costs are a top consideration for all fleets. New and increasingly more stringent emissions and safety regulations have required extensive changes to engines and vehicles, including the addition of expensive technologies such as exhaust after-treatment systems. As a result, vehicle and operation costs have risen significantly over the past 10 years. [EPA-HQ-OAR-2014-0827-1293-A1 p.2]

Fleets can better absorb cost increases associated with the purchase of fuel efficient technologies if they deliver reasonable payback periods and return on investment. We are concerned that the actual costs of Phase 2 technologies for model year 2017-2027 vehicles and trailers will greatly exceed the agencies’ estimates. Fleets look at the total cost of ownership—acquisition and operation costs, fuel, personnel, maintenance, overhead, road charges, insurance, residual values, and taxes. If the incremental investment and operating costs of trucks and trailers manufactured to comply with the Phase 2 regulations are not met by corresponding fuel savings and reliability benefits, it is likely that fleets will avoid buying them. [EPA-HQ-OAR-2014-0827-1293-A1 p.2]

For suppliers to the heavy-duty commercial vehicle industry, “pre-buys” and “low-buys” of Phase 2 technologies have serious economic implications. When EPA mandated new engine technologies effective in 2007, fleets held off buying new vehicles and jobs at U.S. heavy-duty commercial vehicle manufacturers, suppliers, and dealers suffered significantly. We are very concerned that the Phase 2 Rule “Alternative 4” is not achievable and could, as a result, seriously impact fleet operations and have a downward effect on U.S. jobs and the economy. [EPA-HQ-OAR-2014-0827-1293-A1 p.2]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

**Standards in 2027 must drive advanced technologies.**

If the program is extended to 2027, those standards must go well beyond what is currently proposed to meet the agencies’ requirements for appropriate and maximum feasible standards. A crucial function of motor vehicle emissions standards is to promote the further development and accelerate the deployment of promising technologies whose pathway to market acceptance is less clear. EPA has the authority to set technology-forcing standards under the Clean Air Act; it is especially important that the agency exercise that authority in a rule, such as this one, that has a long time horizon. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

The proposed rule recognizes this, and includes technologies such as advanced aerodynamics and vocational hybrids in the compliance scenario for this reason. However, given that the proposed standards can be met without drawing on those technologies, it is necessary to substantially strengthen the 2027 standards to ensure the program does in fact promote the development of these and other

advanced technologies and point the way to further, major gains for heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

*Recommendation: Acceleration of standards to 2024* [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

- Adopt standards for 2024 that are comparable or superior in fuel consumption reductions to the 2027 standards. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

For 2027, adopt technology-forcing standards that will help drive advanced technologies into the market and reduce overall fuel consumption by 31% beyond Phase 1 levels. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

**The proposed 2027 standards – and more – can cost-effectively and feasibly be achieved by model year 2024.**

As discussed in detail below, the fuel consumption reduction achieved by 2027 in the preferred alternative (Alternative 3) can and should be reached or exceeded by 2024. However, the agencies' compliance package for Alternative 4 represents only one pathway to reach those reductions, and it is unlikely to be the lowest cost option to do so. In particular, we find that an overall fuel consumption reduction of 24% relative to 2017 levels could be achieved cost-effectively in 2024 without the use of advanced technologies, as described later in these comments. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

**Other Issues**

Acceleration of Standards to 2024 and ensuring 2027 standards promote adoption of advanced technology

As noted above, ACEEE finds that the overall stringency of the standards proposed in Alternative 4, and more, is readily achievable. That is, the fuel consumption reduction achieved by 2027 in the preferred alternative (Alternative 3), can and should be reached or exceeded by 2024. [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

The majority of improvements beyond Phase 1 would come from fuel consumption reduction in tractor trailers, followed by heavy-duty pickups and vans, and vocational vehicles. Table 9 replicates the agencies' proposed improvement for heavy-duty vehicles and engines and the overall reductions in 2024 and 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

[Table 9 can be found on p.27-28 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

Greater reductions can be achieved in all vehicle and engine classes, however, even without accelerating or increasing reliance on advanced technologies such as waste heat recovery (Rankine cycle/turbocompounding), hybrids, or advanced aerodynamics. By adopting higher effectiveness values from the SwRI study for some incremental engine, transmission, and vehicle technologies, as explained in the previous sections, we can achieve 26% and 31% reductions in overall fuel consumption in 2024 and 2027, respectively, substantially more than the 23.5% reduction from the proposed 2027 standard. [EPA-HQ-OAR-2014-0827-1280-A1 p.28]



Moreover, given concerns that have been raised about the cost, performance and/or durability of some advanced technologies, it is worth noting that similar results can be achieved in 2024 without any adoption of waste heat recovery, advanced aero for tractors and trailers, level 3 tires, start/stop systems or strong hybrids. If we exclude these technologies from our 2024 package and keep the agency penetration rates for all other technologies, we can still attain 24% reduction in 2024, as shown in table 10. This shows that the manufacturers can comply with stronger standards than those proposed with existing technologies in the market. [EPA-HQ-OAR-2014-0827-1280-A1 p.28]

[Table 10 can be found on p.28 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

However, it is important that the standards in fact help to draw new technology into the market, especially if they are set out to 2027. The package mentioned above, delivering an overall fuel consumption reduction of 31% in 2027 using the agencies' assumptions for adoption and effectiveness of advanced technologies would be an appropriate target for that year. [EPA-HQ-OAR-2014-0827-1280-A1 p.28]

Figure 3 shows the fuel consumption reductions in 2024 or 2027 for the three scenarios discussed, and compares them with the Phase 2 proposal for 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

[Figure 3 can be found on p.29 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

*Recommendation: Acceleration of standards to 2024* [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

- Adopt standards for 2024 that are comparable or superior in fuel consumption reductions to the 2027 standards. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]
- For 2027, adopt technology-forcing standards that will help drive advanced technologies into the market and reduce overall fuel consumption by 31% beyond Phase 1 levels. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

**Organization:** American Lung Association

The American Lung Association offers the following recommendations to strengthen the stringency and timing of the proposal and address several key elements of California's commitment to protecting public health and air quality. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.143-144]]

The American Lung Association recommends adopting the most aggressive implementation schedule, Alternative 4, bringing the rule online by 2024, and requiring much stronger fuel efficiency to achieve a 40 percent fuel reduction savings. These changes will help to drive down emissions sooner and help move us further down the path to clean, healthy air by cutting significantly more carbon dioxide emissions, cuts that are crucial to fighting climate change. The urgency of climate change and the air pollution challenges in California indicate that we need all emission reductions possible in the near term. Analysis by the Union of Concerned Scientists shows that a greater reduction in fuel use is possible.<sup>1</sup> Their analysis showed that by going to 10.7 mpg from 6.3 mpg, the standards could achieve a 40 percent reduction in fuel use by 2025. A stronger fuel efficiency standard will reduce petroleum consumption more rapidly and reduce emission of greenhouse gases. There is no reason to delay-action now will also help to spur further action to reduce emissions from the truck sector. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.144.]]

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1 Union of Concerned Scientists. Engines for Change: From Cell Phones to Sodas, How New Truck Standards Can Improve the Way America Ships Goods. March 2015. Available online at <http://www.ucsusa.org/enginesforchange>

**Organization:** American Trucking Associations (ATA)

#### **ATA Opposes Alternative 4**

Phase 2 will only be successful if projected future technology patterns are wholly recognized. Making the best predictions on what the trucking sector will look like in over a decade from now is an extremely difficult undertaking. Factors such as the state of technology development, fleet buying patterns, future industry-wide purchasing estimates, the strength of the national and global economies, along with fuel and equipment pricing, will determine whether the agencies' proposed targets can be achieved. Given this multitude of variables, ATA strongly urges the agencies to adopt Alternative 3 as the chosen pathway subject to addressing various concerns contained in our comments. Current cost projections and efficiency improvements do not, and should not, warrant pulling-ahead the 2027 targets to 2024 as proposed under Alternative 4. Such approach would result in serious market disruptions and force unproven technologies into the market before being fully tested and verified – a dire result the industry seeks to avoid given the recent history fleets experienced involving the regulation of particulate matter ('PM') and nitrogen oxides ('NOx') emissions. [EPA-HQ-OAR-2014-0827-1243-A1 p.5]

**Organization:** Autocar, LLC

4.6 Additional lead time would not provide sufficient relief. Although Autocar appreciates the Agencies' willingness to consider providing additional lead time for compliance by small custom chassis manufacturers, the Company believes that additional lead time would not remedy the difficulties faced by such manufacturers in meeting the proposed standards or the negative consequences for the industry. For example, the manufacturers would still have limited ability to benefit from averaging and to spread compliance costs across many vehicles. We would still suffer from the shortage of technical compliance expertise, and customers would still experience disruption to their businesses due to production delays, upfront cost increases and increased continuing maintenance costs.[EPA-HQ-OAR-2014-0827-1233-A1 p.16]

**Organization:** Barcode Technology Solutions

Please do not delay in enacting this important regulatory policy. [EPA-HQ-OAR-2014-0827-0764 p.2]

**Organization:** Bay Area Air Quality Management District (BAAQMD)

The proposed EPA/DOT Phase 2 rule-making can help us pursue both our air quality and GHG emission reduction goals. To ensure the maximum benefits are achieved from this joint-rule-making effort, we would like to offer the following suggestions. [EPA-HQ-OAR-2014-0827-1136-A1 p.2]

Adopt the schedule proposed in *Alternative 4* to accelerate the roll-out of the Phase 2 standards so full implementation is reached by 2024 instead of 2027. This option will result in greater overall reductions in fuel use and GHGs. [EPA-HQ-OAR-2014-0827-1136-A1 p.2]

**Organization:** Bendix Commercial Vehicle Systems, LLC

The agencies are requesting comment on the alternatives described in Section X below. The agencies seek comment on the feasibility of Alternative 4, whether for some or for all segments, including empirical data on its appropriateness, cost effectiveness, and technological feasibility. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

Bendix believes that Alternative 3 – 2027 proposed standard should be adopted rather than Alternative 4 - 2024 which is also under consideration. Alternative 3 will be more feasible by providing more time for development of technologies required to meet the stringencies proposed by the agencies. In addition, many of the technology adoption rates have significant uncertainty associated with them. We must avoid situations where fleets and smaller customers experience increases in vehicle downtime due to component failures or vehicle acquisition and operating cost increases that diminish the profitability of their businesses. The fleets will create a market pull for technologies that save them operating costs with payback times between 18 and 48 months. A well risk-managed adoption of new technologies is more feasible with Alternative 3 for all regulatory categories. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

**Organization:** BYD Motors

BYD would also support more aggressive implementation of the stringency levels, such as Alternative 4, which would accelerate the stringency levels by 3 years to 2024. This change would cause fleet operators to more seriously consider advanced technologies. It would also allow the agencies the flexibility to evaluate the appropriateness for the inclusion of advanced technologies for future phases and the ability to implement those changes sooner. [EPA-HQ-OAR-2014-0827-1182-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.228.]]

**Organization:** California Air Resources Board (CARB)

1. Strengthen the overall proposal and adopt the Alternative 4 timeline in order to deliver greater climate benefits earlier

CARB strongly recommends that the federal agencies strengthen the overall proposal and adopt the Alternative 4 timeline, rather than adopt the proposed Alternative 3. While the two alternatives are nearly identical in terms of technological feasibility and payback periods for fuel efficient technologies, Alternative 4 accelerates full program phase-in by three years, from 2027 to 2024, and as discussed below, can be strengthened in overall stringency. [EPA-HQ-OAR-2014-0827-1265-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.21-22.]]

By 2030, Alternative 4 as proposed would provide about four million metric tons more cumulative greenhouse gas benefits in California than Alternative 3, and together with Phase 1 would reduce petroleum use from the medium- and heavy-duty sector by about 22 percent. Yet, this still is not enough, and even more needs to be done to strengthen the federal Phase 2 proposal, such as including an increase in the engine-only standard, as described in our next recommendation. Overall, a strengthened Alternative 4 would provide an important step toward reaching Governor Brown's climate goals and 50 percent petroleum reduction target for the transportation sector. [EPA-HQ-OAR-2014-0827-1265-A1 p.2]

Adopting Alternative 4 standards across all vehicle categories would also result in the Phase 2 program being fully phased in by 2024 (by 2025 for pickups and vans), three years earlier than if Alternative 3

standards are adopted. This would allow manufacturers to take action on reducing NOx emissions from the heavy-duty vehicles addressed in this rulemaking in a timelier manner. This is especially important since heavy-duty vehicles are responsible today for one-third of California's NOx emissions. The South Coast Air Basin will need nearly a 90 percent reduction in heavy-duty vehicle NOx emissions by 2031 from 2010 levels to attain the 2008 National Ambient Air Quality Standards (NAAQS) for ozone. Additionally, on November 25, 2014, U.S. EPA issued a proposal to strengthen the ozone NAAQS. If a change to the ozone NAAQS is finalized, California and other areas of the country will need to identify and implement measures to reduce NOx as needed to complement federal emission reduction measures. [EPA-HQ-OAR-2014-0827-1265-A1 p.21]

In this rulemaking action, Alternative 4 provides manufacturers of heavy-duty engines and heavy-duty vehicles approximately eight years of lead-time to develop and apply technologies needed to comply with the most stringent greenhouse emission standards. This time frame is 60 percent longer than the time frame considered by the NRDC court, and in light of the extensive information discussed in this NPRM regarding the numerous control technologies that manufacturers are anticipated to utilize to comply with the proposed standards, their capability of reducing GHG emissions, current states of development, and identification of the major steps needed to refine those technologies for implementation in MY 2024 engines and vehicles, it is clear that Alternative 4 is consistent with the lead time requirements of section 202(a)(2) of the CAA (42 U.S.C. 7521 (a)(2)). [EPA-HQ-OAR-2014-0827-1265-A1 p.25-26]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Lead time**

The NPRM requests comment on the lead time for the proposed rulemaking and market disruption. CARB staff suggests that U.S. EPA and NHTSA conduct additional research on the market impact of the proposed rulemaking, including an ex post (retrospective) analysis of the market impacts resulting from existing GHG and criteria pollutant engine and vehicle regulations. [EPA-HQ-OAR-2014-0827-1265-A1 p.187]

**Organization:** Caterpillar Inc, et al.

#### **Expected technologies must be appropriately demonstrated**

A core principle of the Clean Air Act is that expected technologies must be feasible, including accounting for cost and development lead-time. Given the complexity of modern technology, unique customer duty cycles, and the myriad of federal, state, and local regulations under which commercial vehicles operate, it is not enough to presume a technology will be available and gain market acceptance unless it has been adequately demonstrated in commercial service. An effective "technology demonstration" must include a substantial amount of successful testing (meaning it is reliable, durable, efficient, and cost effective) within a commercial fleet in revenue-generating applications. It is insufficient to rely on demonstration of a few vehicles operating in carefully selected applications or routes tailored to their design. It is even less appropriate to rely on promises of future technology from suppliers who wish to ensure a market for the technologies in their development plans. There is a very long history of failed technologies in both of these categories. A number of key technologies within the Phase 2 rule expectations fail to meet the hurdle of adequate demonstration, including for example: Rankine waste heat recovery; tractor aerodynamics (within the proposed regulatory context); future levels of tire rolling resistance; "deep integration" of vocational powertrains; stop-start for heavy-duty

diesels; and vocational hybridization. It is unacceptable to base stringency targets on such unproven technologies. [EPA-HQ-OAR-2014-0827-1215-A1 p.5]

One thing we are certain of is that we could not achieve, and therefore cannot support, the pull-ahead of these standards according to the plan identified as “Alternative 4” in the proposed rule. [EPA-HQ-OAR-2014-0827-1215-A1 p.7]

One key factor is the cost of an increase in both reliability and durability failures due to forcing technology that is immature or inadequate for all applications within the defined regulatory subcategories and their associated duty cycles (e.g. increased warranty surcharges, repair costs after the warranty period, increased downtime and the resultant loss of income, and penalties for missing delivery on time-sensitive loads). [EPA-HQ-OAR-2014-0827-1215-A1 p.7]

The Agencies have also proposed to revise certain provisions of the Phase 1 protocols. These revisions have the effect of increasing the stringency of the Phase 1 requirements already in the implementation phase. We oppose any such changes because the requisite lead time is not provided to comply.[EPA-HQ-OAR-2014-0827-1215-A1 p.8]

**Organization:** Center for Biological Diversity

#### Accelerated Implementation

As explained in the Proposed Rule, an accelerated schedule for implementation is part of the “maximum feasible and appropriate” alternative. The proposed rule refers to “Alternative 4” as an option to speed implementation by 2 to 3 years. The Center strongly urges the Agencies to adopt this earlier implementation schedule for greenhouse gas standards. Earlier implementation will allow for 13 percent greater cumulative emissions reductions, given the same engine and vehicle standards.<sup>56</sup> As noted in the Proposed Rule, this accelerated implementation schedule would extend the payback period for most commercial trucks by only about 3 months<sup>57</sup> and appears to be “very cost effective.” Earlier implementation is a key component of meeting the technology-forcing mandate of the governing statutes. [EPA-HQ-OAR-2014-0827-1460-A1 p.12]

Besides greater lifetime emissions reductions and fuel savings, an earlier implementation schedule would provide an earlier date to revisit the standards and adjust as necessary. As proposed, the standards would cover nearly 10 years. This is an exceedingly long period in which there is much opportunity for innovation and more advanced technology to come to the fore. Even over the short period of the Phase 1 standards, it has become clear that technology implementation is outpacing the standards. An accelerated implementation schedule for Phase 2 that ends with model year 2024/2025 would allow the Agencies to re-analyze at an earlier date the level of fuel savings and emissions reductions that are feasible and appropriate, with the potential for the next phase of fuel savings to begin sooner. [EPA-HQ-OAR-2014-0827-1460-A1 p.12]

The available data indicate that manufacturers have easily complied with Phase 1 standards, which had a shorter implementation time.<sup>59</sup> For instance, the Proposed Rule indicates that “credit surpluses could be quite large at the beginning of the proposed Phase 2 program.” The accumulation of such excess credits is a clear indicator that the Phase 1 standards were not stringent enough, and by extension, necessitates more stringent Phase 2 standards than what the Agencies are currently proposing. Another indicator that compliance with Phase 1 standards has been nearly effortless is the fact that some technologies assumed for Phase 1 standards have not been used at all to comply with 2014 standards, as is the case with automatic engine shutdown and idle reduction technology on Class 8 tractors. This is particularly

noteworthy considering that idle reduction technology was one of only four classes of technology assumed for the purposes of Phase 1 standards for Class 8 tractors.<sup>62</sup> Finally, there is clear evidence that most manufacturers (including those that also produce heavy-duty pickups and vans) are beating even the more stringent standards for large light-duty pickups and vans.<sup>63</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.12-13]

Another factor that must be considered is the high cost of the total delay in meaningful emissions reductions between both the lenient Phase 1 standards and the currently-proposed decade-long delay until full implementation of the Phase 2 standards. In light of the fact that, under optimistic assumptions, only a few decades remain to achieve sharp greenhouse gas emission reductions to avoid exceeding the 2°C warming increase that is the internationally-agreed target, scheduling full compliance with the Proposed Rule's targets over ten years from now is unreasonable and unjustifiable. As the Administration's laudable recent report on the cost of delaying action on climate change demonstrates, the cost of delay is extremely steep as well as irreversible, and it rises exponentially as delay continues.<sup>64</sup> Based even on this recent report's highly conservative assumptions (omitting, for example, the effects of crucial tipping points such as methane release from melting permafrost), the report values the cost of *delay alone* as at least \$150 billion for *every year* of delayed action if the delay results in overshooting the increase of temperatures over pre-industrial levels by just one degree Celsius, and sharply higher annual amounts for every degree of warming thereafter.<sup>65</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.13]

At present, global emissions continue to increase and are on a path leading to a projected total warming above pre-industrial temperatures of some 4.5° Celsius,<sup>66</sup> resulting in annual costs exponentially higher than those examined by the Cost of Delay report.<sup>67</sup> Plainly, every year of unnecessary delay in implementing the maximal technological feasible reductions in the face of steeply rising, persistent, and irreversible costs – including the acknowledged possibility that mitigation will be too late altogether<sup>68</sup> – is unreasonable and unjustifiable. The final rule should accelerate the implementation timeline to at least 2024. [EPA-HQ-OAR-2014-0827-1460-A1 p.13]

In sum, the Proposed Rule does not embody a reasonable balance between the statutory factors to reach standards that are technology-forcing under the Clean Air Act or that represent the maximum feasible improvement under EISA. This is a result of underestimations of technology availability and effectiveness, market penetration, and overestimation of the time needed to implement the Phase 2 standards. [EPA-HQ-OAR-2014-0827-1460-A1 p.13-14]

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56 Draft RIA at 5-47.

<sup>57</sup> *Id.* at 10-29.

<sup>59</sup> Implementation times: Final rule for Phase 1 was promulgated in 2011, with CO2 standards in effect beginning in 2014; fuel standards were not mandatory until 2016. In the Proposed Rule, the earliest start of standards would be 2021, with final stringency not reached until 2027.

<sup>62</sup> Phase 1 Final Rule, *supra* note 11 at 57,207.

<sup>63</sup> US EPA, <http://www3.epa.gov/otaq/climate/ghg-report.htm>; Union of Concerned Scientists, *Fact Sheet: Tomorrow's Clean Vehicles, Today* (May 2015), available at <http://www.ucsusa.org/sites/default/files/attach/2015/05/tomorrows-vehicles-today.pdf>.

<sup>64</sup> The White House, *Cost of Delaying Action to Stem Climate Change* at 2 (July 29, 2014), available at <http://www.whitehouse.gov/the-press-office/2014/07/29/white-house-report-cost-delaying-action-stem-climate-change> (“Cost of Delay”).

<sup>65</sup> *Id.*

<sup>66</sup> IPCC AR5 WG1 SPM at 14.

<sup>67</sup> See, e.g., Nicholas Stern, *The Structure of Economic Modeling of the Potential Impacts of Climate Change: Grafting Gross Underestimation of Risk onto Already Narrow Science Models*, 51 *Journal of Economic Literature*, (3), 838-59 (2013), available at [http://www.aeaweb.org/atypon.php?return\\_to=/doi/pdfplus/10.1257/jel.51.3.838](http://www.aeaweb.org/atypon.php?return_to=/doi/pdfplus/10.1257/jel.51.3.838); Frank Ackerman and Elizabeth Stanton, *Climate Risks and Carbon Prices: Revising the Social Cost of Carbon*, *Economics: The Open-Access, Open-Assessment E-Journal* 6, 2012-1 (2012), available at <http://www.economics-ejournal.org/economics/journalarticles/2012-10>; Frank Ackerman, Elizabeth Stanton and Ramon Bueno, *Fat Tails, Exponents, Extreme Uncertainty: Simulating Catastrophe in DICE*, 69 *Ecological Economics* (8): 1657-65 (2010), available at [http://econpapers.repec.org/article/eeeeecolec/v\\_3a69\\_3ay\\_3a2010\\_3ai\\_3a8\\_3ap\\_3a1657-1665.htm](http://econpapers.repec.org/article/eeeeecolec/v_3a69_3ay_3a2010_3ai_3a8_3ap_3a1657-1665.htm); Timothy Lenton and Juan-Carlos Ciscar, *Integrating Tipping Points into Climate Impact Assessments* (2013), 117 *Climate Change* (3): 585-97, available at <http://link.springer.com/article/10.1007%2Fs10584-012-0572-8#page-1>.

<sup>68</sup> *Id.* at 20.

**Organization:** Ceres

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 200, 202.]

We urge the agencies to strengthen the proposed phase 2 standard under consideration today by adopting a standard requiring a 40 percent reduction in fuel consumption by 2025. Alternative 4 comes closest to that standard.

Ceres agrees with the California Air Resources Board, which recommends the adoption of the Alternative 4 standards at a minimum, stating this option is both technology forcing and technologically feasible.

**Organization:** Coalition for Clean Air/California Cleaner Freight Coalition

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 217.]

EPA should adopt the 2014 alternative 4 because it is urgent we get the emissions reductions.

**Organization:** Cummins, Inc.

*Cummins supports the timeline of the proposed Alternative 3 standards* [EPA-HQ-OAR-2014-0827-1298-A1 p.18]

Lead-time and stability are critical to achieving the goals of the proposal. The three steps proposed in 2021, 2024 and 2027 give adequate lead-time and stability for manufacturers to develop and implement the technology needed to meet the standards. The long-term certainty of known reductions through 2027 benefits component suppliers, manufacturers and end users who will invest in fuel-saving technologies. Therefore, Cummins supports the proposed timeline of the Alternative 3 standards. [EPA-HQ-OAR-2014-0827-1298-A1 p.18-19] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.49.]]

The Alternative 3 timing proposed by the Agencies, with a final step in 2027, should be maintained in the Final Rule in order to provide the lead time, stability and certainty necessary for manufacturers to invest in and develop reliable technologies. [EPA-HQ-OAR-2014-0827-1298-A1 p.42]

**Organization:** Curl, Tilden

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 185.]

While the agencies' proposal of alternative 3 mostly pushes for technology which is largely of use today, there are some concerns to be recognized. If the agencies pursue alternative 4, there are many more concerns about, again, thrusting unproven technology into the marketplace. This would result in more truckers choosing to keep their current trucks on the road even longer. I want to stress the agencies' approach must allow for ample time for the OEMs to develop the new technology.

**Organization:** Daimler Trucks North America LLC

**Regulatory paradigm of 4 year lead-time and 3 year stability** - The regulatory paradigm of 4 years lead-time and 3 years stability needs to be revisited given the complexities of today's powertrain technologies as required to meet multiple regulations and heightened customer expectations. We believe that a three year cadence of tightened standards is too fast, as our experience has shown us that the three year criteria pollutant emission periods caused significant instability. Moreover, as the agencies press manufacturers for further improvements in fuel efficiency--which we at DTNA have been pursuing for decades--the changes become more difficult and more time-consuming to implement. Development of a new engine or a new cab takes on the order of a decade. Implementing new aftertreatment device requirements or, if it is necessary, waste heat recovery systems on all chassis takes more than three years from the time that we know what the technology will be. OBD calibration development must be performed on final calibrations, so its development is time shifted to later in the timeline and more time is needed overall. Plus, the workload has to be prioritized as cab redesigns, implementing aftertreatment devices, etc. cannot all be done at once; we have a limited engineering staff and a vast array of HDV products. In contrast to simple mechanical emissions controls utilized in engines at the onset of regulations, when 4 year lead-time and 3 year stability was conceived, the process for fuel economy optimization now involves development and integration of highly complex electronically controlled engine systems, transmissions, aftertreatment systems with DPF and SCR based NOx control systems, development of sophisticated diagnostics, and integration with vehicle system. [EPA-HQ-OAR-2014-0827-1164-A1 p.111]

HDV operators rely on higher levels of reliability and durability to prevent downtime that would compromise their investment in increasingly expensive technologies. Even if there is a warranty, HDV operators lose money whenever their vehicle is stranded by the side of the road; they may default on contracts; they may lose future business. HDV operators, therefore, have become very wary of new



technologies released prematurely. For the sake of HDV operators, the agencies should regulate with achievable lead-time and stability. [EPA-HQ-OAR-2014- 0827-1164-A1 p.111]

Therefore, as stringency of the regulations increases, and with it the complexity of technologies required to meet new regulations, the agencies should commensurately provide both additional lead-time for new technology introduction and increase the stability period between regulatory steps. In short, tightening standards every three years is too rapid, both for vehicle and for engine standards. We recommend standards in 2021 based on a lower penetration rate of new technologies and a subsequent round of standards no sooner than (say) [redacted]. [EPA-HQ- OAR-2014-0827-1164-A1 p.111-112]

**Organization:** Diesel Technology Forum

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows: [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

- **That ample lead time and stability are provided:** This is important because the number of commercial trucks made and sold each year (several hundred thousand) is a tiny fraction of the 11-17 million cars made. The significant diversity in the marketplace will require many hundreds if not thousands of different approaches depending on the type of vehicle. Manufacturers must have adequate lead time to make changes in technology for this diverse vehicle population along with regulatory stability so that they can recoup their investments over the longer sales and turnover cycles common in this segment. [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

**Organization:** Eaton Vehicle Group

Eaton believes the NPRM proposes performance-based standards that ensure that the fuel savings certified by the test procedures deliver fuel cost savings to truckers and fleets on the road. Eaton is also encouraged by the potential of a long term rule of 10 years. We believe regulatory certainty will help focus R&D efforts of companies like Eaton that are investing heavily in advanced technologies aimed at significant fuel savings. Clarity provided to the market with the proposed 10 year length of the rule allows Eaton to work with our customers in the near, mid and long term on solutions to meet the prescribed standards. [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

The EPA requested the technology readiness for alternative 4. Eaton supports the preferred Alternative 3. While some of the powertrain technologies discussed are already entering the market, there is significant work ahead of us to ensure the product reliability and its extensions and impact in larger segments. Furthermore, as we show in our remarks on hybrids, we do not see the right market or regulatory conditions for progress in the near future. As the objectives of Phase 2 are dependent on a more significant hybrid adoption, we support MY2027 to target full implementation. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

**Organization:** Environmental Defense Fund (EDF)

### **Overarching principles**

Our technical comments support two overarching recommendations: [EPA-HQ-OAR-2014-0827-1312-A1 p.26]

## **The proposed 2027 standards—and more—should be accelerated to model year 2024**

We recommend that the proposed 2027 standards be strengthened and accelerated to 2024. More protective standards can be met in 2024 by technologies that are already proven and mature – no advanced technologies are needed to go meaningfully beyond the proposed standards.<sup>123</sup> Moreover, the technologies needed are already in use today and manufacturers have indicated that they plan to further deploy them to meet anticipated standards.<sup>124</sup> In addition, these technologies are extremely cost effective and have short payback periods that present a very attractive market proposition for truckers.<sup>125</sup> Nine years provides a feasible lead-time for manufacturers to adopt these available technologies. [EPA-HQ-OAR-2014-0827-1312-A1 p.26]

[The following comments were submitted as testimony at the Chicago, Illinois public hearing held on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 33.]

The second recommendation is to accelerate the timing of the most stringent standards to 2024. The compliance timeline in alternative four is consistent with our assessment of the appropriate timeframe for implementing the most stringent standards. Nearly a decade away, it provides sufficient lead time for manufacturers to cost-effectively scale fuel saving solutions. It also better reflects the urgent need to reduce climate disrupting emissions.

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123 See ACEEE comments submitted to this docket; EPA-HQ-OAR-2014-0827-1280-A1

124 See ICCT comments submitted to this docket; EPA-HQ-OAR-2014-0827-1180-A4

125 Meszler, et al.. Cost effectiveness of advanced efficiency technologies for long-haul tractor-trailers in the 2020– 2030 timeframe, (2015), available at <http://www.theicct.org/us-tractor-trailer-tech-cost-effectiveness>.

### **Organization:** FedEx Corporation

Provide Regulatory Certainty to Ensure Advanced Technology Investments: Longer time frames and enough lead time to develop, mature and deploy advanced technology will provide regulatory certainty and pull through advanced solutions that will provide significant GHG and fuel consumption reduction in an economically sustainable fashion. This is necessary for both manufacturers to make long-term investments that would support the new standards, as well as for fleets that need a high level of reliability and cost effective solutions in order to deploy new technology. [EPA-HQ-OAR-2014-0827-1302-A1 p.2-3]

### **Organization:** First Industries Corporation

(3) EPA must not adopt Alternative 4 [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

### EPA's Must Not Adopt Alternative 4

EPA's proposal for GHG phase 2, known as Alternative 3, is very aggressive and will force technology into the marketplace that does not yet exist. This creates significant risk of a pre-buy/no-buy. Indeed, it is not apparent how OEM's will meet the challenge of Alternative 3. It is very clear, however, that

accelerating the timeline for those technologies by way of Alternative 4, will lead to a pre-buy/no-buy similar to 2007. This is bad for the trucking industry, bad for the US economy and bad for the environment as delayed purchases delay environmental benefits under the rule. Accordingly, we urge EPA to not even consider adopting Alternative 4. [EPA-HQ-OAR-2014-0827-1145-A2 p.5]

**Organization:** Ford Motor Company

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 28.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 158.]

It is of critical importance to provide manufacturers with adequate lead time to meet the requirements.

**Organization:** Honeywell Transportation System (HTS)

Honeywell also appreciates the proposed rule's ten year timeline through 2027 and the three-phased approach because it provides the industry with clear milestones that support long-term investment in the development of enabling technologies. [EPA-HQ-OAR-2014-0827-1230-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.256.]]

**Organization:** Institute for Policy Integrity at NYU School of Law

**Stringency:** The agencies have proposed a technology-forcing standard with compelling net social benefits. However, Alternative 4 would generate even higher net social benefits than the agencies' preferred alternative. And, for most vehicle classes and under most methodological assumptions, Alternative 5 would generate even greater net benefits. Unless the agencies have good reason to believe that their estimates of costs and benefits for these alternatives are wrong, they are under-regulating by failing to select Alternative 4 or Alternative 5. [EPA-HQ-OAR-2014-0827-1195-A1 p.3]

**Organization:** International Council on Clean Transportation (ICCT)

Advancing the proposed 2027 standards by three years would achieve the agencies' requirements for appropriate<sup>1</sup> and maximum feasible<sup>2</sup> standards. Advancing the timing for the standards is based on three fundamental reasons: (1) that the applicable technologies to comply with the proposed standards are already mature, (2) that these technologies are the ones that manufacturers are already planning to deploy, and (3) that these technologies offer a very attractive market proposition for heavy-duty vehicle owners. The rationale and references for these reasons are provided below. [EPA-HQ-OAR-2014-0827-1180-A4 p.4]

**Technology maturity:** The proposed stringency of the Phase 2 standards is predicated on well-understood and proven technologies. Given that the proposed stringency falls short of the demonstrated technology potential in the rule's timeframe, the required technology can be deployed between 2016 and 2024. In many cases the required technology is commercially available. Here are several examples that put the required technology penetration in the context of the full known technical potential: [EPA-HQ-OAR-2014-0827-1180-A4 p.4]

- *Diesel engines* – The engine standards are based on modest incremental improvements including engine friction, air handling, and combustion/controls, which are part of every engine/vehicle manufacturers existing technology portfolio and therefore allow for accelerated deployment before 2024. For context, the agencies proposed standards require less than half of the known technology potential for diesel tractor engines (e.g., see Eckerle, 2015; Thiruvengadam et al, 2014; Reinhart, 2015). The proposed standards (Phase 1 and 2 together from a 2010 baseline) also fall well short of SuperTrucks’ engine technologies (i.e., 10% versus SuperTrucks’ 15%, over the SET cycle) that have already been physically demonstrated in Peterbilt and Daimler tractors (Lutsey, 2015a). [EPA-HQ-OAR-2014-0827-1180-A4 p.4]
- *Transmissions* – Advanced integrated transmissions, including automated manual transmissions that enable downspeeding and optimal engine operation, by leading companies like Eaton and Volvo, have already been introduced (Stoltz and Dorobantu, 2014; Greszler, 2014). Automatic transmissions are the norm in Europe, and increasingly advanced dual-clutch transmissions are being introduced there. The agencies considered this technology as part of their stringency determination, but more advanced versions of this technology have been demonstrated in SuperTruck (Delgado and Lutsey, 2014). [EPA-HQ-OAR-2014-0827-1180-A4 p.4]
- *Trailers* – The trailer technologies upon which the stringency is determined embrace the already commercialized technologies that have been spurred by EPA’s SmartWay program and California’s in-use regulation. These technologies are already being adopted in increasing numbers by leading SmartWay Elite fleets and as part of the California regulation (Sharpe and Roeth, 2014). Asking trailer manufacturers and tractor fleets to move toward 2015’s leading technologies by 2024 provides sufficient lead time. [EPA-HQ-OAR-2014-0827-1180-A4 p.5] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.39]
- *Tractor-trailers* – Overall for tractors, the technologies included in the stringency determination are far short of the full technology potential. Applying the available incremental technologies for engines, transmissions, and aerodynamics can achieve technology potential far greater than agencies’ proposed 8 miles-per-gallon tractor-trailer standards before 2025 (See Delgado and Lutsey, 2015). SuperTruck teams are achieving 10.7 mpg (Peterbilt) and 12.2 mpg (Daimler/Freightliner) in real-world testing (Buchholz, 2014; Daimler, 2015) with combinations of engine, tractor, and trailer technologies that greatly surpass the proposed 2027 standard analysis. After correcting for test cycle differences, the SuperTruck technologies demonstrated by manufacturers would achieve up to 10 miles per gallon (Lutsey, 2015b); because the proposed 2027 stringency levels do not approach these stringency levels, the standards can be advanced by at least several years. [EPA-HQ-OAR-2014-0827-1180-A4 p.5]

**Industries’ expected technology roadmap:** The agencies chose technologies, with input from extensive industry discussions, based on the technologies that the various companies are prepared to, and plan to, deploy in much larger numbers in the rules’ timeframe. Based on publicly available data, the technologies in the engine, powertrain, aerodynamics, and tire areas are exactly the ones that suppliers and vehicle manufacturers have been discussing for the rules’ timeframe (Lutsey, Langer, Khan, 2014; Greszler, 2014; Salemm, 2014; Stoltz and Dorobantu, 2014). All of the major companies (e.g., Peterbilt/Cummins, Daimler, Navistar, Volvo) have participated in the U.S. Department of Energy (DOE) SuperTruck program, which has the explicit goal of using over \$140 million in public funding to demonstrate and help transition the efficiency technologies to the commercial marketplace over time (Delgado and Lutsey, 2014). Manufacturers and suppliers have already begun commercializing many of the technologies (Bloch-Rubin and Gallo, 2014), and therefore moving toward SuperTruck technologies considerably faster than the agencies are projecting. The fact that the technologies are already squarely in the plans of the several major manufacturing companies suggests that the agencies’ proposed timeframe to allow 12 years for implementing the standards is substantially more time than necessary and do not meet the statutory criteria of maximum feasible and appropriate. [EPA-HQ-OAR-2014-0827-1180-A4 p.5]

**Market-ready technologies.** Not only are the technologies mature, but they are well vetted and market-ready due to their attractive fuel-saving proposition for truck owners. At the proposed stringency levels, the standards can be met almost entirely with commercialized technologies that are available today in the marketplace and that have already been embraced by early adopters. Efficiency technologies, though highly cost-effective, are held back by prevailing market barriers (Vernon and Meier, 2012; Roeth et al, 2013). The proposed regulations remove many of these barriers. The applicable technologies, based on the latest analyses, are highly cost-effective – allowing average tractor-trailer owners to return their technology investments in fuel savings in 6 months to 2 years, even if diesel fuel prices are low (Meszler et al, 2015). Similarly, looking just at trailers, the cost-to-fuel saving proposition is even more attractive (See Sharpe et al, 2014). Because the efficiency technologies offer the rapid payback periods as desired by truck owners, the regulated fleet can easily take them up within the nine years between 2015 and 2024. [EPA-HQ-OAR-2014-0827-1180-A4 p.5-6]

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*1 Per the Clean Air Act, EPA has broad discretion to give appropriate consideration and weight to the statutory factors of emission reductions, cost, and lead time and allows EPA to adopt technology-forcing standards.*

*2 Per the Energy Independence and Security Act, NHTSA is instructed to set standards that “achieve the maximum feasible improvement”, previously defined as including factors of appropriateness, cost-effectiveness, and technological feasibility.*

**Organization:** International Foodservice Distributors Association

IFDA is particularly concerned that the proposal’s Alternative 4 would accelerate the timetable well beyond what is feasible both in terms of the ability of manufacturers to comply and adoption by the industry. [EPA-HQ-OAR-2014-0827-1258-A1 p.1]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The UAW supports standards with sufficient lead time allowing for research and development of cost effective and reliable technology that will be accepted by the fleets and other customers. [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

In this vein, we strongly oppose Alternative Four which pulls stringency requirements forward from 2027 to 2024. Pulling the 2027 requirements forward may not only force unreliable and unproven technology to market, it is a de-facto increase in stringency requirements. Alternative Three is highly ambitious but could reach the proper balance if important modifications are made. Our concerns and recommendations are detailed in our comments. [EPA-HQ-OAR-2014-0827-1248-A2 p.3]

**Organization:** Manufacturers of Emission Controls Association (MECA)

MECA supports the EPA proposed reductions in greenhouse gas emissions for the heavy-duty truck segment, and believes that the proposed reductions are technically feasible using technologies that are ready for deployment on trucks today. Numerous analyses have estimated greater potential reductions of CO2 than will be achieved by this proposal suggesting that EPA’s Alternative 4 may be the more realistic scenario. EPA’s own analysis shows that the faster Alternative 4 implementation timeline

provides nearly the same payback periods as the longer Alternative 3 implementation timeline. The Department of Energy's SuperTruck program has demonstrated the magnitude of reductions that engine and vehicle technologies can deliver. A 2024 final implementation date, under Alternative 4, would allow developmental technologies to be optimized and ready for deployment under future, Phase 3 heavy-duty GHG standards to achieve the full potential reductions that exist from this transportation sector. We urge EPA to finalize a set of stringent Phase 2 standards that would incentivize the deployment of the full spectrum of cost effective technologies developed for engines and vehicles to guide industry investment and maximize environmental benefits. At a minimum, MECA is supportive of a final rule with a 2024 final phase-in date. [EPA-HQ-OAR-2014-0827-1210-A3 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.211.]]

**Organization:** Mass Comment Campaign sponsored by Center for Biological Diversity (web) - (4,429)

To that end I support the timeline for implementation as currently set out in 'Alternative 4.' But I also urge you to opt for an alternative that will actually drive innovation by requiring greater reductions in fuel usage over this time. An analysis from the International Council on Clean Transportation has developed a roadmap for achieving up to 30 percent greater reductions in CO2 emissions by 2040 than would be achieved under your currently proposed standards. [EPA-HQ-OAR-2014-0827-1167-A1 p.1]

**Organization:** NAFA Fleet Management Association

Given we are already very concerned over the proposed Phase 2 "Alternative 3" efficiency targets, we ask EPA and NHTSA to reject what is defined in the proposal as "Alternative 4" to avoid serious negative economic implications for fleets and truck manufacturers. Alternative 4 would "pull-- ahead" the 2027 greenhouse gas/fuel efficiency target dates for engines, vehicles, and trailers by three years to accomplish all such milestones in 2024. [NHTSA-2014-0132-0111-A1 p.4]

**Organization:** National Association of Clean Air Agencies (NACAA)

With respect to timing, NACAA strongly supports EPA's proposed Alternative 4, under which the standards would be fully implemented by 2024. This implementation deadline is entirely feasible and vitally important to spur much-needed near-term emissions reductions and technological innovation. Further, Alternative 4 would provide manufacturers of heavy-duty engines and vehicles nearly eight years of lead-time to develop and apply technologies needed to comply with the most stringent GHG emissions standards and is consistent with the lead-time requirements of section 202(a)(2) of the Clean Air Act. NACAA urges EPA to finalize Alternative 4 rather than Alternative 3, which would unnecessarily extend full implementation by three years to 2027, particularly when all of the technologies/approaches required already exist, with many already deployed on today's trucks. [EPA-HQ-OAR-2014-0827-1157-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.53-54.]]

We believe, in general, that the Phase 2 proposal is overly pessimistic regarding the implementation outlook for advanced technologies nationwide. The proposal also underestimates the ability of engine and truck manufacturers to incorporate longer-term technical solutions now for meeting global climate goals. As such, we recommend that EPA take a more assertive stance in challenging industry to accelerate technology innovation by adopting Alternative 4. EPA includes the projected compliance costs for the proposed emission standards under Alternatives 3 and 4 in the proposal. Even the projected higher compliance costs for Alternative 4 – which constitute only a fraction of the base costs of new

engines and vehicles – are more than offset by the cost savings from reduced fuel consumption within two to six years. With respect to fuel efficiency and emission reductions, the proposal indicates that, on a nationwide basis, Alternative 4 overall would save 10 billion more gallons of fuel and provide about 130 more million metric tons of GHG reductions by 2030 than Alternative 3. These are important improvements that can and should be realized. [EPA-HQ-OAR-2014-0827-1157-A1 p.3]

In addition to early climate benefits, federal action on our recommendation to adopt Alternative 4 (full implementation by 2024) would also provide manufacturers the ability to incorporate technologies to significantly reduce NOx emissions from heavy-duty vehicles in a more timely manner. While already crucial for a number of areas, NOx reductions from the heavy-duty sector will become increasingly important to additional areas under strengthened National Ambient Air Quality Standards for ozone, which are expected imminently. We urge that EPA include in the final Phase 2 rule a clear and comprehensive discussion of the need for very substantial additional NOx reductions from heavy-duty vehicles and engines and, even more critically, an explicit commitment to begin immediately a separate rulemaking initiative to capture those reductions. [EPA-HQ-OAR-2014-0827-1157-A1 p.4] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.54.]]

**Organization:** National Association of Manufacturers (NAM)

Finally, the NAM strongly encourages the EPA and NHTSA not to adopt the pull-forward of the vehicle standards from MY2027 to MY2024 under 'Alternative 4.' Manufacturers want and need regulatory certainty, and the vehicle standards pull-forward in Alternative 4 would jeopardize this certainty by creating early deadlines that manufacturers may not be able to meet. [EPA-HQ-OAR-2014-0827-1323-A2 p.2]

**Organization:** National Automobile Dealers Association (NADA)

However, unlike Phase 1 which largely involves currently available technologies, the Phase 2 proposal focuses on many that are not yet fully developed or deployed. For each vehicle group, the proposal suggests that fuel savings should offset the up-front and ongoing costs of new technologies, but fails to adequately recognize how those technologies inevitably will make vehicle ownership and operations more complex. Since commercial truck purchasers are very risk averse, any higher costs, reduced performance, or increased complexities associated with the Phase 2 program could undermine its potential benefits. [EPA-HQ-OAR-2014-0827-1309-A1 p.5]

NADA/ATD categorically objects to Alternative 4, which would effectively impose MY 2027 targets in MY 2024. [EPA-HQ-OAR-2014-0827-1309-A1 p.11]

**Organization:** Natural Resources Defense Council (NRDC)

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372 pp. 42-43.]

First, the compliance timeline should be moved up. The environmental community conducted conservative analysis showing that the new fleet fuel consumption and greenhouse gas emissions can be reduced by at least 40 percent from 2010 levels by 25. Within the proposal alternative four, which achieves full compliance in 2024, is the closest to meeting our target. When it comes to cutting carbon and reducing our dangerous dependence on oil, every year counts.]

The agencies' own analysis shows that alternative four is technically feasible and cost effective. NRDC believes that the 2024 compliance timeline is also appropriate. Compared to the proposal, alternative four reduces oil consumption and carbon pollution by an additional 13 percent, and increases net benefits by over \$24 billion. NRDC urges the agencies to accelerate the compliance timeline.

**Organization:** Navistar, Inc.

In the NPRM the agencies have offered several alternatives and asked for comments on Alternative 4 in particular. This proposal would compress the timeline for adoption from a three - -stage process to a two--stage process, with completion of implementation scheduled in 2024 instead of 2027. The administration believes this alternative is the maximum feasible and appropriate alternative but they have outstanding questions about the relative risks and benefits and are seeking comments. [EPA-HQ-OAR-2014-0827-1199-A1 p.17]

In preparing comments for this Proposed Rule, Navistar devoted significant engineering time to provide a detailed analysis of the rule and the company has already commented extensively on the fundamental problems with Alternative 3, which is the agencies' preferred option. Alternative 4, which would pull the implementation date forward by three model years, would significantly increase the technological risk and in some cases would make compliance with the final rule impossible. [EPA-HQ-OAR-2014-0827-1199-A1 p.17]

The most significant examples of the risk this alternative introduces relate to engine emission standards and the aerodynamics component of the Proposed Rule. The four truck OEM's and the US Department of Energy have spent over \$250 million on the SuperTruck program to develop highly advanced Class 8 line haul tractor-trailers. In these Comments Navistar discusses in detail how the 2027 aerodynamics standard are unachievable even utilizing the tractors developed for the SuperTruck program. Pulling an unachievable standard forward by three years would merely accelerate the problem. [EPA-HQ-OAR-2014-0827-1199-A1 p.17-18]

The impact on the engine would be at least as severe, since one of the critical technologies is waste heat recovery, which is not yet commercially viable and will not be viable by 2024. Alternative 4 does not provide enough lead time for this technology and the NPRM has not shown that any technologies are feasible in the Alternative 4 time frame. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

Alternative 3 also presumes extremely aggressive technology adoption rates. This is particularly the case for the use of hybrid powertrains in the vocational vehicle sector. The NPRM is based on 18% of urban and 18% of multi-purpose vocational vehicles utilizing hybrid powertrains by 2027. As we note in our discussion on hybrids, this is not likely to be feasible. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

The adoption rate for hybrid vocational vehicles is essentially zero today because of low fuel prices and the significant regulatory burden that hybridization faces in the commercial vehicle space. As one of the first companies to market commercial hybrid vehicles, we know there is little evidence to suggest our customers will be willing to buy vocational hybrids in sufficient numbers to meet the standard in 2027. In fact, at its highest, the penetration rate for hybrids never exceeded 1%. Predicating this alternative on the assumption that hybrid adoption rates will reach 18% by 2024, instead of 2027 will inject significant risk into the technology path that the NPRM lays out for vocational vehicles to achieve compliance. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

The NPRM also has an aggressive adoption rate for low rolling resistance drive and steer tires in both vocational and line haul trucks. While low rolling resistance tires offer clear benefits to some



commercial vehicle operators, there is a trade-off in adopting lower rolling resistance tires, which will impact traction and durability in negative ways. This is a tradeoff that many of Navistar's customers will be unwilling to make given the capabilities of low rolling resistance tires today. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

While Alternative 3 has substantial problems, Alternative 4 compounds those problems by shortening the timeframe for compliance. Navistar therefore strongly believes that Alternative 4 would cause massive disruptions in the industry and lead to a significant pre-buy/no-buy in 2023MY-2024MY as customers seek to avoid additional costs and complexity. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

Navistar feels the following are key areas the agencies must address: [NHTSA-2014-0132-0094-A1 p.2]

- The accelerated option of Alternative 4 is not achievable. [NHTSA-2014-0132-0094-A1 p.3]

**Organization:** North American Die Casting Association (NADCA)

NADCA does support comments made by a number of groups that Alternative 4 is not feasible at this time and regulators should reject pressure to adopt these standards. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

The agencies should adopt the timeline proposed in Alternative #4.

Given that the proposed technologies are already mature or have been successfully demonstrated, and given our states' need for significant GHG reductions in the near term, the timeline proposed in Alternative #4 is both reasonable and appropriate. Based on the assessments of the California Air Resources Board (CARB) and the International Council on Clean Transportation (ICCT), a full phase-in of the rules by 2024 is technologically feasible. Given the scope of needed GHG reductions, and the compelling benefits to freight industries and their consumers from reduced fuel expenditures, 2027 is too long to wait to realize the full potential of this rule. [EPA-HQ-OAR-2014-0827-1221-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.136-137.]]

As ICCT<sup>1</sup> and CARB<sup>2</sup> have noted, existing technologies are already available to provide the proposed reductions in the 2024 timeframe. Moreover, manufacturers have expressed their intentions to further increase the deployment of these technologies in the near term. These technologies are cost-effective and have been shown to provide strong return on investment for operators. [EPA-HQ-OAR-2014-0827-1221-A1 p.2]

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1 International Council on Clean Transportation, Advanced Tractor-Trailer Efficiency Technology Potential in the 2020-2030 Timeframe (April 2015). Available at: [http://www.theicct.org/sites/default/files/publications/ICCT\\_ATTEST\\_20150420.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_ATTEST_20150420.pdf).

2 California Air Resources Board, Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency (June 2015). Available at: [http://www.arb.ca.gov/msprog/tech/techreport/epdo\\_ve\\_tech\\_report.pdf](http://www.arb.ca.gov/msprog/tech/techreport/epdo_ve_tech_report.pdf).

**Organization:** Orange EV

Targeting incremental improvements by 2027 may be slower than achievable. [EPA-HQ-OAR-2014-0827-1135-A1 p.1]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

### **Lead Time**

A crucial aspect of this rulemaking is the amount of time which the manufacturers will be given in order to comply with the new standards. OOIDA members are concerned that if there is not sufficient lead time to develop and test new technologies, that trucking companies will be forced to purchase, at an extra cost, unreliable equipment which is susceptible to frequent repairs – further increasing the truck owners costs. [EPA-HQ-OAR-2014-0827-1244-A1 p.15]

For the past decade, the trucking industry has been flooded with emission reduction regulations including EPA 2007, EPA 2010, Onboard Diagnostic (OBD) in 2013, GHG14, OBD in 2016, and GHG17. The rapid succession of regulations has not given the manufactures time to work to reduce the costs of new vehicles, therefore, these forced regulations will dramatically increase the cost of medium-and-heavy-duty trucks. A study published in 2012 entitled A Look Back at EPA’s Cost and Other Impact Projections For MY 2004-2010 Heavy-Duty Truck Emissions Standards, detailed EPA’s significant underestimation of real-world vehicle costs. [EPA-HQ-OAR-2014-0827-1244-A1 p.15]

[Chart 1 can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1244-A1]

Further, the decreased reliability of EPA compliant truck and engine models has been well documented. A 2011 J.D. Power and Associates study suggested that, “With the new technology required to meet emissions standards, today’s engines simply are more problematic than the previous generation. So, while it’s possible that manufactures can continue to improve the quality of the engines, it’s unlikely that they’ll quickly get back to the pre-2004 levels.<sup>19</sup>” In addition, Daimler Trucks North America has stated that vehicle efficiency improvements reduce real-world NOx emission benefits in proportion to power demand reduction. The combustion fundamentals state that any increase in stringency of NOx standards will compromise the ability to optimize for minimum CO2 emissions and maximum fuel efficiency. While EPA admits that there were some problems with the Phase I trucks, the agency fails to recognize that similar problems could develop with Phase II. [EPA-HQ-OAR-2014-0827-1244-A1 p.16]

For example, the MaxxForce engine produced by Navistar was labeled as an “approved engine.” As Navistar attempted to perfect its exhaust gas recirculation (EGR) technology, many trucking companies with MaxxForce powered trucks experienced repeated breakdowns and engine failure between 2010 and 2012, many of which were directly related to the EGR system. [EPA-HQ-OAR-2014-0827-1244-A1 p.17]

Problems with components such as EGR valves, EGR coolers, EGR inlet tubes, EGR sensors, and defective ECM modules were being experienced by trucking companies throughout the United States. Not surprisingly, both Navistar's International trucks and MaxxForce engines experienced numerous recalls and dozens of service bulletins related to the EGR system. These problems led to increased breakdowns, downtime, repair costs, and lost profits for the companies operating these trucks. [EPA-HQ-OAR-2014-0827-1244-A1 p.17]

Without proper lead time, the OEMs will not have sufficient time to produce proven and reliable trucks, which could create a pre-buy scenario in which the agencies have hoped to avoid. OOIDA's preferred option is Alternative 1. This Alternative will allow the market to drive fuel efficient technologies at a pace that is conducive to healthy growth and actual consumer costs, which will assist the agencies in reaching their objectives that much sooner by avoiding pre-buys, risky technology, and negative outlooks on any future rulemakings. [EPA-HQ-OAR-2014-0827-1244-A1 p.17]

OOIDA proposes that agencies' preferred alternative, Alternative 3, as well as Alternatives 4 and 5, are unrealistic and if adopted as part of this rulemaking process, will severely compromise the agencies' praiseworthy objectives to increase the fuel efficiency of medium-and heavy-duty trucks and reduce GHG emissions. Truck drivers certainly desire fuel efficient trucks and appreciate cleaner air to breathe. While various governmental agencies and environmental groups tend to paint owner-operators as individuals who do not care about the environment, nothing could be further from the truth. It is crucial to understand that owner-operators are not only hardworking Americans who help to move our economy, but that they also spend a majority of their life around tractor-trailers. Therefore, it is in their best interest, as well as in the interest of the public, to operate clean and efficient trucks. [EPA-HQ-OAR-2014-0827-1244-A1 p.36-37]

Alternatives 3 or 4 very well could put many owner-operators out of business, and thus would have a major unintended consequence on the nation's economy, as 70 percent of all freight is moved by a truck. [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

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19 CCJ Staff, "J.D. Power, Heavy-duty Engine Quality, Satisfaction Up Since Last Year," Commercial Carrier Journal (2011) <http://www.ccjdigital.com/j-d-power-heavy-duty-engine-quality-satisfaction-up-since-last-year/>

**Organization:** PACCAR, Inc.

**Stringency of Standards: EPA and NHTSA Should Adopt Alternative 3 Standards with Appropriate Revisions Because these Offer the Optimum Combination of GHG Reductions and Lead-Time for Manufacturers** [EPA-HQ-OAR-2014-0827-1204-A1 p.1]

PACCAR has worked closely with EPA and NHTSA in the development of the proposal, providing feedback and data points on many technical aspects of the rule. PACCAR strongly urges the Agencies to adopt Alternative 3, which if appropriately modified, is the best combination of standards and compliance deadlines to achieve environmental protection goals, as well as ensure that consumer demands and expectations are met. Alternative 3 will, without question, require significant technological development and widespread implementation of new technologies. In Section II below, we outline the issues that make compliance with Alternative 3 standards challenging and should be addressed by the Agencies before promulgation of final standards. The lead-time provided in Alternative 3 will minimize disruptions to our customer base while achieving significant improvements in fuel efficiency and GHG emission reductions. [EPA-HQ-OAR-2014-0827-1204-A1 p.2]

**Alternative 4 Pulls Ahead Compliance with more Stringent Standards but Will Not Result in Significant Additional GHG Reductions or Fuel Efficiency Improvements in the Long Run**

In contrast to Alternative 3, Alternative 4 would require greater emission reductions on an accelerated basis. This combination may have the counterproductive effect of causing truck owners to either pre-

buy less-efficient models or delay the purchase of more efficient, yet more expensive and technically complex, new trucks and engines, leaving older, less-efficient trucks on the road for longer. Overall, PACCAR believes that Alternative 3 will achieve the same emission-reduction and fuel-efficiency goals as Alternative 4, but without the market disruption and customer dissatisfaction that Alternative 4 would create. [EPA-HQ-OAR-2014-0827-1204-A1 p.4]

**Organization:** Recreational Vehicle Industry Association (RVIA)

Further, while Alternative 3 in the Proposed Rules would be highly problematic for the motorhome sector for the reasons stated below, EPA should not choose an even more restrictive option, Alternative 4. [EPA-HQ-OAR-2014-0827-1261-A1 p.4]

In no event should EPA choose Alternative 4 for its overall standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

**Organization:** Rubber Manufacturers Association (RMA)

#### **Lead time**

Both the NPRM and the DOT draft Environmental Impact Statement (EIS) propose lead time of not less than 4 model years, consistent with the requirements of the Energy Independence and Security Act of 2007 (EISA) at 49 U.S.C. § 32902(k)(3)(A). Although RMA recognizes that the Clean Air Act does not provide similar guidance to EPA on lead time for its rulemaking, RMA encourages both Agencies to recognize the significant challenges associated with redesigning certain tires (e.g., drive tires for vocational vehicles and tires for non-aero vans and non-box trailers) to meet aggressive rolling resistance targets. As discussed above regarding tires for non-aero vans and non-box trailers, significant lead time is needed to design lower rolling resistance tires for these applications, due to the specialized performance needs of these tires and the fact that SmartWay tires are not appropriate fitments for non-aero vans and non-box trailers. [EPA-HQ-OAR-2014-0827-1304-A1 p.34]

RMA has stated in previous discussions with EPA, DOT/NHTSA, the National Academy of Sciences (NAS) committees that have studied these areas and the California Air Resource Board (CARB), a 5 year lead time is necessary to effect changes to tire technological advances, e.g. design, development, testing, validation, and commercialization. This lead time is critical to assuring the development of new tires that meet the myriad needs of customers in the areas of tire performance, including durability, load carrying capacity, tread wear, traction, rolling resistance and retreadability. [EPA-HQ-OAR-2014-0827-1304-A1 p.34]

Continuous rolling resistance improvements will require an evaluation of available technologies and materials, the development of new technologies and materials, as well as reasonable lead times. [EPA-HQ-OAR-2014-0827-1304-A1 p.34]

**Organization:** Schneider National Inc

Schneider is an early adopter of fuel efficiency technologies and is constantly evaluating options for improving overall freight efficiency. New technologies, however, take time to develop in order to ensure the products are reliable, safe and provide real world benefits. Accordingly, Schneider opposes EPA's Alternative 4, which seeks to move already aggressive targets from 2027 to 2024. Such a proposal creates the risk of forcing technology into the market before it is ready. The increased risk of

such action will likely lead to a pre-buy of existing technologies (as occurred when EPA pulled forward 2004 engine emission standards to October 2002), with the net effect that anticipated air quality benefits were not realized. [EPA-HQ-OAR-2014-0827-1201-A1 p.3-4]

**Organization:** School Bus Manufacturers Technical Council

The SBMTC would also like to comment that we feel that the proposed Alternative 3 implementation timeline (years 2021, 2024, and 2027) is reasonable and gives adequate time for manufacturers to implement reliable technologies and designs to meet end users requirements and to be compliant. We support retaining this timeline in the Final Rule. [EPA-HQ-OAR-2014-0827-1287-A1 p.2]

**Organization:** Sierra Club

### **Accelerate the timeline of efficiency improvements**

While the proposed standards would decrease fuel consumption by 36% by 2027, analysis by the Union of Concerned Scientists, Natural Resource Defense Council, Environmental Defense Fund, and American Council for an Energy-Efficient Economy has shown we can reduce new truck fuel consumption 40% by 2025, compared to 2010 vehicles. [EPA-HQ-OAR-2014-0827-1277-A1 p.2]

Indeed, in the proposed rule, the agencies consider Alternative 4, in which full compliance is achieved by 2024 and find that this alternative is both technically feasible and cost-effective. Not only would this alternative reduce oil consumption and carbon pollution by an additional 13 percent, it would increase net benefits by more than \$24 billion. We urge the agencies to adopt the timeline and stringency of Alternative 4. [EPA-HQ-OAR-2014-0827-1277-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.188-189.]]

**Organization:** South Coast Air Quality Management District (SCAQMD)

### **U.S. EPA and NHTSA Proposed Greenhouse Gas Emissions and Fuel Efficiency Standards**

The SCAQMD staff strongly believes that tighter greenhouse gas emission standards should be established and the timeframe for full implementation be shortened relative to U.S. EPA's recommended standards and timeframe. As such, we strongly support adoption of Alternative 4 rather than Alternative 3 to achieve full implementation by 2024. [EPA-HQ-OAR-2014-0827-1181-A1 p.2]

In summary, the SCAQMD staff urges U.S. EPA to finalize the proposed Phase 2 greenhouse gas emissions and fuels standards rule as early as possible with the inclusion of proposed revisions from CARB and NACAA along with the comments provided above.[EPA-HQ-OAR-2014-0827-1181-A1 p.8] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.34.]]

**Organization:** Truck & Engine Manufacturers Association (EMA)

Phase 1 has required vehicle manufacturers to undertake significant IT investments and complex process upgrades in order to generate and organize the data needed for GHG/FE compliance reporting to EPA and NHTSA. For each vehicle manufacturer, the necessary IT upgrades have involved millions of dollars and multiple years of development effort to generate and finalize all of the required data elements. The IT solution for GHG/FE tracking and reporting has had to be integrated into existing

systems to deliver the required compliance data. In that regard, manufacturers' systems need to interrogate the listing of materials for each vehicle (i.e., each VIN) to identify the relevant vehicle subcategory, aerodynamics, tires, weight, AES/VSL, engine, and other operative GHG/FE factors. That information is then used to calculate the required inputs for "GEM" (the Agencies' greenhouse gas emissions model) and to generate the unique complex vehicle label. GEM is run for each vehicle to find the VIN's predicted CO<sub>2</sub>. All of those data are required for the compliance reports submitted to EPA and NHTSA. In addition to the IT infrastructure and programming, significant resources also have been required to maintain and secure the information necessary for compliance with Phase 1. [EPA-HQ-OAR-2014-0827-1269-A1 p.2-]

For Phase 2, significant additional IT investments will be needed to develop and input engine fuel maps, transmissions (including powertrain test data), rear axles, and other vehicle attributes for the revised and more complex Phase 2 GEM calculations. Consequently, the IT investment for Phase 2 is expected to be even more significant than for Phase 1, which, as noted, was itself very substantial. [EPA-HQ-OAR-2014-0827-1269-A1 p.3]

#### Infeasibility of "Alternative 4"

Leadtime and stability are critical to achieving the goals of the Phase 2 proposal. The Agencies have proposed three steps of standards for engines and vehicles – in 2021, 2024, and 2027. The long-term certainty of knowing the required reductions through 2027 provides benefits to component suppliers and manufacturers, who need to invest in, develop, and validate reliable fuel-saving technologies, and to the end-users who will ultimately depend on those technologies in the market. Pulling ahead the 2027 standards by three years reduces the necessary certainty for manufacturers and results in less reliable technologies. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

In that regard, the Agencies have asked for comment on the feasibility of "Alternative 4," which would pull ahead by three years the proposed effective dates of the Phase 2 Standards as laid out under Alternative 3. Simply stated, Alternative 4 is not feasible for medium-duty and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

Proponents of Alternative 4 may opine that it is feasible based on assumed "pay-back" periods, and based on assertions that the potential pay-back periods would be, by and large, the same under either Alternative 3 or Alternative 4. But that argument is irrelevant. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

The stringency of the Proposed Phase 2 vehicle standards is premised on assumptions (albeit overestimated assumptions) about technological developments and on the market penetration rates for those to-be-developed vehicle technologies, not on assumed "pay-back" periods. Neither the timeline for the necessary technological developments nor the realistic market penetration rates for those vehicle technologies would allow Alternative 4 to be feasible, let alone cost-effective. In that regard, the presumed penetration rates for the higher-bin aerodynamic packages, as well as for stop-start technologies, single tires, hybrid powertrains, and "6x2" axle systems, among other technologies, are all overstated. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

For example, "6x2" axle systems cannot be implemented as the Agencies have assumed, since they are not allowed in all localities. Local and state laws pertaining to bridge loads, per-axle weights and tire-patch requirements simply make it impractical to implement "6x2" axle configurations at the rate of penetration that the Agencies have forecast. There are similar impracticalities with respect to the Agencies' other forecasted penetration rates as well. As a result, a three-year pull-ahead of already

overstated penetration rates would only serve to exacerbate the infeasibility of the proposed vehicle program, cause significant market disruptions, and would result in disproportionately costly and delayed reductions in GHG emissions. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

Accordingly, Alternative 4 should not be the basis for the Proposed Phase 2 Standards. The Alternative 3 timeframe (assuming the Agencies make the required revisions, as noted in EMA's comments) will be challenging enough. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

#### Potential Pre-Buy/Low-Buy Concerns

Other issues exacerbate the problems associated with adopting Alternative 4 for medium-duty and heavy-duty vehicles. As the Agencies well know, there is significant elasticity in the demand for the commercial vehicles at issue in this rulemaking. The Agencies only regulate the manufacturing of new engines and vehicles. There is no obligation for customers to buy the new products – and certainly not at the time of implementation of a new regulation. Moreover, experience has shown that adverse economics, globally or affecting key market segments, have resulted in customers delaying vehicle purchases. Similarly, experience has shown that actual or perceived concerns about the cost, performance, durability, serviceability, or overall efficacy of new-tier vehicle technologies have also resulted in customer “pre-buys” of current-tier technologies and/or the delayed purchase of new-tier technologies. Neither manufacturers (who wish to start recovering their investment in new-tier engine and vehicle technologies as soon as possible) or regulators or the public (who wish to realize the benefits of new regulations as soon as possible) want to experience a pre-buy/low-buy response to the Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.56]

Alternative 4 increases the risk for such a potential response since it likely would result in significantly higher per-vehicle cost increases (compared to Alternative 3), and could produce real or perceived concerns for product durability, reliability and maintenance issues. Those possible circumstances – necessarily more likely under Alternative 4 – could induce vehicle and fleet owners to revise their scheduled purchases of new Phase 2 vehicles. In that regard, and as the Agencies expressly acknowledge, Alternative 4 would deprive manufacturers of three-years of learning time and therefore would decrease the “learning-benefit” savings otherwise available under Alternative 3. [EPA-HQ-OAR-2014-0827-1269-A1 p.56]

The net result could be that manufacturers will be unable to recoup their capital investments in the time period projected in the NPRM. Worse, the very marginal GHG emission benefits ascribed to Alternative 4 might not be realized, even if the three-year pull-ahead could be accomplished, if the Alternative 4 standards proved in the market to be perceived as problematic by customers. The higher costs and potential reliability issues associated with Alternative 4 could be enough to cause vehicle and fleet owners to keep their Phase 1 vehicles longer than otherwise. Consequently, Alternative 4 might actually result in higher aggregate GHG emissions than under Alternative 3, not marginally lower emissions. This is another reason why the Agencies should not implement Alternative 4. [EPA-HQ-OAR-2014-0827-1269-A1 p.56]

#### Overall Feasibility Of The Proposed Phase 2 Vehicle Standards

As noted above, many of the Agencies' Proposed Phase 2 Standards for heavy-duty and medium-duty vehicles are based on a series of very aggressive assumptions regarding the development of efficiency-enhancing technologies and regarding the market penetration rates of those technologies out to the year 2027. In that regard, EPA and NHTSA have developed a number of tables summarizing the Agencies' key assumptions that led to the development of the Proposed Phase 2 Standards for Class 7 and 8 heavy-

duty tractors, heavy-haul tractors, trailers, and vocational vehicles. Each of those tables (including Table III-10, Table III-18, Table IV-4, Table IV-13, Table IV-14, Table V-15, Table V-19, and Table VIII-3) contains assumptions that are incorrect or over-estimated, and that call into question the feasibility of the Proposed Phase 2 Standards for the heavy-duty vehicles at issue. Included among those flawed or over-estimated assumptions are the following: [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

- The assumptions that Class 7 and Class 8 high-roof vehicles will achieve a 35% penetration rate into Bin V, a 20% penetration rate into Bin VI, and a 5% penetration rate into Bin VII are grossly over-stated and unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71][This section can also be found in section 4.3 of this comment summary]
- The assumed aerodynamic performance improvements to be achieved by daycab and mid and low-roof vehicles are over-estimated by at least one Bin, and so are inherently unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71][This section can also be found in section 4.3 of this comment summary]
- The assumptions that 90% of Class 8 sleeper caps and 90% of long-haul tractor trailers will utilize APUs to achieve extended idle emission reductions is based on grossly underestimated cost estimates and is unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71][This section can also be found in section 4.3 of this comment summary]
- The assumption that 40% of all Class 7 and 8 vehicles will utilize automated tire inflation systems lacks any factual basis, overlooks the prevalence of tire inflation monitoring systems, and is unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71][This section can also be found in section 4.3 of this comment summary]

The Agencies will need to correct all of the foregoing unreasonable assumptions, along with the others noted in these comments, before finalizing the Phase 2 Standards. Otherwise the Phase 2 Standards will likely prove to be infeasible for medium-duty and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.72]

**Organization:** Truck Renting and Leasing Association

However, TRALA has several concerns about the Proposed Standards, which we have set forth below: (5) TRALA strongly opposes Alternative 4. [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

#### **TRALA Opposes Alternative 4**

For the reasons stated above, TRALA believes that the Proposed Standards already go too far in imposing burdensome costs and technology-forcing mandates that industry and its customers are not equipped to bear. Making the Proposed Standards even more stringent by, for example, moving up the full implementation date to MY2024 from MY2027 would run the risk of resulting in a largely unworkable regulatory program that would have to be later revised to enable compliance in the years ahead. [EPA-HQ-OAR-2014-0827-1140-A1 p.6]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

#### **The Problem with Technology Forcing and Long-Duration Regulations:**

This proposed regulation postulates an aggressive schedule of technological development for a long period into the future. While we appreciate the experience the agencies have brought forward in making these predictions, and that the regulation is crafted with the intent of bringing a certain degree of



stability to regulation by laying out a roadmap until MY 2027, facts often fly contrary to the best predictions. Moreover, other voices are calling on the agencies to pursue a more aggressive schedule, one that would require an even faster technological development and deployment schedule. Therefore, we request that the regulation have built into it a mid-course review. For areas where there have been unexpected delays, say due to intellectual property rules creating a monopoly for a critical item such as a trailer boat-tail, then this could be addressed. If the rule posited the boat tails would be developed for trailers equipped with roll-up doors despite that no such devices exist today, only to find out that the technical challenges of creating a viable device precluded one, the rule could be revisited. Similarly, if a new device came along that offered improvements beyond what the Agencies envisioned, then the rule's goals could be pushed forward to include that. [EPA-HQ-OAR-2014-0827-1172-A1 p.18]

**Organization:** Union of Concerned Scientists (UCS)

As the agencies move to finalize the standards, we urge you to adopt Alternative 4, with modifications to strengthen the standards for tractor engines, vocational vehicles, and heavy-duty pick-ups. The stringency and timing of this proposal would maximize the overall environmental, economic, and energy security benefits of the standards. [EPA-HQ-OAR-2014-0827-1329-A2 p.1-2]

We would support the timing and stringency of Alternative 4 with the following modifications: [EPA-HQ-OAR-2014-0827-1329-A2 p.4]

- Increasing tractor engine stringency up to 9.0 percent by 2024, compared to the current baseline;
- Increasing vocational vehicle stringency by at least 5 percent;
- Increasing the stringency of gasoline-powered pick-ups and vans by more than 7 percent; and
- Moving to SmartWay Elite levels for van trailers in the timeframe of this rule. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

The agencies' proposal must be 'technology-forcing' and achieve the 'maximum feasible' reductions in the timeframe of the rule. To do this, the agencies must strengthen Alternative 4 by: [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

- Increasing the stringency of the engine standard in 2024 to at least 9 percent from the current baseline to ensure real-world reductions over the lifetime of the vehicles; [EPA-HQ-OAR-2014-0827-1329-A2 p.27][This comment can also be found in section 3.3 of this comment summary]
- Increasing the stringency for tractors by 6 percent in 2024 to reflect the full range of improvements to the powertrain; [EPA-HQ-OAR-2014-0827-1329-A2 p.27][This comment can also be found in section 4.2 of this comment summary]
- Increasing the stringency for gasoline-powered vocational vehicles by 7.8 percent and those for diesel-powered vocational vehicles by 3.6 percent in 2024 to fully reflect the ability for conventional technologies to reduce fuel use from this sector, while incentivizing the adoption of more advanced technologies where appropriate; [EPA-HQ-OAR-2014-0827-1329-A2 p.27][This comment can also be found in section 6.2 of this comment summary]
- Ensuring that light- and heavy-duty pick-up and van standards are more closely aligned by acknowledging the full complement of applicable technologies - this would reduce consumption from gasoline-powered pick-ups and vans by 8.8 percent and diesel-powered pick-ups and vans by 2.1 percent in 2024; and [EPA-HQ-OAR-2014-0827-1329-A2 p.27][This comment can also be found in section 7.2 of this comment summary]
- Proposing guidelines for the inclusion of upstream emissions in these regulations to ensure that as the fuels powering these vehicles become more diverse, the emissions benefits of alternative-

fuel powertrains are appropriately credited and accurately reflect real world performance [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

In making these modifications to the proposal, the agencies will have ensured the further reduction of tens of millions of barrels of oil each year and avoided greenhouse gas emissions equivalent to shutting down 10 coal-fired power plants. In doing so, they will have also saved truckers hundreds of millions of dollars in fuel, costs which are inevitably borne by consumers.

Should the agencies extend the timeframe of the rule to 2027, these modifications must go further. EPA and NHTSA have the opportunity to put heavy-duty trucks on a more sustainable path, and they have an obligation to strengthen the proposed regulation in order to get us there.

**Organization:** United Parcel Service (UPS)

Opposition to Alternative 4

UPS supports Alternative 3, and opposes alternative 4, which would move the targets for 2027 earlier to 2024. In addition to our comments above about forcing premature technologies, and after looking at the state of our suppliers' readiness, we do not see any basis for such acceleration. The trucking industry is already challenged, as perhaps never before, by alternative fuel options, new impending emission requirements from multiple quarters, and unpredictable fuel prices. [EPA-HQ-OAR-2014-0827-1262-A1 p.3]

**Organization:** Volvo Group

### **Timeframe of the Rule**

#### **The extended timeframe of the proposed rule stretches beyond our visibility range for technology development and other influences on trucking operations.**

The proposed rule would first impose new requirements as early as 2020 (when many manufacturers release their MY 2021 vehicles), and then extend additional requirements out to model years 2027 and beyond. Under this timeline, manufacturers will be stripped of the necessary lead-time contemplated by the Clean Air Act at the front end, while simultaneously faced with the considerable uncertainty created by imposing vastly more stringent requirements in the future based on the assumption that new, unproven technologies will emerge. We are very concerned that the feasibility and costs of technology are unknown 12 years into the future. And this concern is supported by the track record for regulators predicting the efficacy of emissions control technology in heavy-duty vehicles far in advance of their use. For example, in 2000 EPA promulgated a rule regulating NOx and particulate emissions from heavy-duty vehicles, which became fully effective in 2010. At the time of promulgation, the presumed technology for NOx control was NOx adsorbers (or NOx trap). The cost of the rule was then projected by EPA based on this technology: "We project that the emission reductions and the resulting significant public health and environmental benefits of this program will come at an average cost increase of about \$1,200 to \$1,900 per new vehicle, depending on the vehicle size." Similarly, the Agency predicted it would cost up to \$368 per vehicle for the EGR systems to be deployed in 2004. By the time these rules were fully implemented in 2010, the actual cost increase for a Class 8 truck was approximately \$20,000 (this figure does not include significant increases in operating and maintenance costs), and not one heavy-duty manufacturer was successful in industrializing a NOx adsorber. Instead, all heavy-duty diesel manufacturers deployed selective catalytic reduction; a technology originally dismissed by EPA.

“SCR has significant NOx control potential, but it has many roadblocks to marketability in this country. These roadblocks include infrastructure issues that we believe would prove exceedingly difficult and potentially costly to overcome. Because of that, we believe that the NOx adsorber is the best technology for delivering significant diesel NOx reductions, while also providing market and operating characteristics necessary for the U.S. market.” [EPA-HQ-OAR-2014-0827-1290-A1 p.16-17]

Apart from the fact that vehicle technology appropriate for meeting 2027 emissions standards is unknown, there are also a host of other potential influencing factors that may change substantially before then. These include the availability and GHG impact of alternative fuels, vehicle size and weight limits, highway congestion, vehicle connectivity and autonomy, engine NOx limits, mandatory road speed limits, and others. These factors will influence vehicle duty cycles (payload, speed profiles, cruise power) and the optimum specifications for efficiency. But manufacturers will be constrained by fixed regulatory duty cycles and protocols, limiting their capacity to react to the changing environment and potentially forcing the introduction of technologies with limited real-world benefits that customers will not want to purchase. [EPA-HQ-OAR-2014-0827-1290-A1 p.17]

It is also possible that new novel concepts may be deployed in this time frame. The advent of connected or autonomous vehicles could significantly change vehicle duty cycles, for example: reducing idle time or modifying vehicle speeds. [EPA-HQ-OAR-2014-0827-1290-A1 p.17]

Given the history of the 2000 emissions regulations (effective in 2010) and the uncertainty of evolution in how vehicles are used, manufacturers are rightfully concerned that this long timeframe will introduce the risk of unpredictable and unintended consequences. In their Regulatory Impact Analysis, the Agencies outline the expected vehicle and engine technology areas and penetration rates for the stringency steps associated with model years 2021, 2024, and 2027. As stated herein, however, this outline remains speculative at best, as it is difficult to know how and whether the potential design changes will deliver the efficiencies predicted in each technology area. [EPA-HQ-OAR-2014-0827-1290-A1 p.17]

We also note that pulling the MY 2027 standard forward (alternative 4) is not a solution to this issue. As discussed below, the alternative 3 stringencies are already infeasible. [EPA-HQ-OAR-2014-0827-1290-A1 p.17]

**Organization:** Waste Management (WM)

### **WM Supports a Regulatory Compliance Schedule with Full Implementation in MY 2027**

EPA and NHTSA have proposed a compliance schedule for fuel efficiency improvements and GHG reductions from trucks to occur over a period beginning in MY 2021, with further reductions required in MY 2024 and final implementation in MY 2027. Although the Agencies have proposed this schedule, they are also taking comment on an expedited schedule with full implementation of required reductions in MY 2024. WM believes this would be an unwise approach. Both equipment manufacturers and purchasers need sufficient lead-time to test new technologies or new applications of existing technologies in the field to understand how they will operate in real world circumstances. Expediting the compliance schedule by three years would significantly curtail valuable field-testing that is so necessary to assess the real world GHG reductions and fuel efficiency enhancements that may be achieved by new technologies. [EPA-HQ-OAR-2014-0827-1214-A2 p.6]

WM has significant experience testing new technologies on our vocational refuse vehicles in the field. We have learned a great deal from those road tests, where we can evaluate equipment while operating in

the various duty cycles that we use in serving our customers. Refuse vehicles are not typical of most vocational fleet vehicles. They are extremely heavy and have difficult duty cycles that place substantial demands on the vehicle. We have found that it is often necessary to test new technologies using a typical refuse duty cycle to assess whether they can achieve the advertised fuel or GHG reductions, or even operate properly in our work environment. We are very concerned that expediting the compliance schedule by three years would preclude much of the valuable field-testing time that we need to assure ourselves that we are purchasing vehicles and equipment that can serve our and our customer's needs. [EPA-HQ-OAR-2014-0827-1214-A2 p.6]

**Response:**

The agencies noted in the proposal that the Phase 2 standards represent a more technology-forcing approach than the Phase 1 approach, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. 80 FR 40154. As such, we recognized that assuring proper lead time would be very important and requested comment on this issue. Many commenters, including most non-governmental organizations, supported more stringent standards with less lead time.

Vehicle manufacturers did not support more stringent standards and emphasized the importance of lead time. Although some technology and component suppliers supported more stringent standards, they also supported the proposed lead time.

To the extent these commenters provided technical information to support their comments on stringency and lead time, it is discussed in Sections II through VI of the Preamble, and in Chapter 2 of the RIA. However, the vast majority of the comments summarized here addressed the issue of lead time from a broader view. This section primarily addresses these broader comments.

*Need for Lead Time*

The standards being adopted provide approximately ten years of lead time for manufacturers to meet these 2027 standards, which the agencies believe is appropriate to implement the technologies industry could use to meet these standards. For some of the more advanced technologies, production prototype parts are not yet available, though they are in the research stage with some demonstrations in actual vehicles. Additionally, even for the more developed technologies, phasing in more stringent standards over a longer timeframe will help manufacturers to ensure better reliability of the technology and to develop packages to work in a wide range of applications. For example, consider the one extreme of technologies that are currently available for some but not all vehicles. These may represent the easiest technologies to develop. Yet even for these technologies, manufacturers will need to spend some time and resources to complete such tasks as:

- Packaging the technology for each vehicle model, including physically fitting the technology within the available space.
- Evaluating and optimizing the effectiveness of the technology across the range of in-use operation.
- Identifying and remedying failure modes for unique or severe duty cycles.
- Retooling facilities.

As noted in the NPRM, providing additional lead time can often enable manufacturers to resolve technological challenges or to find lower cost means of meeting new regulatory standards, effectively making them more feasible in either case. See generally *NRDC v. EPA*, 655 F. 2d 318, 329 (D.C. Cir. 1981). On the other hand, manufacturers and/or operators may incur additional costs if regulations

require them to make changes to their products with less lead time than manufacturers would normally have when bringing a new technology to the market or expanding the application of existing technologies. After developing a new technology, manufacturers typically conduct extensive field tests to ensure its durability and reliability in actual use. Standards that accelerate technology deployment can lead to manufacturers incurring additional costs to accelerate this development work, or can lead to manufacturers beginning production before such testing can be completed. See RIA Chapter 2.3.9. Some commenters identified the introduction of diesel particulate filters and/or SCR in response to the 2007 heavy-duty engine standards as an example of durability problems that can occur. While it is unclear whether the problems occurred because of insufficient lead time or because of other factors, it is clear that manufacturers did not perform sufficient product development validation, and that led to additional costs for operators when the technologies required repairs or resulted in other operational issues in use.

Daimler noted that the combination of greater product diversity and lower sales volumes than light-duty, makes lead time a more critical issue for heavy-duty. The agencies have considered these factors.

Another issue raised by commenters was the possibility of disrupting the market if compliance required application of new technologies too suddenly. Some noted that expectations of reduced reliability, increased operating costs, reduced residual value, or of large increases in purchase prices can lead the fleets to pull-ahead by several months planned future vehicle purchases by pre-buying vehicles without the newer technology. In the context of the Class 8 tractor market, where a relatively small number of large fleets typically purchase very large volumes of tractors, such actions by a small number of firms can result in large swings in sales volumes. We agree with commenters that, to the extent such market impacts occur, they could be followed by some period of reduced purchases that can lead to temporary layoffs at the factories producing the engines and vehicles, as well as at supplier factories, and disruptions at dealerships. Such market impacts also could also reduce the overall environmental and fuel consumption benefits of the standards by delaying the rate at which the fleet turns over. See *International Harvester v. EPA*, 478 F. 2d 615, 634 (D.C. Cir. 1973).

While the agencies do not agree with commenters that argue the proposed lead time will cause such problems, we do agree with the points raised that these things could have resulted if we had provided insufficient lead time. The agencies have taken steps in the design of the program to avoid such these potential disruptions, including:

- Providing ten years of lead time for full implementation of Phase 2
- Adopting standards that will result in significantly lower operating costs for vehicle owners (unlike the 2007 standard, which increased operating costs)
- Phasing in the standards
- Structuring the program so the industry will have a significant range of technology choices to be considered for compliance, rather than the one or two new technologies the OEMs pursued to comply with EPA's 2007 criteria pollutant standard
- Allowing manufacturers to use emissions averaging, banking and trading to phase in the technology even further

#### *Statutory Requirements for Lead Time*

EISA requires that NHTSA provide four model years of lead time (and three years of stability) for heavy-duty fuel consumption regulations. Beyond that, NHTSA has the broad discretion to weigh and balance lead time with the other applicable factors in order to accomplish EISA's mandate of determining

maximum feasible standards. The fact that the factors may often be at odds gives NHTSA significant discretion to decide what weight to give each of the competing factors, policies and concerns and then determine how to balance them—as long as NHTSA’s balancing does not undermine the fundamental purpose of the EISA: energy conservation, and as long as that balancing reasonably accommodates “conflicting policies that were committed to the agency’s care by the statute.”

EPA also has significant discretion in assessing, weighing, and balancing the relevant statutory criteria. Section 202(a)(2) of the Clean Air Act requires that the standards “take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.” This language affords EPA considerable discretion in how to weight the critical statutory factors of emission reductions, cost, and lead time (76 FR 57129-57130). Section 202 (a) also allows (although it does not compel) EPA to adopt technology-forcing standards. *Id.* at 57130; see also responses in Section 1.7 below.

#### *Is the Final Lead Time Sufficient?*

Comments on the sufficiency of the proposed lead time were mixed and somewhat nuanced. Many commenters stated that the proposed lead time was more than sufficient. These comments supporting less lead time are discussed in the next subsection. On the other hand, many other commenters supported the lead time as being appropriate, although some did so while arguing for less stringent standards. Commenters who believe (or appear to believe) that the proposed lead time is insufficient, generally expressed the concern in the context of less stringent standards rather than additional lead time. Comments addressing the stringency of the standards, as well as those regarding the lead time necessary to address specific technologies, are addressed in Sections 3 through 7 of this RTC.

Although the agencies are finalizing the proposed implementation schedule that will provide at least four years of lead time for most standards, we have also revised many aspects of the proposal including providing additional lead time to address concerns raised in the comments.

Daimler commented that “a three year cadence of tightened standards is too fast” and should be revisited. We disagree. Most of the projected technologies can be introduced incrementally and would not need to be tied to vehicle redesign cycles. Also manufacturers may use the averaging provisions to provide additional flexibility. Where product introduction is closely tied to design cycles (e.g. introduction of WHR), the agencies have carefully accounted for projected redesigns. See, e.g. RIA section 2.7. 5.

RMA commented that tires require five years of lead time. Although we do not necessarily agree with this comment, we note that tire manufacturers could provide themselves this amount of lead time if they so choose. The standards that take effect before model year 2024 can be met with tires already on the market. To the extent that the standards require new tire designs in 2024, industry will have eight years of lead time.

Finally, we do not believe comments related to the implementation of the 2007/2010 standards are directly relevant here (other than to highlight the importance of considering reliability when adopting new technologies). In discussions with EPA outside of the context of this rulemaking, manufacturers have acknowledged that their internal processes were not adequate when they implemented the 2007/2010 standards. However, they have also indicated that they have improved these internal processes to ensure similar problems do not occur for other new technologies.

#### *Are the Agencies Providing Too Much Lead Time?*

Comments on lead time overlapped with comments on the overall stringency of the proposed Phase 2 program. Many commenters, including most non-governmental organizations, supported more stringent standards with less lead time. They generally supported the proposed Alternative 4. However, many technology and component suppliers supported more stringent standards but with the proposed lead time. Vehicle manufacturers strongly opposed the reduced lead time of Alternative 4. To the extent any of these commenters provided technical information to support their comments on stringency and lead time, it is discussed in Sections II through VI of the FRM Preamble. Comments regarding the lead time necessary to address specific technologies, are also addressed in Sections 3 through 7 of this RTC.

Many of the comments supporting the Alternative 4 standards stated that they would be “cost-effective”. In general, however, we did not find costs or cost-effectiveness to be a significantly limiting factor in determining the stringency of the standards. Rather, we found that actual technological feasibility and lead time to be the more limiting factors. Manufacturers and suppliers have limited research and development capacities, and although they have some ability to expand, the process of developing and applying new technologies is inherently constrained by time. This limits the extent to which they can bring new technologies to market. EMA also commented that even the IT system improvements will require substantial lead time.

While the agencies agree that many cost effective technologies exist, and indeed, we reflect the potential for many of those technologies to be applied in our analysis for today’s final rule, commenters who focused on the cost-effectiveness of technologies did not consistently recognize certain real-world constraints on technology implementation. Adequate lead time is also necessary to complete durability, reliability, and safety testing and ramp up production to levels that might be necessary to meet future standards. If the agencies fail to account for lead time needs in determining the stringency of the standards, we could create unintended consequences, such as technologies that are applied before they are ready and lead to maintenance and repair problems. In addition to cost-effectiveness, then, lead time constraints can also be highly relevant to feasibility of more stringent standards.

In response to CARB’s comment that the lead time we are providing “is 60 percent longer than the time frame considered by the NRDC court”, we note that this is not relevant. The requirements for lead time do not require any fixed length of time, or any other formulaic value. Rather, the statutes require that we provide the lead time “necessary to permit the development and application of the requisite technology”.

#### *Lead Time for Engine Standards*

Many commenters specifically cited the engine technologies as an area for which the agencies had proposed too much lead time. They generally supported the Alternative 4 lead time with more stringent standards. We agree partially with these commenters. We have reanalyzed the technological feasibility of engine improvements and are now projecting manufacturers will be able to largely achieve the Alternative 4 engine improvements in 2024.

#### *Additional Lead Time for Small Manufacturers*

Autocar commented that providing an additional year of lead time was not sufficient to address the concerns of small custom chassis manufacturers. In response, the agencies note that we are also finalizing other relief for these manufacturers including the optional custom chassis program.

#### *Need for Market Research*

CARB suggested that the agencies “conduct additional research on the market impact of the proposed rulemaking, including an ex post (retrospective) analysis of the market impacts resulting from existing GHG and criteria pollutant engine and vehicle regulations.” We do not believe this is necessary. Our goal was to provide enough lead time to allow manufacturers to develop the applicable technologies and complete the necessary durability testing before widespread use of the technology is required to meet the standards.

#### *Lead Time for Phase 1 Changes*

Caterpillar commented that the agencies have not provided sufficient lead time for changes to Phase 1. However, the changes applicable to Phase 1 are all minor and do not require substantial lead time (and EPA is providing additional lead time to accommodate additional paperwork possibly needed for the revised delegated assembly provisions). Nevertheless, we also note that 40 CFR 1068.40 allows for manufacturers to request additional time (up to 12 months) to comply with newly adopted changes to existing regulations.

#### *Standards beyond 2024*

Several commenters expressed support for setting standards for MY 2027 because they believe it will provide valuable certainty for OEMs and technology manufacturers. However, Volvo expressed concern about the ability to project technology development so far into the future. While we understand Volvo’s concern, we believe the value of longer-term standards offsets this concern.

TTMA supports a “mid-course review” of the standards. While the agencies are not finalizing a formal process for such a review, we note that we expect to do so informally. In addition, manufacturers (and other stakeholders) retain the ability to formally petition us for a reconsideration of some or all of the Phase 2 program based on new information.

#### *Impact of GHG Lead Time on Potential NOx Standards*

Some commenters argued that pulling ahead the Phase 2 standards under the Alternative 4 time frame would allow manufacturers to adopt NOx improvements sooner. However, EPA believes the opposite would be true. If we provided less lead time for Phase 2, it would make it harder for manufacturers to devote resources to improving NOx emissions. As noted in Section 15, EPA believes that the lead time being provided for Phase 2 will allow manufacturers to simultaneously work to reduce NOx emissions by the 2024 model year.

## **1.6 Alternative Refrigerants**

### **1.6.1 Requests for Credit/Incentive for Alternative Refrigerants250**

**Organization:** Daimler Trucks North America LLC

AC refrigerant changes: DTNA agrees with EPA that a change to refrigerants for heavy vehicles should not be assumed. The heavy vehicle industry, with its lower volumes, follows the passenger vehicle industry in this regard and cannot be expected to change refrigerants until several years after the light-duty vehicle industry does. That said, the agencies should consider giving GHG credits for low GWP



refrigerants (of course, adjusted for the GWP reduction from today's refrigerant). [EPA-HQ-OAR-2014-0827-1164-A1 p.110]

**Organization:** Environmental Defense Fund (EDF)

At the same time, the final provisions should incentive the use of lower GWP refrigerants. Shifting the heavy-duty sector to low GWP refrigerants will result in far greater emissions reductions than leakage reductions alone. The light-duty sector has already begun such a shift, proving that the technology and refrigerants are available, cost-effective and successful. The Phase 2 rule should drive the heavy-duty sector toward lower GWP refrigerants. [EPA-HQ-OAR-2014-0827-1312-A1 p.52]

Instead, EPA states in the Preamble that it is not making any attempts to incentivize or require the use of lower GWP refrigerants because, "there is great uncertainty about when significant adoption of alternative refrigerants for HD vehicles might begin, on what timeline adoption might become widespread, and which refrigerants might be involved." By waiting for industry members to take action, EPA is failing to fulfill its duty under the CAA. Indeed, EPA has authority, and the duty, to drive technology and promote the adoption of cleaner refrigerants. It is not necessary for EPA to "attempted to project any specific hypothetical scenarios of transition." EPA's job is to protect human health by adopting provisions that reduce harmful emissions from the heavy-duty sector. [EPA-HQ-OAR-2014-0827-1312-A1 p.52]

We urge EPA to accelerate the SNAP approval process for additional lower GWP refrigerants for use in heavy-duty applications. Simultaneously, EPA should finalize a rule prohibiting the use of HFC-134a in heavy-duty A/C systems. In the interim, EPA should take steps in this final rule to incentivize the adoption of low GWP refrigerants before high GWP ones are prohibited. [EPA-HQ-OAR-2014-0827-1312-A1 p.52]

These actions would support the Obama Administration's Climate Action Plan call for EPA to use its authority under the Significant New Alternatives Policy (SNAP) Program to encourage alternatives and prohibiting the use of the most harmful chemical alternatives.<sup>220</sup>

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220 The White House, The President's Climate Action Plan, (June 2013), available at <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

**Organization:** Honeywell Fluorine Products

We support EPA's approach to use the established processes to expand the pool of qualified low GWP refrigerants to replace HFC-134a. While EPA has not yet approved HFO-1234yf under SNAP for use in HD, MD and VV, we believe that the crediting methodology in 40 CFR 86.1867-12(e) offers an appropriate approach to leak crediting/scoring once EPA grants SNAP approval for these applications. [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

**Organization:** FCA US, LLC

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 62.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 134.]

As far as A/C system improvements, we believe there is value in recognize the greenhouse gas and fuel consumption contributions from reducing the energy demand of the A/C systems. We also believe there's additional opportunity to further harmonize with the Light Duty Program and recognize the added greenhouse gas emission benefit beyond leak reduction. That's switching to a lower global warming potential a refrigerant can provide.

**Organization:** American Automotive Policy Council

#### Light-Duty MAC Refrigerant/Leakage

The table above documents the rapid reduction in refrigerant leakage resulting from the direct MAC credit program. Leakage reduction improvements increased 69% to 10.3 million megagrams in only three years, from 2009 to 2012. The increase on a per vehicle basis was from approximately 3.5 grams per mile of CO<sub>2</sub> per vehicle in 2009 to approximately 4.0 grams per mile in 2012 (EPA Manufacturer Performance Report for the 2012 Model Year, p. 29). [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

Although industry-wide statistics have not yet been published beyond 2012, production capacity for the new low-global-warming refrigerant R-1234yf has increased. Following its introduction on a few models in 2013, R-1234yf has been implemented on many important vehicle platforms totaling millions of vehicles. The incentive created by pre-defined MAC credits has accelerated the U.S. HFC reduction program into a leading position worldwide, laying the groundwork for eventual phase-out or dramatic phase-down of high GWP automotive refrigerants. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

#### Class 2b/3 Pre-Defined Refrigerant Credit List

The experience from the Light-Duty vehicle program shows that a pre-defined list of credits for refrigerant improvements on heavy-duty vehicles would accelerate these improvements. Credits for low leak air conditioner systems and credits for low-global-warming refrigerants should both play a role, laying the basis for eventual industry-wide refrigerant replacements in systems with high refrigerant containment integrity. By using an incentive approach, rather than mandates, companies move as quickly as they can, according to their various constraints and capabilities, with the result that the most eager early actors break down barriers and reduce costs to smooth the path for an eventual industry-wide switchover. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

The current rulemaking is an appropriate time to create this incentive structure in heavy-duty vehicles. At a minimum, given the similarities in the air conditioning systems between Class 2b/3 trucks and many light-duty trucks, as well as the experience of the light-duty vehicle manufacturers with these provisions of the Light-Duty regulation, a pre-defined credit list for refrigerants should be created for Class 2b/3 trucks. The credit levels and other provisions should be identical to the credit provisions for light-duty trucks in the same time period, through 2025 model year, including acknowledging further improving leakage and moving R-134a systems to low-GWP refrigerants. [EPA-HQ-OAR-2014-0827-1238-A1 p.20]

**Organization:** Chemours Company FC, LLC

Chemours recognizes the need for concerted action to avoid significant future growth in greenhouse gas emissions. That is why we are bringing low global warming potential (GWP), energy efficient products to market across various end uses. We also believe it is critical that emissions are reduced in a manner that ensures that we are able to deliver the critical societal benefits that HFCs provide today including safe and energy efficient air conditioning. [EPA-HQ-OAR-2014-0827-1231-A1 p.1]

The proposed regulation includes two options for reducing greenhouse gas emissions related to HFC refrigerants. Under EPA's current proposal manufacturers could continue to meet the leak-tight A/C systems requirements or could choose to comply by installing systems that use a low GWP SNAP-listed MVAC refrigerant. While this is a good proposal, it may not offer credit to those manufacturers who have already complied. [EPA-HQ-OAR-2014-0827-1231-A1 p.1]

Therefore, Chemours suggests that an opportunity to secure CO<sub>2</sub> credits be offered in addition to the current "leak-tight" requirements. In addition to these credits, Chemours recommends that credits for early adoption should also be given. These early adopter credits could motivate manufacturers to transition to low GWP solutions sooner further reducing greenhouse gases than might be emitted under the current proposed standard. The value of these credits should be set at a sufficiently high value to incentivize vehicle manufacturers to absorb the higher cost of the low GWP refrigerant option. The successful credit structure in the 2017-2025 EPA/NHTSA CAFE/Greenhouse Gas Final Rule for Light Duty Vehicles provides a template that should also work for medium- and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1231-A1 p.1]

EPA specifically requested comments on ways to prevent or discourage manufacturers that transition to an alternative low GWP refrigerant from discontinuing existing, low-leak A/C system components and instead reverting to higher-leakage components. Incentives or credits could be provided to manufacturers who elect to convert to a low GWP refrigerant and utilize leak-tight A/C systems concurrently as a means of encouraging the continued use of low-leak A/C system components. [EPA-HQ-OAR-2014-0827-1231-A1 p.1]

### **Response**

A transition to lower-GWP A/C refrigerants by HD vehicle manufacturers, although not specifically required or incentivized in this rule, may already be underway. LD vehicle manufacturers are currently making investments in systems designed for lower-GWP refrigerants, both domestically and on a global basis. In support of the LD GHG rule, EPA projected a full transition of LD vehicles to lower-GWP alternatives in the United States by MY 2021. We expect the costs of transitioning to decrease over time as alternative refrigerants are adopted across all LD vehicles and trucks, in part due to increased availability of components and the continuing increases in refrigerant production capacity, as well as knowledge gained through experience. As lower-GWP alternatives become widely used in LD vehicles, some HD vehicle manufacturers may wish to also transition their vehicles. Transitioning could be advantageous for a variety of reasons, including platform standardization and company environmental stewardship policies. Also, the recently-proposed EPA action under the SNAP program to list HFO-1234yf as acceptable for some HD vehicles (subject to use conditions) could affect future plans, depending on what EPA ultimately finalizes. (See the response to Section 1.7.2 below).

Because the Phase 1 HD A/C refrigerant leakage standards are separate from the CO<sub>2</sub> standards (unlike the LD leakage standards), and because the Phase 2 program is not changing these standards or their structure, the program does not have a mechanism for providing credit for lower-GWP refrigerants.

### **1.6.2 Requests for EPA Action on Status of Current or Alternative Refrigerant**

**Organization:** Natural Resources Defense Council (NRDC)

Encourage the rapid adoption of alternative refrigerants with low global warming potentials. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

***Encourage Rapid Transition to Alternative Refrigerants***

Using energy-efficient, low global warming potential (GWP) refrigerants in medium- and heavy-duty motor vehicle air conditioning systems is an important part of reducing the overall greenhouse gas impact of the sector. NRDC recommends approaches to facilitate a smooth transition to low-GWP refrigerants as they become available for heavy-duty vehicles in comments filed separately from these with partners at the Institute for Governance and Sustainable Development. Please refer to those comments for details. [EPA-HQ-OAR-2014-0827-1220-A1 p.10]

**Organization:** Natural Resources Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD)

As EPA recognizes, transitioning to energy-efficient, low-GWP refrigerants in medium- and heavy-duty motor vehicle air conditioning systems is an important part of reducing the overall greenhouse gas impact of the sector. The most important way in which EPA can achieve this result is by promptly using its Significant New Alternatives Policy Program (SNAP) authority to approve low-GWP alternative refrigerants for use in medium- and heavy-duty vehicles and to prohibit use of the high-GWP refrigerants currently in use. We understand that EPA is currently considering a low-GWP candidate, HFO-1234yf, in certain types of medium- and heavy-duty vehicles. As EPA approves low-GWP replacements for use in medium- and heavy-duty vehicles, EPA should also move forward as quickly as possible to phase out use of high-GWP HFC-134a. [EPA-HQ-OAR-2014-0827-1305-A1 p.1]

**Organization:** California Air Resources Board (CARB)

Include requirement for low-GWP refrigerants once commercially available

The NPRM requests comment on industry development and other aspects of low-GWP refrigerants for heavy-duty vehicles. CARB staff supports U.S. EPA and NHTSA's intent to consider and evaluate alternative, low-GWP, refrigerants for use in heavy-duty AC systems. Using low-GWP refrigerants would significantly reduce the climate impact from the direct refrigerant emissions from heavy-duty vehicles. R-744 (CO<sub>2</sub>) and HFC-152a have already been approved by U.S. EPA Significant New Alternatives Policy (SNAP) program for use in all (including heavy-duty) AC applications. One chemical manufacturer, Chemours, is preparing an application to U.S. EPA SNAP program to qualify HFO-1234yf (another low-GWP refrigerant which is SNAP approved for light-duty use) for heavy-duty applications. In general, however, industry development and adoption of low-GWP refrigerants in heavy-duty subsectors has been relatively slow compared to light-duty applications, despite the substantial similarity between the AC systems for light-duty and for heavy-duty. [EPA-HQ-OAR-2014-0827-1265-A1 p.144-145]

CARB staff believes that regulatory requirements or incentives can motivate those research and development activities, and speed up the transition to low-GWP refrigerants for heavy-duty applications. Therefore, CARB staff is considering developing regulations to prohibit the use of high-GWP refrigerants for these applications, as a part of CARB strategies to reduce short-lived climate pollutants. For the same reason, CARB staff urges U.S. EPA and NHTSA to expedite the review and determination process for the upcoming HFO-1234yf SNAP application for heavy-duty. Furthermore, CARB staff recommends that U.S. EPA and NHTSA include in the Phase 2 standards a requirement of using low-GWP refrigerants, starting as early as legally and technologically possible. (For example: "Starting in Model Year 2021, or the model year commencing four years after this provision is promulgated, or the model year commencing three years after a low-GWP refrigerant for this end-use becomes commercially available, whichever comes last, the GWP of Motor Vehicle AC refrigerants used by manufacturers in new heavy-duty vehicles be equal to or less than 150. Being 'Commercially Available' in this provision means having been approved for the concerned end-use by the SNAP

program, having been determined to be acceptable for adoption by at least one vehicle manufacturer, and being produced at commercial quantities. This provision must stay in effect till the end of the current regulation, and no less than three model years.” The three-year lead time is based on a stakeholder (Honeywell) comment on CARB Short-Lived Climate Pollutant Concept Paper that manufacturers would need two to three years to implement a transition to a low-GWP alternative once the refrigerant has been evaluated. [EPA-HQ-OAR-2014-0827-1265-A1 p.145]

**Organization:** Chemours Company FC, LLC

EPA has requested comment on the possible change of status of HFC-134a for use in Medium- and Heavy-Duty vehicles. Chemours supports a change of status of HFC-134a to unacceptable for use in Medium- and Heavy-Duty vehicles after equipment manufacturers have had sufficient time to finalize designs to utilize the new refrigerants and after low GWP replacements have been approved and listed under the SNAP program. [EPA-HQ-OAR-2014-0827-1231-A1 p.1-2]

**Organization:** Honeywell Fluorine Products

Honeywell is a strong supporter of EPA’s commitment to reducing the use of substances with a high global warming potential (GWP) and the use of its Significant New Alternatives Policy (SNAP) program and motor vehicle related rules to transition the automotive industry to low-GWP alternatives. We have been working diligently to develop and commercialize products and technologies to further those goals. [EPA-HQ-OAR-2014-0827-1191-A1 p.1-2]

Honeywell appreciates EPA’s continued recognition that low GWP refrigerants can contribute significantly to the reduction of GHG emissions from the transportation sector, including from heavy duty (HD), medium duty (MD), and now, through this Proposed Rule, in vocational vehicles (VV). (Also referred to collectively throughout as HD) [EPA-HQ-OAR-2014-0827-1191-A1 p.2]

In response to EPA’s request in the Proposed Rule for “comment on all aspects of our proposed approach to HD vehicle refrigerant leakage and the potential future use of alternative refrigerants for HD applications,” Honeywell offers the following: [EPA-HQ-OAR-2014-0827-1191-A1 p.2]

1. Low GWP Refrigerants Are Poised to Make Significant Contribution to a Reduction of GHG emissions from HD Vehicles Without Compromising Performance or Safety [EPA-HQ-OAR-2014-0827-1191-A1 p.2] HFO-1234yf has been proven effective in light duty vehicles. We estimate that approximately five million light duty vehicles using HFO-1234yf will be on the road by the end of this year. European Union regulations require the phase out of R-134a in all new light duty vehicles by January 1, 2017 and the vast majority of European auto manufacturers intend to use HFO-1234yf. In the United States, many manufacturers are adopting voluntarily HFO-1234yf as part of their strategy to comply with EPA’s stringent CO2 emission requirements. [EPA-HQ-OAR-2014-0827-1191-A1 p.2]

As EPA recognizes in the Proposed Rule, air conditioning systems in HD vehicles are very similar in design to light duty vehicles, only with bigger equipment that holds a significantly larger charge of refrigerant. Many of the same Tier 1 manufacturers make the air conditioning systems for both light and HD vehicles, and Honeywell believes that HFO-1234yf would work well in HD and MD vehicles as well. [EPA-HQ-OAR-2014-0827-1191-A1 p.2]

As EPA notes, “most manufacturers of LD vehicles have identified HFO–1234yf as the most likely refrigerant to be used in that application. For that reason, EPA would anticipate that HFO–1234yf could

be a primary candidate for refrigerant substitution in the HD market in the future if it is listed as an acceptable substitute under SNAP for HD A/C applications.” [EPA-HQ-OAR-2014-0827-1191-A1 p.2]

Honeywell agrees with EPA that low GWP refrigerants such as HFO-1234yf will offer similar performance and safety in HD vehicles as they have demonstrated in light duty vehicles. Compared to 134a, HFO-1234yf demonstrates comparable energy efficiency over the complete operating range and good life cycle performance in all climates. After extensively studying the use of HFO-1234yf for light duty vehicles, SAE concluded that HFO-1234yf has the best environmental performance and judges it to be safe in use through extensive risk assessments. [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

Honeywell is committed to working with EPA, NHTSA and industry to address any issues regarding the safe and effective adoption of 1234yf. Parallel to this effort, Honeywell will seek SNAP approval for HFO-1234yf in HD, MD and vocational vehicles. [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

**Organization:** FCA US, LLC

As far as A/C system improvements, we believe there is value in recognize the greenhouse gas and fuel consumption contributions from reducing the energy demand of the A/C systems. We also believe there's additional opportunity to further harmonize with the Light Duty Program and recognize the added greenhouse gas emission benefit beyond leak reduction that switching to a lower global warming potential a refrigerant can provide.

**Organization:** American Automotive Policy Council

Light-Duty SNAP Program

Based on the early start and clear incentives provided by the MAC provisions in the Light-Duty greenhouse gas regulation, EPA recently published a final rule (80 Federal Register 42870) under its Significant New Alternatives Program (SNAP) which will remove high-GWP R-134a entirely from use as an air conditioner refrigerant in new light-duty vehicles by the 2021 model year. AAPC recommends that EPA approve R-1234yf and other low GWP refrigerants for use in heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

**Response:**

Under EPA’s Significant New Alternatives Policy (SNAP) Program, EPA has found acceptable, subject to use conditions, three alternative refrigerants that have significantly lower GWPs than HFC-134a for use in A/C systems in newly manufactured light-duty vehicles: HFC-152a, CO<sub>2</sub> (R-744), and HFO-1234yf. HFC-152a has a GWP of 124, HFO-1234yf has a GWP of 4, and CO<sub>2</sub> (by definition) has a GWP of 1, as compared to HFC-134a which has a GWP of 1,430. CO<sub>2</sub> is nonflammable, while HFO-1234yf and HFC-152a are flammable. All three are subject to use conditions requiring labeling and the use of unique fittings, and where appropriate, mitigating flammability and toxicity. Currently, the SNAP listing for HFO-1234yf is limited to newly manufactured A/C systems in light-duty vehicles, whereas HFC-152a and CO<sub>2</sub> have been found acceptable for all motor vehicle air conditioning applications for new equipment, including heavy-duty vehicles.

A change in A/C refrigerants requires significant engineering, planning, and manufacturing investments. EPA is not aware of any significant development of A/C systems designed to use alternative refrigerants in heavy-duty vehicles. However, all three lower GWP alternatives are in use or under various stages of development for use in LD vehicles. Of these three refrigerants, most manufacturers of LD vehicles

have identified HFO-1234yf as the most likely refrigerant to be used in that application. For that reason, EPA anticipates that HFO-1234yf will be a primary candidate for refrigerant substitution in the HD market in the future if it is listed as an acceptable substitute under SNAP for HD A/C applications.

As mentioned above, EPA has listed as acceptable, subject to use conditions, two lower-GWP refrigerants, R-744 (CO<sub>2</sub>) and HFC-152a, for use in new HD vehicles. On April 18, 2016, EPA also proposed to list HFO-1234yf as acceptable, subject to use conditions, in A/C systems for newly manufactured MDPVs, HD pickup trucks, and complete HD vans (81 FR 22810). In that action, EPA proposed to list HFO-1234yf as acceptable, subject to use conditions, for those vehicle types for which human health and environmental risk could be assessed using the currently available risk assessments and analysis on LD vehicles. Also in that action, EPA requested “information on development of HFO-1234yf MVAC systems for other HD vehicle types or off-road vehicles, or plans to develop these systems in the future.” EPA also stated “This information may be used to inform a future listing” (81 FR 22868).

In another rulemaking action under the SNAP program, on July 20, 2015, EPA published a final rule (80 FR 42870) that will change the listing status of HFC-134a to unacceptable for use in newly manufactured LD motor vehicles beginning in MY 2021 (except as allowed under a narrowed use limit for use in newly manufactured LD vehicles destined for use in countries that do not have infrastructure in place for servicing with other acceptable refrigerants through MY 2025). In that same rule, EPA listed the refrigerant blends SP-34E, R-426A, R-416A, R-406A, R-414A, R-414B, HCFC Blend Delta, Freeze 12, GHG-X5, and HCFC Blend Lambda as unacceptable for use in newly manufactured light-duty vehicles beginning in MY 2017. EPA’s decisions were based on the availability of other substitutes that pose less overall risk to human health and the environment, when used in accordance with required use conditions. Neither the April 2016 proposed rule nor the July 2015 final rule consider a change of listing status for HFC-134a in HD vehicles.

Overall, EPA acknowledges commenters’ perspectives about alternative refrigerants and will consider the comments as it evaluates possible future status change rules under the SNAP program. These comments support the Agency’s understanding that HFO-1234yf could be a primary candidate as an alternative refrigerant for certain heavy-duty vehicles in the future if it is listed as an acceptable substitute under the SNAP program.

### **1.6.3 Comments Relating to Alternative Refrigerants and Compliance with Leakage Standards**

**Organization:** Natural Resources Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD)

EPA also seeks comment on whether manufacturers using low-GWP refrigerants would be likely to revert to more leak-prone systems if EPA were to no longer require maximum leak rates. We expect that manufacturers are not likely to do so. HFO-1234yf is more costly than HFC-134a and we expect that manufacturers will want to continue to use the same systems that are currently required in order avoid more expensive refrigerant recharges. Even if some greater leakage did occur, the environmental effect of leaking HFO-1234yf is of course not nearly as harmful as leaks of HFC-134a. Thus, if EPA believes that it can encourage a transition to low-GWP systems early by exempting the leak provisions, then such a strategy is likely to reduce greenhouse gas emissions. If such an exemption is provided for low-GWP systems, EPA should require that the system be recharged only with low-GWP refrigerants. [EPA-HQ-OAR-2014-0827-1305-A1 p.2

**Organization:** Environmental Defense Fund (EDF)

We encourage EPA to ensure that the proposed new “deemed to comply” provision does not result in backsliding of HFC emissions. EPA is proposing that if a manufacturer switches to a lower GWP refrigerant listed as acceptable under the SNAP program, it will be “deemed to comply” with the low leak standard – meaning that A/C system will not have to employ low leakage components as finalized in the Phase 1 rule. Without requirements for continued in-use compliance with a lower GWP refrigerant, we are concerned this proposed provision would allow manufacturers who choose a lower GWP refrigerant to switch back to higher leakage components at the time of manufacture and compliance. Subsequently, the consumer could immediately, or at the time of replacement, switch back to a high GWP refrigerant, seriously undercutting the benefits and flouting the intent of the program. We strongly encourage EPA to put in place in-use protocols to ensure that high GWP refrigerants are not used for recharge. If this cannot be ensured, we recommend EPA maintain the low leak requirement for all heavy-duty A/C systems at least until the SNAP listing for HFC-134a is changed to “unacceptable” for use in new heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.52]

**Organization:** California Air Resources Board (CARB)

Not appropriate to allow manufacturers to be “deemed to comply” with Air Conditioning (AC) leakage standard by using an alternative refrigerant

U.S. EPA and NHTSA are proposing to allow a manufacturer to be “deemed to comply” with the leakage standard by using a lower global warming potential (GWP) alternative refrigerant. [EPA-HQ-OAR-2014-0827-1265-A1 p.139]

Although CARB supports the promotion of the development and use of lower-GWP refrigerants for heavy-duty vehicle air conditioning, CARB staff has significant concerns regarding the proposed “deemed to comply” provisions, because CARB staff believes that maintaining a low leak rate is important, regardless of the refrigerant in use, for the reasons discussed below. [EPA-HQ-OAR-2014-0827-1265-A1 p.139]

First, having a low leak rate helps realize the full direct refrigerant emission benefits of a transition to a low-GWP refrigerant by reducing the need for AC service, and hence reducing the potential for consumers to recharge their low-GWP AC systems with hydrofluorocarbon (HFC)-134a (a high-GWP refrigerant), as HFO-1234yf (a low-GWP refrigerant) is more expensive than HFC-134a. Due to similar thermodynamic properties between HFO-1234yf and HFC-134a, it is possible that an HFO-1234yf AC system can have satisfactory performance when recharged with HFC-134a. A leak-tight system will reduce this possibility, simply because the AC system is less likely to need recharging. [EPA-HQ-OAR-2014-0827-1265-A1 p.140]

Second, having a low leak rate also reduces the possibility of loss of cooling performance and energy efficiency due to undercharging. Experimental and modeling studies have shown that as an AC system loses refrigerant charge, its cooling performance generally decreases, and its energy efficiency (Coefficient of Performance, or COP) first remains constant or increases slightly, then decreases markedly after the charge drops below a certain level, usually about half the nominal charge.<sup>53</sup> When significant charge loss occurs, vehicle drivers or operators would have to either endure compromised performance and efficiency, or have the AC recharged, in many cases more frequently than necessary, hence incurring emissions and cost associated with service. The most efficient and cost-effective means to tackle the undercharging issue is to use better refrigerant containment technologies to make the AC leak rate low. [EPA-HQ-OAR-2014-0827-1265-A1 p.140]

Therefore, having a low leak rate complements using a low-GWP refrigerant, and ensures that the optimal benefits of the use of a low-GWP refrigerant would be achieved. Such rationale also applies to light-duty vehicle AC systems, and formed the basis for a “high-leak disincentive” term in the AC



leakage credit provisions in the U.S. EPA GHG emission standard for MY 2017-2025 light-duty vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.140]

CARB staff further believes that retaining a leakage standard separate from a low-GWP requirement is necessary to maintain low leak rates. Such a separate leakage standard would apply to existing manufacturers to ensure that they continue to use good refrigerant containment technologies after the Phase 1 implementation period ends. The leakage standard would also apply to new entrants to the market to hold them to the same requirements. A “deemed to comply” provision would result in the use of either low-leak technologies or low-GWP refrigerants, but likely not both, hence losing the benefits that can only be realized when a leakage standard and a low-GWP requirement work in tandem. [EPA-HQ-OAR-2014-0827-1265-A1 p.141]

Therefore, CARB staff recommends that U.S. EPA and NHTSA not include such a “deemed to comply” mechanism, but rather develop a provisional requirement for the use of low-GWP refrigerants (see CARB comment regarding alternative refrigerants) while retaining the leakage standard. [EPA-HQ-OAR-2014-0827-1265-A1 p.141]

**Organization:** Honeywell Fluorine Products

**3. Honeywell Supports EPA’s Decision to Adopt a “Deemed to Comply” Standard for HD Vehicles that Use Low GWP Refrigerants** [EPA-HQ-OAR-2014-0827-1191-A1 p.4]

Honeywell supports EPA’s decision to ease “the burden associated with complying with the lower-leakage requirements when a lower-GWP refrigerant is used instead of HFC–134a. These provisions would recognize that leakage of refrigerants would be relatively less damaging from a climate perspective if one of the lower-GWP alternatives is used. Specifically, EPA is proposing to allow a manufacturer to be “deemed to comply” with the leakage standard by using a lower-GWP alternative refrigerant.” P. 40172. [EPA-HQ-OAR-2014-0827-1191-A1 p.4]

Honeywell supports EPA’s approach to deem manufacturers in compliance with the AC leakage requirements for any vehicle that uses approved low GWP refrigerants. Such an approach will provides certainty that a proper incentive is in place as the market transitions to lower GWP refrigerants. We agree that the environmentally friendly aspect of refrigerants such as HFO-1234yf eliminates concern for extensive procedures and technologies to assure compliance with the leakage rates offered in the Proposed Rule. [EPA-HQ-OAR-2014-0827-1191-A1 p.4]

“In order to be “deemed to comply” the vehicle manufacturer would need to use a refrigerant other than HFC-134a that is listed as an acceptable substitute refrigerant for heavy-duty A/C systems under SNAP, and defined under the LD GHG regulations at 40 CFR 86.1867-12(e). The refrigerants currently defined at 40 CFR 86.1867-12(e), besides HFC-134a, are HFC-152a, HFO-1234yf, and CO2. If a manufacturer chooses to use a lower-GWP refrigerant that is listed in the future as acceptable in 40 CFR part 82, subpart G, but that is not identified in 40 CFR 86.1867-12(e), then the manufacturer could contact EPA about how to appropriately determine compliance with the leakage standard.” [EPA-HQ-OAR-2014-0827-1191-A1 p.4-5]

**4. Honeywell Agrees that EPA Must Establish and Implement Appropriate Measures to Assure Compliance with the Proposed Rule, including compliance with Leakage Rates and to Protect Against Backsliding** [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

As EPA is well aware, even the best designed regulatory program will not achieve its objectives unless there are high levels of compliance with the rules. [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

“We specifically request comment on whether there should be additional provisions that could prevent or discourage manufacturers that transition to an alternative refrigerant from discontinuing existing, low-leak A/C system components and instead reverting to higher-leakage components.” [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

Honeywell encourages EPA to consider ways to better promote, monitor and assure compliance with all standards that EPA adopts with regards to the use of refrigerants in HD vehicles. This is important both with regards to assuring that new vehicles contain a proper mix of equipment from EPA’s A/C menu to comply with maximum leakage rates, as well as to assuring that vehicles which utilize low GWP refrigerants do not backslide to higher GWP refrigerants upon recharge without detection. Given that lack of existing legal mechanisms to prevent against backsliding to higher GWP refrigerants during retrofit and recharge, we support regulatory measures that protect against reverting to higher GHG emissions over the life of a vehicle. We recommend that EPA provide incentives for the aftermarket industry to assure use of compliant, low GWP refrigerants. One option is for EPA to consider a credit based system similar to the effective light duty CO2 credit program as a way to accelerate the transition away from R-134a in HD vehicles. [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

We support requirements for manufacturers to attest to the durability of components and systems used to meet the maximum refrigerant leakage standards, however we believe that independent, real world testing is the preferred method that EPA should adopt. Independent, real world testing on refrigerant leakage rates of HD vehicles will promote transparency and best ensure data accuracy. [EPA-HQ-OAR-2014-0827-1191-A1 p.5]

Honeywell appreciates EPA’s and NHTSA’s recognition of the meaningful contribution that low GWP refrigerants offer to reducing the GHG emissions from HD, MD and vocational vehicles. Assuring a rapid and smooth transition to low GWP refrigerants will deliver comparable cooling in all climates, while saving time, costs, and environmental impact for years to come. [EPA-HQ-OAR-2014-0827-1191-A1 p.6]

We respectfully request EPA to continue to work with all stakeholders to establish a regulatory program that fairly accounts for GHG emissions from air conditioning in HD vehicles and establishes mechanisms to assure compliance with all aspects of the proposed rule in advancing our nation’s clean energy and environmental objectives. [EPA-HQ-OAR-2014-0827-1191-A1 p.6]

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4 Compare Establishment of Leakage Rates of Mobile Air Conditioners in Heavy Duty Vehicles: Part 1 Trucks (ENV.C.1/SER/2005/0091r), Prepared for the European Commissions (DG Environment) by Winfried Schwarz (Öko-Recherche) (27 January, 2007) with Minnesota Pollution Control Agency, MY 2015 Mobile Air Conditioner Leakage Rates. See also, A. Burnette and R. Baker, CARB. Contract No. 06-342 (showing very high leakage rates in HD vehicles. Study involved approximately 65-70 vehicles, measured initial charge in vehicle, sent into field for a few months, re-measured charge for comparison).

5 The SAE J2727 that EPA recommends does take into account variation in components. For example, a single o-ring connection will have a higher leak rate than seal washer connection for two reasons: 1) average leak rate through properly installed o-ring is higher than average leak rate through properly installed seal washer, and 2) o-ring is more likely to be mis-assembled (i.e. pinched/cut upon assembly) which leads to even higher leak rates. J2727 was based upon study of assembly of many connections and some of the o-ring connections were less than optimal (pinched/cut, etc). However, there is no

additional variation added for things like road damage, accidents, service failures, etc. It only considers variation from “normal wear and tear” of system during operation.

**Response:**

EPA proposed to allow a manufacturer to be “deemed to comply” with the leakage standard if its A/C system used a refrigerant other than HFC-134a that was both listed as an acceptable substitute refrigerant for heavy-duty A/C systems under SNAP, and was identified in the LD GHG regulations at 40 CFR 86.1867-12(e). 80 FR 40172.

For several reasons, EPA has reconsidered the proposed “deemed to comply” provision for this rule, and instead, the Phase 2 program retains the Phase 1 requirement that manufacturers attest that they are using low-leak components, regardless of the refrigerant they use. In general, we expect that the progress LD vehicle manufacturers are making toward more leak-tight A/C systems will continue and that this progress will transfer to HD A/C systems. Still, we agree that continued improvements in low-leak performance HD vehicles is an important goal, and that continuing the Phase 1 leakage requirements in the Phase 2 program should discourage manufacturers from reverting to higher-leak and potentially less expensive components. It is also important to note that there is no “deemed to comply” option in the parallel LD-GHG program – manufacturers must attest to meeting the leakage standard. There is no compelling reason to have a different regime for heavy duty applications.

At the same time, EPA does not believe that finalizing the “deemed to comply” provision would have an impact on any future transition of the HD industry to alternative refrigerants. As discussed above, two lower-GWP refrigerants are already acceptable for use in HD vehicles, and EPA has proposed to list HFO-1234yf as acceptable, subject to use conditions, for limited HD vehicle types. As also discussed above, and especially in light of the rapid expansion of alternative refrigerants that has been occurring in the LD vehicle market, similar trends may develop in the HD vehicle market, regardless of EPA’s action regarding leakage of alternative refrigerants in this final rule.

Although leakage of lower-GWP refrigerants is of less concern from a climate perspective than leakage of higher GWP refrigerants, we also agree with the concern related to the servicing of lower-GWP systems with higher-GWP refrigerants in the aftermarket. We agree that this could result due to factors such as price differentials between aftermarket refrigerants. However, as is the case for Phase 1, as a part of certification, HD manufacturers will attest both to the use of low-leak components as well as to the specific refrigerant used. Thus, in the future, a manufacturer wishing to certify a vehicle with an A/C system designed for an alternative refrigerant will attest to the use of that specific refrigerant. In that situation, any end-user servicing and recharging that A/C system with any other refrigerant would be considered tampering with an emission-related component under Title II of the CAA. For example, recharging an A/C system certified to use a lower-GWP refrigerant, such as HFO-1234yf, with any other refrigerant, including but not limited to HFC-134a, would be considered a violation of Title II tampering provisions.

#### **1.6.4 Additional Issues**

**Organization:** Structural Composites, Inc. and Compsys, Inc.

Our preliminary research indicates that approximately one-tenth of the HFC-134a used in our composite preforming process is released into the atmosphere. Our polyurethane foam is sprayed into a mold that is completely encapsulated in a composite coating. Because of the size of the HFC-134a molecule, it cannot pass through the composite coating. Thus, any HFC-134a that reaches the atmosphere occurs

during the spray process. Once the foam is enclosed and fully encapsulated, any HFC-134a retained in the foam will be permanently enclosed. [EPA-HQ-OAR-2014-0827-1205-A1 p.2]

As a result, the GHG emissions and overall global warming potential associated with HFC-134a use in composite preforming are extremely low. Moreover, such GHG emissions are non-recurring and are negligible in comparison to the overall GHG reductions that will be achieved by improving boat and vehicle fuel economy. Our calculations indicate that use of Prisma preform technology in refrigerated trailers can reduce GHG emissions by approximately 25 tons of CO<sub>2</sub>-equivalent per year and 650,000 lbs. of CO<sub>2</sub>-equivalent over the useful life of the trailer. Also associated with use of lightweight Prisma products would be hundreds of thousands of gallons of fuel savings. [EPA-HQ-OAR-2014-0827-1205-A1 p.2]

***EPA Should Coordinate Internally to Ensure that the Agency's SNAP Rule Does Not Prevent Significant GHG Reductions under the Heavy-Duty Engine and Vehicle GHG Program.***

Our technology has the potential to offer significant overall GHG reductions and fuel savings for this transportation sector. However, in a final rule issued at 80 Fed. Reg. 42,870 (July 20, 2015), entitled "Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes Under the Significant New Alternatives Policy Program," EPA appears to have eliminated Compsys' ability to produce our Prisma product in the U.S. after 2020. We therefore urge EPA to carefully consider the relationship between the SNAP program and the heavy-duty GHG rule. Due to the great potential for longer-term GHG reductions at the cost of de minimis emissions of HFC-134a from the foam blowing process, Compsys and Structural Composites urge EPA to continue to allow unrestricted use of HFC-134a as a blowing agent for composite preforming. If the SNAP rule limits or prohibits the use of HFC-134a as a foam blowing agent for our process, EPA will have eliminated a potential avenue for achieving even greater GHG reductions from the on-road transportation sector. [EPA-HQ-OAR-2014-0827-1205-A1 p.2]

Compsys and Structural Composites have requested that EPA reconsider the final SNAP rule and clarify that the use restrictions placed on HFC-134a as of January 1, 2020 do not apply to our product or process. Compsys and Structural Composites have researched, and continue to investigate, whether alternatives to HFC-134a can be used in our process. We previously phased out HCFC-22 and replaced that substance with HFC-134a. However, we have not yet identified a substitute for HFC-134a. We continue to examine alternatives but urge EPA's Office of Transportation and Air Quality and Office of Stratospheric Protection to work together to ensure that the SNAP rule does not prevent the achievement of significant lifetime GHG reductions under the heavy-duty vehicle and engine GHG program. [EPA-HQ-OAR-2014-0827-1205-A1 p.2]

The SNAP rule also would permit the importation of refrigerated trailers and other products produced outside of the U.S., even if those items are produced using foam blowing agents such as HFC-134a that would be prohibited for use within the U.S. Any reductions in GHG emissions that EPA expects to achieve under the SNAP rule may easily be offset by companies moving production of foam blowing operations outside of the U.S. Even leaving aside environmental considerations, EPA's decision to continue to allow imported foam products while prohibiting the same manufacturing processes within the U.S. has massive financial and competitive consequences for the foam blowing industry. Companies with operations located solely within the U.S.—including small businesses such as Compsys and Structural Composites—that contribute to the growth and prosperity of the U.S. economy will be put out of business. Compsys respectfully requests that OTAQ and the Office of Stratospheric Protection coordinate efforts to ensure that on-road trucking products manufactured within the U.S. are protected to avoid bankrupting successful, innovative American small business. [EPA-HQ-OAR-2014-0827-1205-A1 p.2-3]

**Response:**

EPA appreciates the comments by Compsys and Structural Composites; however, these comments go beyond the scope of the current rulemaking. The commenter has also raised these comments in connection with the SNAP program, and EPA will address them through that process.

**Organization:** EOS Climate

Our comment is focused on the flexibility that is proposed for use of alternative (nonhydrofluorocarbon, HFC) under Section 1037.115(e)(2). Under the proposal, an alternative refrigerant is defined as a refrigerant other than HFC-134a that is listed as an acceptable substitute under EPA's Significant New Alternatives Policy (SNAP) program. Manufacturers using an alternative refrigerant are exempt from reporting on their vehicles' air conditioning leakage rate. [EPA-HQ-OAR-2014-0827-1170-A1 p.1]

We recommend the Agency consider expanding the definition of alternative refrigerant to include HFC-134a that has been reclaimed. Reclaimed HFC is refrigerant that has been previously used, recovered from equipment (typically at equipment end-of-life), and processed to remove contaminants (e.g., oil, water, other refrigerants) and restored to virgin-grade purity for re-use in other equipment by an EPA-certified refrigerant reclaimer. In contrast to HCFC-22 which is being phased out of production in the United States, there is no economic incentive to recover and reclaim HFC refrigerant today. Even under the most conservative assumptions, the best estimate is that less than 5-10% of HFC refrigerant is being reclaimed for re-use. By using reclaimed HFC-134a, vehicle manufacturers would be displacing new production of virgin HFC-134a and thereby preventing additional greenhouse gas (GHG) emissions. [EPA-HQ-OAR-2014-0827-1170-A1 p.1]

The reduced GHG emissions associated with use of reclaimed HFC refrigerant is quantified and verified under a new protocol under the American Carbon Registry (ACR)<sup>1</sup>. Our company, EOSClimate, originated the protocol, in conformance with the International Standards Organization (ISO) Standard 14064-2. The protocol relies on data and modeling from the U.S. EPA, the International Panel on Climate Change (IPCC), the Montreal Protocol Technology and Economic Assessment Panel (TEAP), the California Air Resources Board, and other technical literature, and has been peer reviewed by industry and government experts, and the public. The protocol establishes baseline scenarios, emission factors, monitoring and reporting requirements, regulatory parameters, project eligibility criteria, and the other elements involved in generating GHG emission reductions that are then verified by certified 3rd parties. [EPA-HQ-OAR-2014-0827-1170-A1 p.1]

As an example, using the quantification methodology in the new ACR protocol, if a heavy-duty truck has an air conditioning system with a 3 pound refrigerant charge of HFC-134a, using reclaimed HFC-134a would prevent the equivalent of 1.35 metric tons of CO<sub>2</sub> over 10 years (the crediting period under the protocol, accounting for normal system leaks and the baseline reclamation rate in the United States). Alternatively, the manufacturer could achieve the same greenhouse gas reduction by purchase of 1.95 verified credits (representing the equivalent of 1.95 metric tons of CO<sub>2</sub>) which would correspond to the reclamation of 3 additional lbs of HFC-134a refrigerant for re-use in the United States. [EPA-HQ-OAR-2014-0827-1170-A1 p.1-2]

We encourage EPA, and your colleagues at the Department of Transportation to consider reclaimed HFCs and reclaimed HFC credits as part of a comprehensive approach to reduce GHG emissions across multiple components of trucks and automobiles, including for example, use of re-refined motor oil. By using reclaimed HFC refrigerant, or alternatively, by purchase of the verified GHG credits generated by reclaiming HFC refrigerant, vehicle manufacturers would be reducing the GHG footprint of their new

vehicles. Prior to full market availability of new low- GWP alternatives, use of reclaimed HFC or purchase of verified, reclaimed HFC credits delivers immediate GHG reductions associated with vehicle air conditioning systems and gives the industry a market-ready tool to promote EPA’s goals, as highlighted in the President’s Climate Action Plan, of expanding reclamation of fluorochemical refrigerants across the United States and driving down HFC emissions. [EPA-HQ-OAR-2014-0827-1170-A1 p.2]

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1 [americancarbonregistry.org/carbon-accounting/standards-methodologies/use-of-reclaimed-hfc-refrigerants-andadvanced-refrigeration-systems](http://americancarbonregistry.org/carbon-accounting/standards-methodologies/use-of-reclaimed-hfc-refrigerants-andadvanced-refrigeration-systems)

**Response:**

EPA does not believe the definition of alternative refrigerant should be revised to include reclaimed R-134a. EPA has defined “reclaim” refrigerant at 40 CFR 82.152 to mean “to reprocess refrigerant to all of the specifications in appendix A to 40 CFR part 82, subpart F (based on ARI Standard 700–1995, Specification for Fluorocarbons and Other Refrigerants) that are applicable to that refrigerant and to verify that the refrigerant meets these specifications using the analytical methodology prescribed in section 5 of appendix A of 40 CFR part 82, subpart F.” Additionally, EPA does not differentiate between virgin and reclaimed refrigerants based on the difficulty in determining whether refrigerant that is undergoing a phase-out for certain end-uses in the United States (e.g., R-134a) is virgin refrigerant or is used refrigerant that has been reclaimed. This is especially true for appliances and components that are produced and pre-charged abroad and imported into the United States. It would not be possible for EPA to determine whether such imported pre-charged appliances and components were manufactured with reclaimed refrigerant.

**Organization:** Chemours Company FC, LLC

To make this a lasting environmental improvement, Chemours strongly encourages the EPA to pursue additional efforts to prevent both intentional and unintentional improper service (servicing vehicles with low GWP refrigerant based A/C systems with R-134a). Further, Chemours suggests that EPA clearly state on the SNAP website that any low GWP MVAC refrigerant system only be serviced with the OEM refrigerant listed in the vehicle A/C manual and A/C system label and require that all HFC-134a MVAC service containers be clearly marked that it is a violation to use the product for servicing vehicles other than those that were originally charged with HFC-134a or CFC-12. [EPA-HQ-OAR-2014-0827-1231-A1 p.2]

In addition, EPA requirements for Certification for Refrigerant Handling Equipment and Technician Training and Certification are one-time events, and such training and certification can at this point be decades old. Much has changed in the world of MVAC, including transitioning from non-flammable to mildly flammable refrigerants, and new compressor certification standards. Refresher training is commonly applied in many fields to both ensure technicians are reminded of basic requirements and to update technician knowledge with more recent developments. Chemours recommends mandatory technician training and certification be required every five years to ensure technicians are current on regulatory requirements, including use conditions, and appropriate industry standards. This requirement could be phased in such that any technician whose training and certification was more than five years old as of the date the final rule goes into effect would have a period of time (such as 12 months) to complete the training and certification. [EPA-HQ-OAR-2014-0827-1231-A1 p.2]

**Response:**

These comments go beyond the scope of the current rulemaking as they concern CAA section 609, which directs EPA to establish standards and requirements regarding the servicing of MVACs. However, EPA appreciates receiving this information and will consider the comments as it evaluates possible future actions.

In the SNAP July 2015 final rule (80 FR 42953), EPA listed R-134a as unacceptable for newly manufactured light-duty vehicles beginning in Model Year 2021, except where allowed under narrowed use limits. In this rule, we stated that “HFC-134a is listed, and will remain listed, as an acceptable refrigerant for retrofit of existing systems designed to use CFC-12, but because of the use restrictions for refrigerants listed as acceptable, it cannot be used as a retrofit for MVAC systems using other alternatives. EPA did not propose to revise the listing decision for use of HFC-134a as a retrofit and thus did not establish a new use condition as part of the final rule. See section V.B.6.e of that SNAP final rule for a response to several comments on servicing CFC-12, HFC-134a, and the lower-GWP alternative refrigerant MVAC systems. EPA understands that Chemours and/or other refrigerant manufacturers may be interested in voluntarily providing information to customers on permitted uses of their products and EPA sees no barriers to such communication. EPA will consider updating the information on our website, as appropriate.

EPA agrees on the importance of technician training on safe handling of refrigerants, and notes that EPA has received additional requests to establish recertification requirements for technicians outside of this rulemaking process. The Agency is currently working with the approved CAA section 609 technician training and certification programs to update training material to focus on HFC-134a and the new climate-friendly alternatives that technicians will encounter in the coming years. The goal of this update is to ensure that technicians entering the field today are aware of the growing use of additional MVAC refrigerants and their unique properties, current regulatory requirements for MVAC under CAA section 609, section 612 (SNAP), and section 608, and relevant industry standards. EPA has also made an effort to update the information available on our website

## **1.7 General Comments on Regulatory Framework and Rule Principles**

**Organization:** American Automotive Policy Council

**Need for Customer Acceptance** - AAPC strongly believes that the Phase 2 program must continue to recognize the unique functionality and utility needs of the trucking industry, and that this regulation must preserve the performance integrity of these work trucks. [EPA-HQ-OAR-2014-0827-1238-A1 p.2]

**Organization:** American Gas Association (AGA) et al.

### **We Strongly Support the Preservation of the Conversion Factor between CO<sub>2</sub> and Fuel Consumption**

The agencies’ three previous rulemakings (the LD Phase 1 Rule,<sup>13</sup> the LD Phase 2 Rule,<sup>14</sup> and the HD Phase 1 Rule<sup>15</sup>) established a “one-to-one” relationship between CO<sub>2</sub> emissions and fuel consumption. This relationship converts measured CO<sub>2</sub> emissions into fuel consumption by using gasoline- and diesel-specific conversion factors. [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

We support the preservation of this approach in the Phase 2 Proposal because it maintains a “uniform approach to rulemaking”<sup>16</sup> across the range of GHG and fuel consumption rules in the transportation

sector and continues the approach of calculating fuel consumption according to measured levels of CO<sub>2</sub>, regardless of fuel type.<sup>17</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.4]

We commend your efforts to propose an equitable Phase 2 Rule that will deliver significant environmental and fiscal benefits to 2027 and beyond. [EPA-HQ-OAR-2014-0827-1223-A1 p.14]

**Organization:** Behrendt, Diane

We are as small as a small business can be. We operate one tractor and one trailer and have done so for the last 23 years. My husband has been a professional driver for the last 36+ years. So our experience with 'big trucks' goes back decades. [EPA-HQ-OAR-2014-0827-0949-A1 p.1]

The EPA and the NHTSA need to realize trucking is not a one size fits all industry. We live in a country with lots of variables, such as the weather. A truck cannot have automatic engine shut off, when temps are below fuel gelling conditions. The 2010 International had a maximum run time of 90 minutes, this does not work when you live in central Minnesota and do not have a heated garage. Let alone when your job takes you through the harshest conditions in the country. Engine idling wastes fuel, but are necessary if you don't want to freeze to death, or suffer heat stroke. Idling also clogs up the DPF. [EPA-HQ-OAR-2014-0827-0949-A1 p.2]

The government should not mandate technology that does not exist at this time. Society will pay a heavy price for goods and services if this failed “technology” continue to bankrupt an industry that has been financially strained for years. When you pay 140-160 thousand dollars for a truck, it needs to be reliable and last far longer than 5 years or 435,000 miles that the EPA proposes in its GHG Phase 2 plan. [EPA-HQ-OAR-2014-0827-0949-A1 p.2-3]

**Organization:** Bendix Commercial Vehicle Systems, LLC

In summary, the market should have choices and options to achieve the goals of the regulation. Through choice, optimum flexibility is enabled, providing multiple options to achieve the intent of the regulation and deliver the results expected. Bendix is committed to policies that enable the introduction of new technologies needed to support sustainable mobility. The interconnectedness of the industry drives the need for consistent, long-term policies, regulations and standards so that all stakeholders can more effectively incorporate technologies into the nation’s fleet. Suppliers are a key part to producing the results outlined by the Administration. Bendix urges the agencies to consider all of these comments as the final rule is developed. [EPA-HQ-OAR-2014-0827-1241-A1 p.8]

**Organization:** Caterpillar Inc, et al.

### **Expected technology penetration rates must align with market needs and legal restrictions**

EPA and NHTSA must ensure that their assumptions about various technologies match with market reality and that their cost estimates are comprehensive and accurate so that environmental benefits and efficiency gains are realized in a logical and cost-effective manner. Stringency of the standards should be based on products customers can actually afford to purchase and that do not interfere with operations. Customers will not buy technologies in order to meet a regulatory target. [EPA-HQ-OAR-2014-0827-1215-A1 p.5]



The following proposed penetration rates are a few examples of overly aggressive targets and in our estimation must be adjusted downward: [EPA-HQ-OAR-2014-0827-1215-A1 p.5]

**Organization:** Center for Biological Diversity

We also note that there has been a call from various organizations for fuel neutral standards (i.e., a single standard for both gasoline and diesel engines) since the Phase 1 rulemaking.<sup>30</sup> The principal reason for moving to fuel neutral standards is that a single standard allows all engines to compete in the same market, thus driving selection and innovation further. Many international standards are fuel neutral, as are the large light-duty pickup and van CAFE standards. The market is already largely segregated between gasoline and diesel engines depending on work capacity such that the largest overlap would be in the pickup and van classes where there are abundant technologies being developed for large light-duty pickups and vans that could easily be applied to heavy-duty pickup and van engines. [EPA-HQ-OAR-2014-0827-1460-A1 p.8]

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30 See, e.g., summary contained in ICCT Pickup Report, *supra* note 27 at 11.

**Organization:** Cummins, Inc.

Through these avenues and our comments here, Cummins supports continuation of the Phase 1 regulatory framework as the foundation for the Phase 2 program. Key elements include separate engine and vehicle standards, clear enforceability to ensure real world benefits, adequate lead-time and stability and regulatory flexibilities for manufacturers. Phase 2 should also strive for performance-based standards that are fuel neutral. [EPA-HQ-OAR-2014-0827-1298-A1 p.5-6]

**Organization:** Caterpillar, Daimler, Navistar, PACCAR, and the Volvo Group

Careful execution of fuel efficiency standards for this industry will enable the classic win-win scenario. As manufacturers, we support a practical, achievable greenhouse gas and fuel efficiency regulation that does not disrupt the market due to over-reaching demands, while allowing the flexibility to offer each customer the features they need in their specific operation. [EPA-HQ-OAR-2014-0827-1215-A1 p.2]

It's imperative that our ability to deliver on these fundamental customer expectations is preserved by this regulation. Said another way, correctly finalizing the certification and compliance protocols in this rule and the associated standards is essential to maintaining customer demand for these work tools, and thereby critical to successfully achieving the environmental goals of the program. [EPA-HQ-OAR-2014-0827-1215-A1 p.2]

To assure this success, the Phase 2 regulation must be finalized with seven basic principles in mind: [EPA-HQ-OAR-2014-0827-1215-A1 p.3]

- Regulation must appropriately reflect real-world reductions
- There must be a single, national GHG regulation adopted by EPA, NHTSA and CARB
- Expected technologies must be appropriately demonstrated

- Expected technology penetration rates must align with market needs and legal restrictions
- Regulation must take into account total cost of ownership
- Protocols must be clearly defined, and accommodate production and test variability
- Regulation must recognize the trade-off of NOx and CO2 reduction targets [EPA-HQ-OAR-2014-0827-1215-A1 p.3]

We believe that if these principles are fulfilled in the crafting of the final version of this regulation, the stage will be set to deploy a new fleet of highly efficient, low-emitting medium-and heavy-duty vehicles fully capable of fulfilling the mission for which they were purchased, with minimal risk of unintended consequences. [EPA-HQ-OAR-2014-0827-1215-A1 p.3]

**Organization:** Daimler Trucks North America LLC

**The agencies should not require powertrain testing nor premise standards on a significant amount of powertrain testing** – The agencies request comment regarding EPA requiring broad use of powertrain testing (80 FR 40179). DTNA believes that complete vehicle simulation be established in Phase 2 as the preferred method of certification. Complementing GEM simulation with selectable dropdown fuel efficiency features that represent benefits of specific powertrain controls is a reasonable, efficient, and cost effective way to include benefits of integration features. EPA should go no further than to offer powertrain testing as an option for manufacturers and should not consider powertrain testing more broadly. 80 FR 40179 [EPA-HQ-OAR-2014-0827-1164-A1 p.66-67]

**Organization:** Diesel Technology Forum

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows: [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

**The program must be fuel neutral in nature.** Through the adoption of emissions standards, testing procedures and other provisions, the proposed rule must ensure that one fuel or technology is not directly or indirectly favored over others, for any of the categories of vehicles covered. Manufacturers and their customers are best suited to select the technology that makes the most sense for their specific needs. [EPA-HQ-OAR-2014-0827-1171-A2 p.5] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.111-112.]]

**Organization:** Eaton Vehicle Group

As we did in Phase 1, Eaton supports the push for a new generation of clean, fuel-efficient commercial vehicles that will reduce greenhouse gas emissions and strengthen the U.S. economy. Phase 1 has been successful in that it put together a sound regulatory framework that is aligned with market forces. The separate engine and vehicle standards reflect the reality of the commercial vehicle. Also, Phase 1 was a nationally harmonized 50-state solution which is essential for commercial and compliance purposes. We are encouraged by the EPA’s preference to keep in place the Phase 1 regulatory structure that minimized market disruption and compliance burdens. [EPA-HQ-OAR-2014-0827-1194-A1 p.4]

We believe that the framework outlined in the NPRM for Phase 2 is a good step toward a final regulation that will drive innovation, foster both technology and competition, while maintaining fleet

diversity and incentivizing over-compliance with emissions and fuel economy targets. By following the structure in Phase 1, the agencies are relying upon an established regulatory structure, testing and processes that are efficient and fair. [EPA-HQ-OAR-2014-0827-1194-A1 p.4-5]

The NPRM sets forth clear, achievable objectives that spur innovation and deployment, while avoiding negative impact on the economy and promoting leadership in commercial vehicle fuel efficiency. We believe that many of the technologies needed to achieve the proposed standards are available. Some are in low volume production, and others need a path into a market that values their contributions to emissions reduction and fuel efficiency. Phase 2 will provide clear and realistic targets for industry and will accelerate adoption of these technologies. [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

Eaton was a founding member of The Heavy Duty Fuel Efficiency Leadership Group; we believe the Phase 2 NPRM generally reflects the Statement of Principles put forward by the Leadership Group, as follows [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

1. The Phase 2 rule should maintain market, fleet and technology choice by allowing OEMs and component suppliers to continue to produce vehicles that perform the work required of them [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

-The EPA Phase 2 regulations should ensure continued investment in advanced powertrain technology to maintain market dynamic and fleet technology choice.

-The EPA should not promulgate standards that would prohibit, either directly or indirectly, the continued production of specialized commercial vehicles

-The EPA should expand the list of current exempt vehicles to include highly specialized, low volume vehicles

2. The EPA should ensure that all testing and certification requirements are cost-effective, straight forward, and they accurately measure fuel efficiency and GHG reductions. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

Powertrain testing should remain an optional requirement that can measure the real world performance differentiation among drivetrains; GEM should be refined in order to accurately capture the benefits of closely integrated engines and transmission.

The EPA should provide a method to protect intellectual property of component suppliers

3. If the EPA includes different transmission architectures in GEM, they must be fully supported with data and technical analysis. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

Phase 2 Rule should ensure that no transmission architecture is unduly favored in GEM

4. Duty cycles must accurately measure fuel economy and GHG reductions. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

They must reflect real world driving conditions.

They must incorporate substantially more transient operation than Phase 1 standards for vocational vehicle sector.

5. The EPA should maintain current responsibilities in Phase 1 regarding certificates of conformity in the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

6. Vocational vehicles should be further subcategorized to reflect usage. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

7. The EPA should continue advanced and innovative technology credits in Phase 2. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

-The EPA should allow for certification using full vehicle, powertrain or component testing.

8. A long-term Phase 2 rule would provide certainty to drive investments in technology development. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

**Organization:** Enovation Controls (ENC)

EPA/NHTSA Phase 2 Heavy-Duty Greenhouse Gas Regulations are of particular interest to ENC because our company's Class 6, 7 and 8 on-highway products directly enable lower tailpipe emissions using natural gas. We believe a fuel-agnostic approach must be taken to any emissions regulation in order to provide a level playing field for traditional and alternative forms of energy. The proposed regulation must result in lower greenhouse gases to effectively result in cleaner air and increasing energy independence. [EPA-HQ-OAR-2014-0827-1203-A1 p.1]

1.1 Continuation of Phase 1 Approach - ENC agrees with the general direction presented to adopt the Phase 1 approach to calculated fuel consumption based on tailpipe emissions. However, the wording should be unified between petroleum consumption and CO2 emissions in order to specifically highlight the overarching goal for the legislation. It is our opinion that CO2 emission limits properly and accurately address concerns regarding both greenhouse gas environmental impact and petroleum consumption. A lack of clarity between fuel / petroleum consumption and CO2 emissions is likely to create areas of misalignment. [EPA-HQ-OAR-2014-0827-1203-A1 p.1]

**Organization:** Environmental Defense Fund (EDF)

### **The Proposed Rule: an Important First Step**

EDF fully supports a comprehensive and robust heavy-duty program.

The Phase 1 rule established an effective structure and many key components to a successful program that have been carried over to the Phase 2 proposal, and in some cases improved upon. While we believe the final standards should go much farther in driving technology and providing benefits to our families and communities, the Agencies' proposed structure can help secure these reductions. [EPA-HQ-OAR-2014-0827-1312-A1 p.15]

**Standards in 2027 must drive advanced technologies**

If the program is extended to 2027, those standards must go well beyond what is currently proposed to truly force technology development. Doing so would be consistent with EPA's CAA technology-forcing authority and NHTSA's maximum feasible mandate in EISA. A crucial function of motor vehicle emissions standards is to promote the further development and foster the deployment of promising technologies whose pathway to market acceptance is less clear. The proposed rule recognizes this, and includes technologies such as advanced aerodynamics and vocational hybrids in the compliance scenario for this reason. However, the proposed standards can be met without even drawing on these technologies; to promote the development of these and other advanced technologies the 2027 standards must be substantially strengthened.<sup>126</sup> With many previous rulemakings, EPA has set a precedent for establishing standards based on a reasonable projection that technology still in the research stages of development when the rules were adopted would be available at the time the standard went into effect.<sup>127</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.27]

#### **A. A stronger rule is necessary for broader climate and health benefits**

A rigorous Phase 2 program could fundamentally alter the path of medium- and heavy-duty GHG emissions – reducing fuel consumed by the entire on-road truck fleet to below today's levels, while helping the freight economy grow. To achieve this, however, the Phase 2 program must fully mobilize all existing modern technologies and drive the development and deployment of advanced technologies. [EPA-HQ-OAR-2014-0827-1312-A1 p.17]

A joint analysis by EDF, NRDC, UCS, ACEEE and the Sierra Club in 2014 found that by 2025, the first and second phases of standards together could cut fuel consumption of new trucks by at least 40 percent compared to 2010 levels.<sup>75</sup> The analysis – based on a broad set of analyses by the National Research Council, research by Southwest Research Institute (“SwRI”) and results from the Department of Energy (“DOE”)’s SuperTruck program – also found that the technologies to improve fuel efficiency are cost-effective in the 2025 timeframe. [EPA-HQ-OAR-2014-0827-1312-A1 p.17]

While the proposal is an important step in this direction, it does not drive these technologies to their full potential. The Agencies estimate that the proposed standards would cut climate pollution by 1 billion tons and reduce fuel consumption by 1.8 billion barrels of oil over the life of the vehicles subject to the rule. These are necessary and significant reductions. However, finalizing standards that are consistent with a 40 percent reduction in fuel consumption by 2015, as outlined by EDF and others, would save an additional 200,000 barrels of oil per day in 2035 and reduce 40 million additional tons of GHG emissions annually.<sup>76</sup> A more protective rule would also hasten and possibly enhance NOx reductions– 2.4 million tons reduced over the life of the program. Our comments in Section VI below provide more detailed recommendations on how these improvements can be achieved. [EPA-HQ-OAR-2014-0827-1312-A1 p.17]

#### **C. Comprehensive, rigorous program is needed to address market barriers**

Robust Phase 2 standards are needed to deliver the full benefits available from existing and developing efficiency technology. There is clear evidence, as summarized in the proposal, that market barriers exist preventing consumers from investing in efficiency technology that will save them money in the long term. For example, consumers may not have complete or reliable information about the effectiveness and durability of the technology or vehicle they are interested in – both in the new vehicle market and the resale market. An additional barrier in the heavy-duty market is a split incentive where the party paying the upfront cost may be different from the party realizing the fuel cost savings. These barriers impede the development and uptake of the full array of modern technologies. As the Agencies stated in the Preamble, “a significant number of fuel efficiency improving technologies would remain far less

widely adopted in the absence of these proposed standards.” This is true. However, a weak final rule would also leave certain advanced technologies on table. Therefore, it is imperative that the agencies finalize more robust fuel economy and greenhouse gas standards to realize the full potential of efficiency improvements from the heavy-duty sector. Doing so “would provide regulatory certainty and generate important economic benefits in addition to reducing externalities.” [EPA-HQ-OAR-2014-0827-1312-A1 p.18-19]

### **EPA and NHTSA Must Finalize Standards that Reflect the Full Range of Existing and Advanced Technologies**

EDF provides extensive comments and recommendations below on how the Agencies can improve and strengthen the final standards to reflect today’s available technologies and drive adoption of more advanced technologies. Making these important improvements to the final standards will deliver additional emissions reductions and fuel savings while saving customers and businesses money and providing certainty for manufacturers investing in innovative solutions. As examined in detail below, the Agencies’ proposed engine standards are unlawful in failing to carry out the Agencies’ delegated statutory responsibilities, in proposing standards that are unreasonable in light of the body of evidence indicating that far more protective standards are available, and in proposing resulting emission standards that are fundamentally irrational in relying on decision criteria and conclusions that break the bond of reasoned decision-making, severing the facts available in the record before the Agencies from the proposed choices made by the agencies. This is contrary to law. See *Motor Veh. Mfrs. Ass'n v. State Farm Ins.*, 463 U.S. 29 (1983). [EPA-HQ-OAR-2014-0827-1312-A1 p.26]

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1 The White House, Remarks by the President on Climate Change, Georgetown University (June 25, 2013), available at <http://www.whitehouse.gov/the-press-office/2013/06/25/remarks-president-climate-change>.

2 The White House, The President’s Climate Action Plan, (June 2013), available at <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

3 White House press release, US-China Joint Presidential Statement on Climate Change, (September 25, 2015), available at <https://www.whitehouse.gov/the-press-office/2015/09/25/us-china-joint-presidential-statement-climate-change>.

4 Energy Information Agency (EIA), Annual Energy Outlook (2015), Tables A-7 and A-19.

5 EIA, Annual Energy Outlook (2015), Table 19.

75 EDF et al., Big Fuel Savings Available in New Trucks, (2014), available at <http://www.edf.org/sites/default/files/content/trucksavingsfactsheet-2014-06-11.pdf> .

76 Union of Concerned Scientists (UCS), Newly Proposed Heavy-duty Truck Efficiency Standards for 2018-2029, (July 2015), available at <http://www.ucsusa.org/sites/default/files/attach/2015/07/proposed-heavy-duty-vehicles-standards.pdf>.

77 Assumes Class 8 truck VMT of 120,000 miles and average fuel economy of 6.1 MPG, and sedan VMT of 11,318 and average fuel economy of 31 MPG. Energy Information Agency (EIA), Annual Energy Outlook 2014, Table 68; Freight Transportation Energy Use. Heavy Duty Fuel Efficiency,

Existing Trucks by Size Class. University of Michigan Eco-Driving Index available at [www.umich.edu/~umtriswt/data/UMTRI\\_sales-weighted-CAFE\\_April-2015.xls](http://www.umich.edu/~umtriswt/data/UMTRI_sales-weighted-CAFE_April-2015.xls); and Federal Highway Administration, Table VM-1 American Public Transit Association's Public Transportation Fact Book Tables 8, 16, and 21.

78 American Transportation Research Institute, An Analysis of the Operational Costs of Trucking, (September 2013), available at <http://truckexec.typepad.com/files/atri-operational-costs-of-trucking-2013-final.pdf>.

79 EDF et al., Big Fuel Savings Available in New Trucks, (2014), available at <http://www.edf.org/sites/default/files/content/trucksavingsfactsheet-2014-06-11.pdf>.

126 Walsh and Charlton, Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines, Consultant Report, (September 2015). See also ICCT comments submitted to this docket, UCS comments submitted to this docket and ACEEE comments submitted to this docket.

127 For example, the 2007/10 heavy-duty NO<sub>x</sub> and PM standards that EPA finalized in 2001 required the application of both NO<sub>x</sub> and PM aftertreatment to HD trucks for the first time. These aftertreatment technologies had existed in research laboratories before the rule was finalized, but system- and component-level development and demonstration had not taken place. EPA projected that with 6 to 9 years lead-time manufacturers could continue the development of these technologies and successfully deploy them commercially beginning in 2007. In fact, the industry was able to successfully deploy PM aftertreatment (traps) to their entire 2007 truck fleet. Again in 2010, the industry successfully deployed NO<sub>x</sub> aftertreatment (selective reduction catalysts (SCR)) to their entire fleet. The Agency had projected NO<sub>x</sub> adsorbers would be the system of choice for 2010, but instead the industry utilized SCR, a technology not even relied upon by EPA. This rule demonstrates the successful application of the CAA technology forcing authority and the ingenuity of industry in meeting those requirements.

**Organization:** FedEx Corporation

Achieve Significant Environmental, Economic and Energy Security Benefits: Phase 1 has begun reducing U.S. oil consumption, cutting GHG emissions and producing fuel costs savings for fleets. Phase 2 should also drive GHG reductions and fuel savings while achieving important economic and energy security benefits. [EPA-HQ-OAR-2014-0827-1302-A1 p.2]

Maintain Market, Fleet and Technology Choices: Fleets are necessarily diverse in weight, size and capability to perform specific work tasks. Phase 2 should achieve significant GHG/Fuel Efficiency gains without restricting fleet choice of product specifications and GHG/Fuel Efficiency technologies needed for different applications. [EPA-HQ-OAR-2014-0827-1302-A1 p.2]

Build on Success of Phase 1: Phase 1 utilized proven testing/certification protocols while establishing incentives to drive adoption of advanced and innovative technologies. Additionally, it minimized compliance burdens by relying heavily on the existing emissions protocols. Phase 2 should not impose requirements that shift compliance burdens to end-users. The Phase 1 framework, which minimized market disruption and compliance burdens, should be maintained and improved for Phase 2. [EPA-HQ-OAR-2014-0827-1302-A1 p.2]

**Organization:** Honeywell Transportation System (HTS)

Honeywell believes the goals of the proposed rule can be best achieved through a technology/fuel neutral approach. [EPA-HQ-OAR-2014-0827-1230-A1 p.1]

Whenever possible, government should set regulatory standards, and industry innovation should be allowed to meet those standards in the most economical and consumer friendly manner. [EPA-HQ-OAR-2014-0827-1230-A1 p.1]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

We believe it is possible to craft a regulation that sets reasonable standards while promoting good jobs and protecting the environment. [EPA-HQ-OAR-2014-0827-1248-A2 p.1-2]

The medium and heavy duty truck industry is already working to comply with the Phase 1 Greenhouse Gas Emission and Fuel Efficiency Standard that is projected to save 530 million barrels of oil and reduce carbon emissions by 270 million metric tons. In fact, we do not know the full impact of prior regulations as comprehensive data is only now being gathered and analyzed for the 2014 model year. The new data should be carefully evaluated and compared to the estimates and assumptions used to formulate both Phase 1 and the proposed Phase 2 of the heavy duty regulations. [EPA-HQ-OAR-2014-0827-1248-A2 p.7]

We urge EPA, NHTSA and other regulatory agencies to refrain from altering intersecting regulations in a way that affects Phase 2 standards outside of existing timelines and benchmarks. This is a major concern in light of the numerous initiatives the Administration has undertaken to combat climate change. [EPA-HQ-OAR-2014-0827-1248-A2 p.7] The SNAP program impacted the agreement reached by the EPA, NHTSA, and UAW, automakers, environmentalists and CARB. Clearly a similar scenario can occur in the future in conjunction with this proposed regulation, all the more reason why the final rules should be flexible and designed with caution. [EPA-HQ-OAR-2014-0827-1248-A2 p.7-8]

Manufacturers need flexibility to meet stringency standards via a mix of different technologies and paths based on competitive advantages, market position, brand, customer demands and product cadence. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

Medium and heavy truck manufacturers have overcome challenges meeting Phase 1 stringency requirements that were developed assuming market adoption of existing off the shelf technology. Phase 2, in contrast is technology forcing. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

The UAW supports developing and bringing new technology to the fleet as long as the technology is reliable, cost effective and manufacturers have more than one technology path to comply with stringency requirements. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

We strongly agree with the EPA and NHTSA's warning that poorly crafted regulations forcing unproven technology can lead to: [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

Expectations of reduced reliability, increased operating costs, reduced residual value, or of large increases in purchase prices can lead the fleets to pull-ahead by several months planned future vehicle purchases by pre-buying vehicles without the newer technology. Such market impacts would be followed by some period of reduced purchases that can lead to temporary layoffs at the factories



producing the engines and vehicles, as well as at supplier factories, and disruptions at dealerships. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

The stringency of the Phase 2 standards must be crafted with the realities of the market in mind. As we have seen, regulations requiring customers to buy technology that are not proven or cost-effective lead to unintended consequences as customers often keep their vehicles longer or pre-buy vehicles in advance of new standards. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

Stringency requirements must recognize customer expectations, vehicle work and functionality requirements, product cadence, lower volumes and cost structure of the market. Final regulations should not be overly prescriptive. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

**Organization:** Mannix, Brian

### **Impact on Competition**

The RIA does not include an analysis of the impact of the proposed standards on competition. Generally it is a good idea to explore such impacts, particularly to counteract the tendency of a benefit-cost analysis to point to one apparently “optimum” solution to a given problem. Such a calculated solution is rarely optimal, and never optimal for very long, so it is important not to lock it in. Moreover, competition remains the most effective overall regulator of economic performance and efficiency, and by-the-book regulators need to be very careful, while pursuing their own missions, not to inflict a greater harm by impairing competition. The proposed standards appear to have been developed in close consultation with industry incumbents, and incorporate prescriptive requirements that are likely to create barriers to entry. Rather than encouraging innovation, the standards are likely to make innovation very difficult. Even the exemptions for small manufacturers incorporate caps and grandfather features that appear to be designed to suppress competition. [EPA-HQ-OAR-2014-0827-1222-A1 p.7]

The danger of impaired competition is even greater when regulations require the use of proprietary technologies. Complying with the proposed Phase 2 standards will require vehicle manufacturers to use a range of advanced technologies, discussed in detail in Chapter 2 of the RIA. In many cases these technologies appear to be proprietary. For example, the RIA discusses the effectiveness of SABIC Roof Fairing Technology<sup>16</sup> in reducing drag, but does not discuss the potential costs that can result when a regulation effectively requires the use of patented technologies,<sup>17</sup> leaving manufacturers at the mercy of the patent holder. The agencies seem unconcerned about the danger of creating mandated monopolies: “We are currently coordinating with SABIC [Saudi Arabia Basic Industries Corporation] on future efforts to determine feasibility and capability of this concept on additional areas of the tractor (e.g., bumper, hood, fuel tank/chassis skirt fairings, cab side extenders).”<sup>18</sup> The proposed standards appear to be dramatically increasing our dependence on proprietary intellectual property, even “as we take another big step to grow our economy and reduce America’s dependence on foreign oil.”<sup>19</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.7-8]

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16 RIA, p. 2-19.

17 “Saudi Basic Industries Corporation (SABIC) has passed the milestone of having more than 10,000 patents either issued or pending approval, making it the largest owner of intellectual property in the Middle East.” Arab News, “SABIC becomes region’s largest patent developer,” 13 June 2014. <http://www.arabnews.com/news/585811>

18 RIA, p. 2-20.

19 President's remarks.

**Organization:** Manufacturers of Emission Controls Association (MECA)

Technology development has a 15-20 year cycle from the lab to commercialization. This is why stringent standards are a critical signal to industry to make investments today for technologies that will be needed in the future. MECA members are engaged in developing a large portfolio of efficiency technologies that will directly or indirectly impact CO2 emissions. These technologies include advanced SCR catalysts, passive NOx adsorbers (PNA) and substrates, waste heat recovery, turbochargers, turbo-compounding, EGR coolers, EGR valves and other air management technologies, thermal management strategies including insulated dual wall manifolds and exhaust systems, active thermal management approaches, advanced fuel injection and ignition systems. Technologies, like turbo-compounding and advanced air management strategies are already being commercialized in Europe whereas others such as Rankine cycle systems and advanced high pressure injection, are under demonstration and technologies with still longer term horizons, such as thermoelectric generators are still in the laboratory. MECA members estimate that using the proposed Alternative 3, 2027 engine efficiency standards, some of these technologies, such as waste heat recovery, will fall significantly short of the penetration rates forecasted in the proposal. [EPA-HQ-OAR-2014-0827-1210-A3 p.2]

**Organization:** Meritor, Inc.

#### **Maintain Broad Regulatory Framework - Nationally and Internationally**

Meritor supports the proposed nationwide regulatory framework as demonstrated in Phase 1 and proposed for Phase 2. We encourage the agencies to resolve any open issues with state regulatory bodies to ensure a unified, national regulation. As a global company, we also encourage the agencies to take a leadership role and collaborate internationally so that the final regulation may harmonize with global actions that are proposed or already completed. Addressing the global issue of reducing greenhouse gas on a state-by-state or a country-by country level will contribute to proliferation which increases cost and requires that limited resources be dedicated to compliance rather than the pursuit of technologies that will further drive greenhouse gas reduction. Although we recognize the feasibility limitations of global regulatory standards, we encourage the agencies to continue efforts to commonize global regulation where possible. [EPA-HQ-OAR-2014-0827-1254-A1 p.2]

As noted in the April 2015 white paper from the International Council on Clean Transportation, "Heavy-Duty Vehicle Fuel Efficiency Simulation: A Comparison of U.S. and EU Tools," a key area for harmonization is the alignment of test procedures to quantify a technology's performance or efficiency benefit. For example, it would be ideal to conduct a single axle-efficiency test to create an input map for both the U.S. and EU regulatory models. [EPA-HQ-OAR-2014-0827-1254-A1 p.2]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Ensure Technology-Neutral, Performance-Based Standards** [EPA-HQ-OAR-2014-0827-1274-A1 p.3]

MEMA maintains that instituting technology-neutral, performance-based standards are the best way to ensure that the compliance targets are achieved by utilizing application-appropriate technologies and

concurrently preserving choice and avoiding unintended market shifts. In this manner, then the overall objectives of the Phase 2 program are not unintentionally compromised. Ultimately, the end goal of this regulation is to reduce emissions and to take the nation to a new level of clean air and energy independence. We believe that a technology-neutral approach is the ideal way to approach the standards. [EPA-HQ-OAR-2014-0827-1274-A1 p.3]

Not only would a technology- and performance-based approach be fair and equitable, but also it would establish regulatory consistency with elements of other emissions standards, enable the industry to develop the best available GHG emission reduction technologies and provide the intended CO<sub>2</sub> reduction in the most cost-effective, customer-friendly, and technology-neutral way. [EPA-HQ-OAR-2014-0827-1274-A1 p.4]

MEMA and the supplier industry are committed to policies that enable the introduction of new technologies needed to support sustainable mobility. The interconnectedness of the industry drives the need for consistent, long-term policies, regulations and standards so that all stakeholders can more effectively incorporate technologies into the nation's fleet. [EPA-HQ-OAR-2014-0827-1274-A1 p.12]

**Organization:** National Automobile Dealers Association (NADA)

The Phase 2 technology-forcing proposal does not fully recognize the complex and varied nature of commercial vehicle manufacturing, sales and ownership. For example, commercial purchasers often do not spec and purchase truck bodies and trailers from tractor and truck chassis manufacturers and their dealers, but rather from body and trailer manufacturers and dealers. Moreover, vehicle purchasers often spec engines and other major components from a variety of manufacturers with no single manufacturer having complete dominion over the finished product. Also, due to the prevalence of leasing (35-40 percent) and other commercial realities, operators often do not own and control the trucks, tractors, and trailers they operate. [EPA-HQ-OAR-2014-0827-1309-A1 p.5-6]

**Organization:** Schneider National Inc

Schneider strongly supports all efforts to improve the fuel efficiency of our vehicles. Our experience has shown this can best be done in a free market where customers and suppliers can work together to define the most fuel efficient vehicles available which meet the needs of the driver and the end customer. A realistic improvement goal for the supplier of equipment, with flexibility to deploy specific components where the overall total business benefit is positive, is strongly preferred. Regulations should promote adoption of cost-beneficial technologies, maintained by users, and that continue to generate positive environmental and total business results. Forcing technologies into industry applications for which there is no benefit will simply add to costs and the technology will not be sustained/maintained for its life. If the cost and operating risks are severe enough, purchasing cycles could be impacted with pre-buys to avoid unfavorable mandates. No one in the industry wants to alter purchasing cycles to postpone the consequences of a poor regulation, and we believe this should be avoided by promoting improvement with the flexibility to obtain efficient new vehicles which meet the many diverse and unique requirements of end users of the equipment. [EPA-HQ-OAR-2014-0827-1201-A1 p.4]

**Organization:** Truck & Engine Manufacturers Association (EMA)

While implementing the Phase 1 standards has been a formidable task, the Proposed Phase 2 Standards are more challenging in very fundamental ways. Phasing-in between 2021 and 2027 (starting in 2018 for trailers), the Proposed Standards for heavy-duty vehicles are truly "technology-forcing," relying on

technological advancements and improvements that have yet to be fully developed, demonstrated or commercialized. Consequently, there are many assumptions based on unproven technological advancements in fuel efficiency, and on uncertain adoption rates for those technological advancements, that form the foundation for the Proposed Phase 2 Standards. To the extent that those assumptions are wrong or over-estimated, compliance with certain of the Proposed Standards for heavy-duty vehicles will be infeasible. As a result, the GHG/FE Standards that EPA and NHTSA are proposing in Phase 2, which in their present form are infeasible and impractical for many categories of heavy-duty vehicles, are fundamentally different from what the many key stakeholders negotiated and consensed around in Phase 1. [EPA-HQ-OAR-2014-0827-1269-A1 p.3]

It is very important, therefore, that EPA and NHTSA recognize and acknowledge that the pending Phase 2 rulemaking is not simply a continuation of the Phase 1 rulemaking. More specifically, the Agencies will need to make significant and, in some cases, fundamental changes to their Phase 2 proposal in order to avoid the adoption of a number of infeasible and cost-prohibitive heavy-duty vehicle standards. Indeed, as explained below, without certain fundamental changes to the Phase 2 proposal, many of the projected improvements in vehicle fuel efficiency could remain theoretical only, and the primary outcome of this rulemaking could be significant disruptions in the manufacture and sale of medium-duty and heavy-duty on-highway vehicles, products that are quite literally the driving force behind this nation's economic welfare. That said, and as was the case with the development of the Phase 1 standards, EMA remains willing to work diligently with EPA and NHTSA to craft the revisions necessary to ensure a viable and successful Phase 2 program. [EPA-HQ-OAR-2014-0827-1269-A1 p.3]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

The existing proposal is overly complex and in our "Ways to Simplify/Streamline" section (9), we discuss a few ideas to modify it. [EPA-HQ-OAR-2014-0827-1172-A1 p.2]

**Organization:** Volvo Group

All, or nearly all, heavy-duty vehicles are purchased by businesses to perform services that support the business and enhance profits. In the largest market segment, Class 8 tractor-trailer rigs, fuel costs are a high percentage of the operating cost, creating a strong commercial incentive to minimize fuel use. Heavy-duty on-road vehicles cover a vast range of size, load capacity, and function. Examples include tractor-trailer rigs, dump trucks, concrete mixers, urban delivery, refuse collection, street sweepers, urban buses, motor coaches, and utility trucks. Vehicles are specified by customers, working with manufacturers, to serve the target application efficiently and cost-effectively. Tractor-trailers use the majority of fuel and deserve the greatest attention, but even in this segment there is huge variety with tractors designed to haul single box vans, multiple trailers, tankers, flatbeds, etc., and with load capacity ranging up to 120,000 lbs. and more. Purchasers often target their vehicles to operate in specific regions, accounting for terrain, speed, loading, and other variables in their specifications. Vehicles may need to get in and out of construction sites, mines, dumps, oil drilling sites, or other off-road situations. Manufacturers offer an enormous number of options to accommodate this vast array of customer requirements, including many engine ratings, transmission types, gearing options, axle ratios, axle combinations, tires, aerodynamic treatments, weight ratings, sleeper cabs, etc. All of these options impact fuel consumption and GHG emissions. [EPA-HQ-OAR-2014-0827-1290-A1 p.8]

No regulation can accommodate all these variables without considerable complexity. An enforceable regulation requires each vehicle to be assigned to a regulatory category or market segment that defines its regulatory duty cycle including load, speeds, road grades, trailer type (if applicable) and other operating parameters to assess performance. Proliferation of vehicle categories and duty cycles

increases the burden to determine which category is appropriate for any vehicle, to develop a representative duty cycle, and to establish regulatory targets based on appropriate technologies and penetration rates. In some cases a vehicle manufacturer builds a chassis for a body builder without knowing what the application will be, further frustrating the ability to segment vehicles into finer categories. [EPA-HQ-OAR-2014-0827-1290-A1 p.8]

Well-chosen regulatory duty cycles and load factors can approximate actual in-use performance for an average vehicle in a particular category, but cannot account for performance in any specific application. This creates two key issues. First, accurate characterization of duty cycles requires a large number of vehicle measurements in each vehicle category over an extended time period, a difficult task during an expedited rulemaking. Second, there must be adequate flexibility to design and specify vehicles for the intended function rather than the regulatory duty cycle. If these factors are not considered and accounted for, in-use operational efficiency and fuel consumption will be compromised, not improved. Ideally, the rule should be carefully crafted and tested to ensure that regulatory requirements translate to real world efficiency, and avoid unintended consequences. Volvo Group is concerned that the compressed schedule for adopting the GHG Phase 2 regulation has not allowed sufficient time to fully consider all of the factors at play in this rulemaking. In Europe, regulators are proposing to test their heavy-duty CO2 rule by requiring efficiency labelling for several years. This preliminary step offers manufacturers and regulators the opportunity to evaluate the testing and evaluation protocols, and to gain an understanding of the market efficiency baseline before setting limit levels. Unfortunately, it appears that the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) will move ahead on an arbitrary, compressed schedule, without market testing. [EPA-HQ-OAR-2014-0827-1290-A1 p.8]

It should be noted that the current (Phase 1) rule provides little guidance toward the Phase 2 rule. The Phase 1 rule governs only a few of the design parameters that impact efficiency, using an EPA devised “generic” engine and powertrain for each vehicle category rather than the components actually installed by the manufacturer. For vocational vehicles, the only variable considered in Phase 1 is rolling resistance of the tires. Even if there is a modicum of guidance available from Phase 1, it only became mandatory in 2014, which means that the August 2015 final reports for this first year were not available to inform the proposed rulemaking. [EPA-HQ-OAR-2014-0827-1290-A1 p.9]

Given the requirement for regulation enforceability, the expedited rulemaking schedule (although there may be some delay, President Obama announced a final rule to be completed by March, 2016), limited Agency resources and data, and the need to avoid an impossibly complex rule, the only practical way to avoid negative unintended consequences under the current rulemaking schedule is to set reasonable stringency targets that provide averaging margin to allow the best specification for each vehicle’s application, while still achieving the average target for the vehicle category. Appropriately, the EPA and NHTSA have attempted to do this by evaluating the effectiveness and optimal penetration level for each efficiency technology in each vehicle category. Even so, the effectiveness and market acceptance of many of these technologies as far as 15 years into the future is speculative and therefore unknown, and many of the targeted technology penetration rates are unrealistically high. [EPA-HQ-OAR-2014-0827-1290-A1 p.9]

The 2300 page draft NPRM and Regulatory Impact Analysis (RIA) underscores the huge complexity of the heavy-duty vehicle market and the difficulty in creating an appropriate regulation while avoiding unintended consequences that could actually degrade efficiency. EPA and NHTSA have made great effort to create effective measurements for GHG emissions and vehicle efficiency and to set stringency targets that force development and deployment of available technologies at a rate and cost that the

market will accept. There remain, however, many problematic elements that demand resolution if this rule is to be workable and effective. [EPA-HQ-OAR-2014-0827-1290-A1 p.9]

## UNINTENDED CONSEQUENCES

### Manufacturers Need Flexibility to Meet Application Requirements

A truck, tractor, or bus is only useful if it can efficiently perform its work at an acceptable cost. Efficient performance is not only measured in fuel consumption, but in time and cost to complete its mission, including all costs of ownership. If a vehicle does not have the features needed for efficient performance, it will not be purchased. Breakdowns, equipment damage, inadequate traction for any part of a mission, reduced load capacity, inadequate torque or power, inadequate ground clearance, poor drivability, and a host of other concerns must be considered when specifying each vehicle. Rule makers have the luxury to focus on a single desired outcome, but manufacturers must have flexibility to meet all requirements. This means many vehicles will not be able to utilize fuel efficiency features that the Agencies expect in a given vehicle segment. This is anticipated by the Agencies and AB&T (Averaging, Banking, and Trading) is provided to accommodate this need. But this is only effectual if target stringencies are based on realistic technology effectiveness and penetration rates that markets will accept while still meeting all operational requirements. If technology penetration rates exceed market acceptance due to mission requirements or cost, the customers will opt to maintain and rebuild existing vehicles to the detriment of regulator's objectives while causing potentially severe market and economic disruptions. [EPA-HQ-OAR-2014-0827-1290-A1 p.30]

Overly stringent expectations can actually lead to greater in-use fuel consumption if we are forced to specify vehicles optimized to Agencies' duty cycles rather than customer's requirements. For example, a truck set up with a lower axle ratio that is efficient at 65 mph may actually run a gear down if the customer typically runs at lower speed or sets his road speed limit at 62 mph, resulting in more fuel consumption than if the appropriate axle was specified. This issue is even more acute if the regulatory duty cycles do not match the typical in-use duty cycles, an issue further discussed in these comments. [EPA-HQ-OAR-2014-0827-1290-A1 p.30]

### Compromising Vehicle Utility

Given the previously stated concerns regarding inability to meet the standards with the Agencies assumed technology packages and penetration rates, the far reaching timeframe for the Phase 2 regulation, the uncertainty in the feasibility of the proposed technologies and their penetrations, and the expected increases in fuel economy and GHG performance measured on non-representative duty cycles that are still under revision, Volvo Group is concerned that the proposed regulation will force technologies that are not suited for the specific intended applications and duty cycles. One such example is expected penetration of Waste Heat Recovery on a highway tractor which could serve to limit aerodynamic performance due to increased cooling package size, as well as suitability for weight sensitive applications. If, forced to introduce this technology, OEMs could likely face pre-buy, no-buy, or delayed-buy effects, all of which would result in continued operation of old trucks and large scale rebuilding of older vehicles and engines. This again renders the proposal uncertain to accomplish its intended purpose. [EPA-HQ-OAR-2014-0827-1290-A1 p.31-32]

**Organization:** Walsh, Michael and Charlton, Stephen

A stated goal of the Phase 2 GHG rule for Medium and Heavy-Duty Engines and Vehicles is to be 'technology advancing' over the lifetime of the rule, i.e. through 2027 – in response to the President's

directive on February 18, 2014 [13]. Such a goal makes sense in light of the climate crisis we are facing and is consistent with the technology forcing nature of the Clean Air Act. [NHTSA-2014-0132-0102-A1 p.10]

This analysis finds the agencies to be overly conservative in their assessment of technology effectiveness, cost / retail price and adoption rates, which is reflected in the very modest HD tractor engine standards proposed. [NHTSA-2014-0132-0102-A1 p.10]

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13 “FACT SHEET: Opportunity For All: Improving the Fuel Efficiency of American Trucks – Bolstering Energy Security, Cutting Carbon Pollution, Saving Money and Supporting Manufacturing Innovation”, The White House, Office of the Press Secretary, February 18, 2014.

**Organization:** Waste Management (WM)

In particular, we support the Agencies developing a Phase 2 rule that builds on the success of the Phase 1 rule, which minimized compliance burdens on end-users and provided compliance flexibilities for regulated original equipment manufacturers (OEMs). WM also strongly supports a final Phase 2 rule that maintains market, fleet, fuel and technology choices for end users. Phase 2 can provide advances in GHG reductions and fuel efficiency without restricting our choice of product specifications or technologies needed to conduct our refuse collection services. [EPA-HQ-OAR-2014-0827-1214-A2 p.2]

EPA and NHSTA have Appropriately Proposed a Fuel-Neutral Vehicle Emission Program

The regulatory framework adopted by EPA and NHTSA establishes a vehicle emission program that is fuel-neutral. In EPA’s Denial of the Petition To Reconsider the Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (77 FR 51705), EPA discusses the fundamental premise of a fuel-neutral vehicle standard. [EPA-HQ-OAR-2014-0827-1214-A2 p.3-4]

“The Phase 1 rules comprise a coordinated and comprehensive Heavy-Duty National Program designed to address the urgent and closely intertwined challenges of reduction of dependence on oil, achievement of energy security, and amelioration of global climate change.” EPA further explained, “A further reason this heavy-duty rule does not regulate GHG emissions from a lifecycle perspective, ... is that it would no longer be possible to establish harmonized, performance-based tailpipe GHG emissions standards (EPA) and fuel efficiency standards (NHTSA). [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

**Organization:** Werner Enterprises

Additional concerns within the proposal include the technology-forcing standards for both the engine and the vehicle that affect 2021, 2024, and 2027 model year vehicles and engines. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

There are several key areas the Agencies need to address: [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

- Unproven technologies with too many associated unknowns should not be included in this rule. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

- Accurately reflect operators' total cost of ownership, and provide realistic targets in a realistic timeframe. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

Ultimately, the manner in which Phase 2 is implemented will decide the success and failure of this rule. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

**Response:**

The commenters make numerous suggestions as to the regulatory framework and guiding principles that a final Phase 2 program should follow. As discussed in Section I of the Preamble, the agencies set standards based on our respective authorities and have certain statutory considerations to take into account when determining feasibility of the final program. EPA's HD Phase 2 GHG emission standards are authorized under the Clean Air Act, and NHTSA's HD Phase 2 fuel consumption standards are authorized under the Energy Independence and Security Act of 2007. The agencies are adopting these standards because, based on the information available at this time and careful consideration of all comments, we believe they best fulfill our respective statutory authorities when considered in the context of available technology, feasible reductions of emissions and fuel consumption, costs, lead time, safety, and other relevant factors.

We agree with the commenters on the importance of basing the structure of the Phase 2 program on the existing Phase 1 standards, and we have continued to do so for the final standards. The Phase 2 standards will maintain the underlying regulatory structure developed in the Phase 1 program, such as the general categorization of MDVs and HDVs and the separate standards for vehicles and engines. Also like the Phase 1 program, we are applying the Phase 2 standards in a manner that is fuel neutral (See Preamble Section I for further discussion).

The Diesel Technology Forum commented that the "program must be fuel neutral in nature." Although we see many positive features of fuel-neutrality, we recognize that they must be balanced against other important market factors. We believe that continuing the Phase 1 approach appropriately balances these factors.

Many commenters stressed the importance of flexibility. The Phase 2 standards are performance-based, meaning that the industry will have a significant range of technology choices to be considered for compliance, rather than the one or two new technologies the OEMs pursued to comply with EPA's 2007 criteria pollutant standard. It is important to emphasize here that the agencies are generally not mandating the use of a specific technology to meet the Phase 2 standards, rather manufacturers would be able to choose the technologies, or combinations of technologies, that are best for them in achieving the standards.<sup>25</sup> In emphasizing the need for flexibility, commenters raised concerns about market disruptions. As discussed further in Preamble Section I, the agencies have considered the possibility of market disruptions (e.g., we understand the potential impact that fleets pulling ahead purchases can have on American manufacturing and labor, dealerships, truck purchasers, and on the program's environmental and fuel savings goals), and we have taken steps in the design of the program to avoid such disruption. These steps include the following:

- Providing considerable lead time
- Adopting standards that will result in significantly lower operating costs for vehicle owners (unlike the 2007 standard, which increased operating costs)
- Phasing in the standards

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<sup>25</sup> The one exception to this general rule is the category of non-box trailers which have simple design standards.



- Structuring the program so the industry will have a significant range of technology choices to be considered for compliance
- Allowing manufacturers to use emissions averaging, banking and trading to phase in the technology even further

Commenters have varying views about how technology-advancing (or technology-forcing) the standards should be: some commenters arguing that the standards go too far and rely too much on “unproven” technologies, while others argue that the standards do not go far enough and should further “force” more advanced technology. As discussed in Preamble Section I, the Phase 2 standards represent a more technology-forcing approach than the Phase 1 approach, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. The agencies are adopting standards for MY 2027 that we project will require manufacturers to make extensive use of these technologies. The standards increase in stringency incrementally beginning in MY 2018 for trailers and in MY 2021 for other segments, ensuring steady improvement to the MY 2027 stringency levels. For existing technologies and technologies in the final stages of development, we project that manufacturers will likely apply them to nearly all vehicles, excluding those specific vehicles with applications or uses that prevent the technology from functioning properly. We also project as one possible compliance pathway that manufacturers could apply other more advanced technologies such as hybrids and waste engine heat recovery systems, although at lower application rates than the more conventional technologies. To the extent that commenters provided technical information on their specific technologies, we address these comments in the appropriate sections of the Preamble, the RIA, and this Response to Comment document.

With respect to the Daimler’s comment that we “should not require powertrain testing nor premise standards on a significant amount of powertrain testing” we note that the final standards are premised on less powertrain testing than the proposed standards. Nevertheless, we do not agree that “selectable dropdown fuel efficiency features” are inherently preferable to powertrain testing.

Finally, Volvo identified many issues to emphasize the complexity of the HD Phase 2 program and underscore the potential for unintended consequences. We have considered these factors, most of which were discussed in the NPRM or are addressed in more detail in other sections of this RTC. Nevertheless, the agencies will monitor the implementation of this program and would take appropriate action that would be necessary to avoid these unintended consequences.

## 1.8 Basing Standards on Life Cycle Analysis<sup>283</sup>

**Organization:** American Iron and Steel Institute

In this regard, AISI has previously filed comments with respect to the Model Year ('MY') 2012-2016 Light-Duty Vehicle Greenhouse Gas Rule and the MY 2017 and Later Light -Duty Vehicle Greenhouse Gas Rule. Our comments concerning this Proposed Rule center on some of the same concerns that we have previously expressed, namely that the Environmental Protection Agency ('EPA') and the National Highway Traffic Safety Administration ('NHTSA') more accurately take into account the greenhouse gas ('GHG') emissions associated with vehicles and engines, specifically life cycle emissions associated with the use of various materials in vehicle and engine manufacturing. Our comments with respect to the Proposed Rule, however, take on added importance regarding the agencies' new effort to promulgate medium- and heavy-duty standards, which will be implemented over the next decade. EPA and NHTSA must make every effort in such a long-term rule to address important structural issues in how GHG emissions and fuel efficiency are measured. We do not believe that EPA and NHTSA can maintain a 'wait and see' approach to life cycle analysis. Doing so undermines both the accuracy and legal basis for this rulemaking. [EPA-HQ-OAR-2014-0827-1275-A1 p.1-2]

## **A. Life Cycle Analysis of Materials Will Provide More Accurate Assessment of Vehicle GHG Impacts and Improve GHG Benefits of Final Rule**

The Proposed Rule represents a 'more technology-forcing approach' than Phase I standards. Specifically, it 'will effectively require manufacturers to develop new technologies (or to significantly improve technologies) from standards that can be met using off-the-shelf technology alone.' According to EPA analysis, fully-phased in standards will result in 24 percent lower carbon dioxide ('CO<sub>2</sub>') emissions for Class 7 and 8 combination tractors and a 16 percent CO<sub>2</sub> reduction from Phase I for vocational vehicles.<sup>24</sup> Total GHG reductions from the program are estimated at 1 billion metric tons. [EPA-HQ-OAR-2014-0827-1275-A1 p.9]

Emissions from steel manufacturing are substantially lower than alternative materials used in motor vehicles.<sup>26</sup> Within the context of the Proposed Rule - which contains interim standards in MY 2021 and MY 2024 and extends through MY 2027 -EPA must incorporate life cycle analysis and not 'lock in' vehicle material choices for the next decade. While current vehicle CO<sub>2</sub> emissions are dominated by the utilization of the vehicle, as GHG and fuel efficiency standards for medium- and heavy-duty vehicles are implemented with increasing stringency, the balance between emissions associated with materials versus driving will shift and selection of materials will become increasingly important. EPA should not ignore this evolving opportunity to increase, and not unintentionally decrease, the projected benefits of the final rule. [EPA-HQ-OAR-2014-0827-1275-A1 p.9-10]

Within the LDV sector, production phase GHG emissions can account for about 40% of total CO<sub>2</sub> emissions from a vehicle.<sup>28</sup> It has also been estimated that the percentage of such emissions could rise to 50% by 2020. Since the LDV sector is defined in terms of 8,500 lbs. Gross Vehicle Weight Rating ('GVWR') and below, the relative GHG emission reductions associated with vehicles in medium- and heavy-duty sector, with range from 8,500 to over 60,000 GVWR will be comparatively greater based on weight. Even accounting for the greater utilization of commercial versus personal LDVs, significant reductions in GHGs could be expected by influencing the selection of materials in vehicle construction. [EPA-HQ-OAR-2014-0827-1275-A1 p.10]

In general, heavy-duty trucks are limited with respect to payload because of road restrictions. Therefore, if a truck weighs less, it is able to carry additional payload (in most situations), while the total weight of the vehicle remains the same. Since more payload is able to be transported per vehicle, benefits are created with respect to reducing the number of trips that are required to engage in the same commercial activity. This results in a direct benefit in terms of overall GHG emissions. The resulting benefit is correspondingly greater in city driving and stop/start performance. Since reduction in mass is central to this benefit, EPA and NHTSA must more accurately assess the GHG emissions associated with the reduction in mass, namely through utilization of life cycle analysis. [EPA-HQ-OAR-2014-0827-1275-A1 p.10]

Methodologies to incorporate life cycle emissions into the regulatory structure of this rulemaking are available and would improve the accuracy of EPA's assessment of a vehicle's GHG emissions. In this regard, Ricardo has examined the feasibility of considering a vehicle's entire life cycle to be able to compare the impact of different LDVs.<sup>30</sup> While this assessment recognized that there are indeed strengths to the current system of testing and certifying vehicles over a defined drive cycle, the report noted multiple limitations to this regulatory system, including the lack of measurement of emissions upstream of vehicle use where the strong influence of the carbon intensity of material can be quantified. [EPA-HQ-OAR-2014-0827-1275-A1 p.11]

24 EPA and NHTSA Proposed Standards to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Vehicles for Model Year 2018 and Beyond, EPA-420-F-15901, June 2015.

26 Incorporating Life Cycle Principles in Vehicle Regulations, Jody Shaw, U.S. Steel, Great Designs in Steel Conference, July 27, 2011. Attachment B.

28 Comparative LCA Model, Roland Geyer, University of California at Santa Barbara (download from <http://www.worldautosteel.org/Projects/LCA-Study/2010-UCSB-model.aspx>).

30 Preparing for a Life Cycle CO2 Measure, Ricardo, May 20, 2011.

**Organization:** American Iron and Steel Institute

EPA and NHTSA have statutory authority to incorporate life cycle analysis into GHG emission and fuel efficiency standards. To the extent either agency may believe it is legally constrained in this area, past practice would allow either agency to 'conform' its final standards to those promulgated by the other agency. [EPA-HQ-OAR-2014-0827-1275-A1 p.2]

If EPA and NHTSA believe that there is insufficient information in the Proposed Rule to incorporate life cycle analysis in a final rule, there are several administrative alternatives to correct this situation. The agencies have authority to issue supplemental rules or a Notice of Data Availability ('NODA'). In the alternative, a 'look-back' mechanism could be incorporated into the final rule that would allow for future integration of such analysis. [EPA-HQ-OAR-2014-0827-1275-A1 p.3]

### **III. EPA and NHTSA Should Incorporate Life cycle Analysis into Phase 2 HD Standards**

AISI has previously submitted comments and detailed information with respect to life cycle analysis in EPA/NHTSA vehicle rulemakings and other agency interactions. Some of this information is attached and submitted to the docket for the agencies' further consideration in this rulemaking, including recent WorldAutoSteel studies.<sup>15</sup> We respectfully request that the agencies thoroughly review this information and engage AISI if there are questions concerning study methods or results.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.7]

To date, however, the agencies have only provided summary responses to AISI's comments in this area<sup>17</sup> and, within the Proposed Rule, EPA and NHTSA are now specifying 'that Phase 2 standards apply exclusively at the vehicle tailpipe . . . compliance is based on vehicle fuel consumption and GHG emission reductions, and does not reflect so-called life cycle emission properties.' EPA and NHTSA, however, should reconsider this course of action for several legal and policy reasons, including improving the accuracy and reliability of its regulation in this area and the opportunity to secure additional improvements in GHG emissions and fuel efficiency. Indeed, given the lengthy phase-in of new medium- and heavy-duty regulations over the next 12 years, the Proposed Rule provides a perfect opportunity for the agencies to incorporate life cycle analysis into the final standards. The long timeframe of the rule would allow the market to respond and better incorporate material selection into their compliance strategies. Moreover, there are existing GHG emissions measurement models and several different regulatory methods that can be utilized, including phase-in of such analysis or supplementary rulemaking that would provide additional adjustment to the GEM utilized in this rulemaking. [EPA-HQ-OAR-2014-0827-1275-A1 p.7-8]

The National Research Council has recognized that EPA and NHTSA should address 'well to wheel GHG and petroleum reduction benefits' with respect to light duty alternative- fueled vehicles.<sup>19</sup> In its report regarding light-duty vehicle technologies, the council noted that starting in MY 2020, EPA and NHTSA will utilize data with respect to the actual use of alternative fuel in such vehicles. The intent of this change in regulatory policy is abundantly clear: emission benefits in alternative-fueled vehicles are only achieved if the vehicles are utilizing fuel which contains fewer upstream GHG emissions, i.e., the GHG emissions associated with the production of alternative fuels versus 'conventional' fuels such as gasoline and diesel. The same concept applies with respect to vehicle materials: the benefit of weight reductions can only be accurately measured if the full life cycle of the materials are considered. Without consideration of such upstream GHG emissions, EPA and NHTSA estimates of the resulting benefits of this rulemaking will be inaccurate as well as any standards premised on such estimates.<sup>21</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.8]

Similarly, the Department of Energy ('DOE') has considered the relevance of 'well to wheels' assessment related to different types of fuel as part of its 21st Century Truck Partnership. Particularly regarding natural gas vehicles, DOE noted that 'Natural gas based fuels for heavy-duty vehicle applications are of importance to the [21st Century Truck Partnership]. Several recent U.S. studies have examined the impacts of shale gas and conventional [natural gas] production, so any effort to examine these fuels should build on this work.' Again, since the focus of this analysis is with respect to upstream production of fuel utilized in vehicles, there is no logical distinction between considering such emissions and those associated with the life cycle emissions attributable to the materials utilized in vehicle production. [EPA-HQ-OAR-2014-0827-1275-A1 p.9]

The agencies' discussion of life cycle analysis in the Preamble along with the review and solicitation of comment on using such analysis with respect to natural gas vehicles forms a basis under which the agencies could finalize a broader use of life cycle analysis for materials in the final rule. [EPA-HQ-OAR-2014-0827-1275-A1 p.18]

In the alternative, the agencies could solicit additional comment on the broader use of life cycle analysis of vehicle materials and components, either in a supplemental rule or NODA to this rule. If this course is taken, we would request that this procedure occur in a timeframe so as to allow incorporation of life cycle analysis prior to the implementation of the new GHG and fuel efficiency standards established by this rulemaking. [EPA-HQ-OAR-2014-0827-1275-A1 p.18]

AISI previously submitted draft regulatory language to create a life cycle assessment report in the context of the LDV rule. Regarding this rulemaking, EPA and NHTSA should incorporate a regulatory provision that creates an advisory board to assess current information on life cycle analysis of materials and then require subsequent action to revise the GHG and fuel efficiency standards applicable to in-use heavy duty vehicles beginning in MY 2021 and 2024. Draft regulatory language to accomplish this result is attached to these comments.<sup>57</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.19]

The long-term nature of this rulemaking means that accuracy of GHG emission reduction estimates and the mechanisms by which the agencies seek to achieve GHG reductions and improvements in fuel efficiency must be improved. This rulemaking is the appropriate time to incorporate life cycle analysis since it would improve the data utilized in GEM to project vehicle emissions and to certify vehicles. As EPA and NHTSA seek to reduce emissions and improve fuel efficiency, the relative amount of materials-related emissions will grow. It would be arbitrary and capricious for EPA to ignore such a long-term condition, which threatens the accuracy of its estimates of the benefits of this rulemaking as well as the accuracy of its compliance mechanism. While the agencies have broad statutory criteria under which to establish final standards, administrative discretion is not unlimited. Continuing to ignore

life cycle analysis or delay its consideration could undermine the rational basis of this rulemaking and lead to the unintended consequence of increasing emissions. [EPA-HQ-OAR-2014-0827-1275-A1 p.19]

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15 See Attachment A.

16 While EPA, like other parts of the Executive Branch, is not required to 'discuss every item of fact or opinion included in the submissions is receives in response to a Notice of Proposed Rulemaking, it must respond to those comments which, if true, would require a change in [the] proposed rule. Louisiana Federal Land Back Association, *FCLA v. Farm Credit Administration*, 336 F. 3d 1075, 1080 (D.C. Cir. 2003). See also *Delaware Department of Natural Resources and Environmental Control v. EPA*, Slip op. 13-1093 (D.C. Cir. 2015). 'Naturally, an agency need not 'discuss every item of fact or opinion included in the submissions made to it.' *Pub. Citizen, Inc. v. FAA*, 988 F. 2d 186, 197 (D.C. Cir 1993) . . . But an agency must respond sufficiently to 'enable us to see what major issues of policy were ventilated . . . and why the agency reacted to them as it did.' *Id.* at 24.

17 See 2017 and Later Model Year Light Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards: EPA Response to Comments, Section 14, Treatment of Life-Cycle Emissions Related to Vehicle Manufacturing, August 2012 at 14-1921.

19 Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles, National Research Council, Recommendation 10.6.

21 To the extent EPA and NHTSA might treat such emissions as a 'credit' versus a direct part of the calculation of emission standards applicable to vehicles is of no matter. The consideration of weight based on different material use serves as a compliance mechanism for the standards and is integral to the implementation of the final heavy-duty GHG requirements. Thus, if this credit is inaccurately measured due to the failure to consider the life cycle impact of various materials, the regulatory requirements of the final rule are negatively affected.

57 See Attachment K; EPA-HQ-OAR-2014-0827-1275-A12 In the event that EPA and NHTSA do not directly incorporate life cycle analysis into the final rule, we request that EPA and NHTSA incorporate this review mechanism into the rule

**Organization:** American Iron and Steel Institute

### **The Clean Air Act Allows for Life Cycle Analysis**

EPA cites Clean Air Act ('CAA') Sections 202(a), 203 and 207 as authority for this rulemaking. Under CAA Section 202(a), EPA is required to promulgate regulatory standards for 'any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines' which are considered to cause or contribute to air pollution that 'may reasonably be anticipated to endanger public health or welfare.' EPA has previously taken an expansive view of this authority.<sup>4</sup> In this rulemaking, EPA addresses arguments that it cannot regulate trailers since they do not emit pollutants and therefore cannot be subject to emission standards. EPA considers this argument 'without legal predicate' and states that '[t]here is no requirement that pollutants be emitted from a specified part of the motor vehicle or engine.' This interpretation of its authority applies equally to life cycle analysis. [EPA-HQ-OAR-2014-0827-1275-A1 p.3-4]

Historically, EPA has not considered itself to be constrained to one particular regulatory approach in addressing engine and vehicle emissions. For example, EPA's current Light-Duty Vehicle ('LDV') rules utilize a mathematical curve-based computer modeling of 'feasible' levels of emissions relative to the footprint of a vehicle. Many other engine and vehicle programs allow for fleet averaging and emission credits to be generated and used, rather than standards applied solely on the basis of contemporaneous emissions. Therefore, it is abundantly clear that EPA does not believe the CAA limits the agency to promulgate only traditional 'tailpipe' standards that rely on the direct measurement of air pollution. [EPA-HQ-OAR-2014-0827-1275-A1 p.4]

EPA has, in fact, made previous statements that it does possess the authority to utilize life cycle emissions as part of engine and vehicle regulations. Within the Response to Comments document for the MY 2012-2016 LDV rule, EPA indicated that the agency 'agree[d] that the issue of life cycle emissions accounting may be appropriate to consider for subsequent rulemakings.'<sup>6</sup> In addition, EPA believes it can advance different policy objectives through its engine and vehicle rulemakings. In the MY 2012-2014 LDV rulemaking, for example, EPA indicated using a vehicle's footprint as part of its regulatory standard would minimize incentives to 'downsize' vehicles as a compliance strategy. Thus, it would be reasonable to conclude that EPA considers the authority Congress granted to it within Title II of the CAA and CAA Section 202 specifically, to encompass an ability to incorporate life cycle analysis into motor vehicle regulatory standards. [EPA-HQ-OAR-2014-0827-1275-A1 p.4]

### **C. EPA's Denial of Petition for Reconsideration on Fuels Does Not Impact Life Cycle Analysis Based on Materials**

In support of its decision to utilize tailpipe standards and not to propose standards that 'reflect any so-called life cycle emission properties,' EPA cites its denial of a petition for reconsideration from POP Diesel with respect to the MY 2014-2018 medium- and heavy-duty GHG rule. But EPA's rationale in denying the POP Diesel petition has no bearing on the use of life cycle analysis with respect to materials in this rulemaking. Instead, EPA's denial was focused on the existence of other programs that already control GHGs from fuels, i.e., the renewable fuel standard contained in CAA Section 211(o). Clearly, there is no corollary program regarding the life cycle analysis of materials within the statutory authorities cited for this rulemaking. Otherwise, EPA's denial of the POP Diesel petition was largely on procedural grounds - on that the basis of their petition for reconsideration did not, in fact, occur after the period for public comment had closed. Since we are currently in the rulemaking process itself, this rationale is also inapplicable to incorporating life cycle analysis of materials. [EPA-HQ-OAR-2014-0827-1275-A1 p.14]

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4 For example, in the proposed rule for light-duty greenhouse gas standards for MY 2012-2016 EPA stated that Title II of the CAA provides for 'comprehensive regulation of mobile sources' and that the title offers 'sweeping grants of authority' that allow the Agency to consider numerous factors including technological effectiveness, the impact of standards on oil conservation and energy security and other energy impacts. 79 Fed. Reg. at 49,454.

6 'Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards EPA Response to Comments Document for Joint Rulemaking,' Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-R-10-012aEPA-420-R-10-012a, April 2010 at. 4-16. (Emphasis added).

**Organization:** California Air Resources Board (CARB)

**Support/Comment on Topic Where NPRM Requests Comment**

### **Comment – Upstream emissions/deemed zero language for BEVs**

Like the Phase 1 standards, Phase 2 standards are based on tailpipe emissions. Because the expected penetration of BEVs is low, U.S. EPA and NHTSA propose to continue to treat BEVs as if they have zero emissions of CO<sub>2</sub>, methane, and nitrous oxide (N<sub>2</sub>O) without accounting for upstream emissions from charging. The NPRM specifically requests comment on this continued use of deemed zero language for EVs. While there are clearly emissions associated with power production to charge medium- and heavy-duty EVs, emissions associated with producing a kW of power are declining, and medium- and heavy-duty BEVs currently comprise a small portion of the fleet that the emissions associated with charging the vehicles is comparatively insignificant. [EPA-HQ-OAR-2014-0827-1265-A1 p.99]

The 2017 to 2025 MY light-duty vehicle GHG rule includes a cap whereby upstream NHTSA believe such a cap is not needed for medium- and heavy-duty BEVs due to their anticipated low likelihood of significant production volumes in the Phase 2 timeframe. CARB staff agrees such a cap need not be included in this regulation at this time. CARB staff believes a different regulatory structure for the likely small number of anticipated vehicles would put an extra burden on manufacturers and would not result in significant emission reductions. [EPA-HQ-OAR-2014-0827-1265-A1 p.99-100]

**Organization:** Cummins, Inc.

*Cummins supports the Agencies' proposal for GHG/FE compliance based on tailpipe emissions, not lifecycle emissions* [EPA-HQ-OAR-2014-0827-1298-A1 p.41]

Cummins supports the proposal that Phase 2 GHG/FE compliance is based on tailpipe emissions. As stated in the Preamble (80 FR 40503), this approach allows for fuel neutral standards and maintains a unified program between EPA and NHTSA, so the tailpipe approach should continue in Phase 2. [EPA-HQ-OAR-2014-0827-1298-A1 p.41]

**Organization:** National Biodiesel Board

4) EPA and NHTSA Properly Focus on Tailpipe Emissions Rather than Lifecycle Emissions. [EPA-HQ-OAR-2014-0827-1240-A1 p.11]

EPA and NHTSA are proposing that the Phase 2 standards apply exclusively at the vehicle tailpipe. 80 Fed. Reg. at 40,158-40,159. In other words, “compliance is based on vehicle fuel consumption and GHG emission reductions, and does not reflect any so-called lifecycle emission properties.” Id. at 40,159. NBB agrees that the agencies should not seek to undertake a separate analysis of lifecycle emissions here. 77 Fed. Reg. at 62,823. Indeed, the lifecycle analysis utilized by EPA for the RFS cannot assess actual emissions and should not be applied here.<sup>13</sup> [EPA-HQ-OAR-2014-0827-1240-A1 p.11]

13 In the RFS rulemaking, EPA rejected inclusion of a global rebound effect in assessing emissions. See EPA Response to Clean Air Taskforce, World Wildlife Fund, National Wildlife Federation, and Friends of the Earth's Petitions for Reconsideration of the Renewable Fuel Standards (RFS2) (2011), available at <http://www2.epa.gov/sites/production/files/2015-08/documents/rfs-response-to-petitions-02-17-11.pdf>. NBB believes such analysis is speculative and unnecessary in light of the GHG emission reductions and energy security goals of the proposal.

**Organization:** Waste Management (WM)

As discussed throughout the final rule, close coordination in this first heavy-duty rule enabled EPA and NHTSA to promulgate complementary standards that appropriately allow manufacturers to build one set of vehicles to comply with both agencies' regulations." WM, therefore, strongly recommends the Agencies abstain from incorporating lifecycle GHG emissions accounting in the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

## **WM Supports the Adoption of Tailpipe-based GHG and Fuel Efficiency Standards**

### **I. Executive Summary**

Electricity as a transportation fuel offers significant long-term environmental benefits. Increased deployment of medium- and heavy-duty PEVs will both increase fuel efficiency and reduce emissions of GHGs and criteria pollutants from the transportation sector. These environmental benefits will only be multiplied by the continued reductions in upstream emissions of both GHGs and criteria pollutants related to the generation of electricity that will fuel the PEVs. [EPA-HQ-OAR-2014-0827-1327-A2 p.3-4]

EI strongly supports the EPA's and NHTSA's decision to apply the proposed Phase 2 standards exclusively at the tailpipe. Consistent with Phase 1, the agencies correctly recognize that EVs emit 0.0 g/mile, for both GHG emissions and criteria pollutants, and therefore assess emissions and fuel economy appropriately. For purposes of compliance with vehicle emissions or fuel efficiency standards, any assessment of emissions should continue to be confined to the tailpipe and should not include estimated upstream emissions. However, should EPA and NHTSA determine that a review of upstream emissions for the Phase 2 Program, or in other future rulemakings, any such assessment must be fair, assessing the upstream national and/or international emissions of all transportation fuels (conventional and PEVs), and it must be based on current data with a clear recognition of regulatory developments that address and limit those stationary emissions sources. [EPA-HQ-OAR-2014-0827-1327-A2 p.4]

### **A. Tailpipe Emissions From Electric Vehicles Are Zero and the Phase 2 Program Correctly Focuses on Tailpipe Emissions**

As a preliminary matter, EI strongly supports the EPA's and NHTSA's decision to apply the proposed Phase 2 Program standards for medium- and heavy- duty engines and vehicles exclusively at the vehicle tailpipe.<sup>15</sup> As proposed, the Phase 2 Program standards correctly focus compliance on vehicle fuel consumption and GHG emission reductions. Similar to the Phase 1 Program, the agencies appropriately recognize that EVs emit 0.0 g/mile, for both GHG emissions and criteria pollutant emissions.<sup>16</sup> For purposes of compliance with vehicle emissions or fuel economy standards, any assessment of emissions should continue to be confined to tailpipe emissions (consistent with past EPA practice under Title II of the Clean Air Act) and should not include estimated upstream emissions.<sup>17</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.7-8]

Consistent with the Phase 1 Program, and unlike the 2017-2025 light-duty standards, the agencies appropriately do not propose a "cap" for the technically accurate application of the 0.0 g/mile standard for heavy duty EVs. In the proposed rule, however, EPA and NHTSA state that this is "because of the small likelihood of significant production of EV technologies in the Phase 2 timeframe."<sup>18</sup> All EVs should be judged on their actual tailpipe emissions, which are 0.0 g/mile. [EPA-HQ-OAR-2014-0827-1327-A2 p.8]



**B. If Assessed At All, Estimated Upstream Emissions Should Be Calculated Using Recent, Accurate Data and Should Recognize Current and Future Regulations that Limit These Emissions**

While EPA and NHTSA propose to measure compliance with the proposed Phase 2 Program standards at the tailpipe, the agencies have specifically requested comment on this issue.<sup>19</sup> This request appears to be aimed at concerns relating to upstream emissions—those emissions related to the production and delivery of transportation fuels. As a general matter, and consistent with the approach proposed for the Phase 2 Program, vehicle emissions standards should focus on actual vehicle emissions. However, should EPA and NHTSA determine that it is appropriate to assess upstream emissions for EVs, this assessment must be fair—it must assess the upstream impacts of all transportation fuels<sup>20</sup>—and its must be based on current data (national and international) and recognize regulatory developments that address and limit upstream emissions. [EPA-HQ-OAR-2014-0827-1327-A2 p.8]

With respect to EVs, the agencies have not included any analysis or discussion of the upstream emissions related to electricity as a transportation fuel. However, the proposed Phase 2 Program makes unsubstantiated statements about the environmental benefits of EVs that appear to be related to concerns about estimated upstream emissions from electricity production. For example, in discussing possible compliance flexibilities and incentives for heavy duty (HD) pickups and vans, EPA states that incentives for EVs “would result in reduced benefits in terms of CO2 emissions...due to the Phase 2 Program.”<sup>21</sup> As EV deployment would reduce emissions from vehicle tailpipes, it can only be assumed that this statement reflects concerns about upstream electricity emissions. [EPA-HQ-OAR-2014-0827-1327-A2 p.9]

As discussed in the proposed rule, back in 2010, NHTSA and EPA issued a joint final rule that established CAFE and GHG standards for passenger cars and light trucks for MY 2017-2025.<sup>22</sup> As part of that rule, EPA conducted an assessment of upstream emissions from electricity generation and determined that it would only use the technically correct emissions value of 0.0 grams/mile for a limited number of EVs sold per manufacturer. In support of this position, and based on outdated data from 2005, EPA calculated a nationwide average electricity upstream GHG emissions rate. Using this national annualized average, EPA came to the spurious conclusion that “actual” GHG emissions attributable to EVs exceed the GHG emission of conventional fuel vehicles.<sup>23</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.9]

As the agencies have not provided any discussion related to upstream electricity emissions in this docket, EPA and NHTSA may be continuing to rely on this outdated analysis. However, in the draft EIS for the vehicle standards for passenger vehicles and trucks for model years 2022-2025, which was released in 2012, NHTSA found that “even in modeled scenarios in which EVs charge from a carbon-intensive grid mix (i.e., electricity generated mostly from coal plants), the vehicle life-cycle emissions from EVs are less than conventional gasoline vehicles.” Draft EIS at 6-22. At a minimum, it is unclear why the agencies are not using their own, more recent assessments of upstream emissions from EVs and the potential for EVs to reduce emissions. Moreover, it is inappropriate to rely on EPA’s 2010 analysis of upstream emissions related to electricity production because it is flawed, outdated and does not consider significant regulatory developments that will further reduce both GHG and criteria pollutant emissions from the electric sector. [EPA-HQ-OAR-2014-0827-1327-A2 p.10]

First, EPA’s creation and use of a national annualized average electricity upstream GHG emissions rate fails to account for significant regional differences in electricity generation. National averages cannot help the agencies estimate any localized or regional impacts of potential increased penetration of PEVs. Emissions associated with generation of electricity vary significantly from utility to utility—with nuclear, wind, solar, geothermal, and hydroelectric powered sources emitting very low or no GHGs or

criteria air pollutants in varying degrees across the country. Any meaningful estimates of upstream emissions associated with electricity as a transportation fuel would need to be tailored not only to reflect regional variations in current electricity baseload generation and expectations for marginal electricity generation mix, but also assumptions about usage and recharging of the vehicle as well as state/regional/federal electric generation policies (such as state Renewable Electricity Standard (RES) requirements) and state/regional/federal GHG emissions limits and reductions programs (*e.g.*, California's A.B. 32, the New England Regional Greenhouse Gas Initiative, and the federal CAA). For example, the timing of recharging patterns is highly significant because if, as expected, PEVs are largely charged at night, they will be charged at a time when nuclear, wind, and other clean sources provide perhaps the highest contribution to our electricity generation mix, depending on the region. Appropriate consideration of these regional variations and usage rates represent an integral step in producing a full and fair analysis of the upstream emissions for PEVs. [EPA-HQ-OAR-2014-0827-1327-A2 p.10]

Another significant flaw in the prior analysis lies in the utilization of historic and not projected data on power plant emissions. For example, according to the Energy Information Agency (EIA), total carbon dioxide emissions from electric generation were 10.8 percent lower in 2009 and 14.6 percent lower in 2013 respectively, when compared to the 2005 data relied upon for standards that will be in effect through 2025.<sup>24</sup> As a result, historic data cannot be viewed as a reasonable proxy for expected emissions 10 plus years into the future. Any analysis that fails to use projected data would be inaccurate at best and most likely highly misleading. Given that any future standard would have to rely on these projections, the agencies should document all assumptions and allow for public review and comment on any estimates related to future electricity supply and demand. [EPA-HQ-OAR-2014-0827-1327-A2 p.11]

Most importantly, however, analysis of upstream emissions that relies on 2010 data fails to consider significant regulatory developments that have and will continue to reduce both GHG and criteria pollutant emissions. In particular, this means that EPA and NHTSA have failed to account for the implementation of the Mercury and Air Toxics Standards (MATS), which began in April 2015. It also means that neither agency considered the long-term GHG reductions that will be associated with the final Clean Power Plan, which the EPA Administrator signed on August 3, 2015. This program, by EPA's own estimates, will reduce power sector GHG emissions by 32 percent below 2005 levels by 2030.<sup>25</sup> The final Clean Power Plan also includes incentives for early—2016-2021—deployment of renewables and certain end-use efficiency programs. As EIA noted in its analysis of the proposed Clean Power Plan, which was projected to achieve lesser reductions, “the Clean Power Plan has a significant effect on projected retirements and additions of electric generating capacity. Projected coal plant retirements over the 2014-40 period, which are 40 GW in the AEO2015 Reference case (most before 2017), increase to 90 GW (nearly all by 2020)... [and] the Clean Power Plan increases projected renewable capacity additions in all cases.”<sup>26</sup> The agencies cannot assert that increased EV deployment will undermine the GHG emissions reduction goals of the Phase 2 Program (or of any vehicle standards) because of potential increases in upstream emissions without assessing the impacts of the final MATS and Clean Power Plan.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1327-A2 p.11-12]

If the agencies chose to include upstream GHG or criteria pollutant emissions in the final Phase 2 Program or in other future rulemakings, the analysis must be fuel neutral, assessing the upstream national and/or international emissions of all fuels, conventional and alternative, and all vehicles, conventional and PEV. Moreover, the agencies must recognize the significant changes to the emissions profile of electricity generation that are occurring as a result of other regulatory programs aimed at stationary sources. [EPA-HQ-OAR-2014-0827-1327-A2 p.12]

4 For more information, see <http://www.pluginamerica.org/drivers-seat/plug-electric-vehicle-sales-pace-double-first-five-years-plugless-hybrid-sales>.

5 See U.S. Department of Energy (DOE) and EPA, *Model Year 2015 Fuel Economy Guide* (Updated Sept. 9, 2015).

6 For more information, see <https://www.whitehouse.gov/the-press-office/2014/11/18/fact-sheet-growing-united-states-electric-vehicle-market>.

7 For more information, see <http://www.eei.org/resourcesandmedia/newsroom/Pages/Press%20Releases/EEI%20and%20DOE%20Launch%20Partnership%20to%20Accelerate.aspx>.

8 For more information, see <http://globenewswire.com/news-release/2015/09/09/767097/10148751/en/UPS-Expands-Hybrid-Electric-Fleet.html>.

9 DOE, *Quadrennial Technology Review*, p. 294 (Apr. 2015).

10 *Id.*

11 Electric Power Research Institute, *Environmental Assessment of a Full Electric Transportation Portfolio, Volume 2: Greenhouse Gas Emissions*, p. 12 (Sept. 2015).

12 *Id.* at 96.

13 ICF International and Energy and Environmental Economics, *California Transportation Electrification Assessment, Phase 1: Final Report*, p. 11 (Aug. 2014) (updated Sept. 2014) (*California Transportation Electrification Assessment: Phase 1*).

14 *California Transportation Electrification Assessment, Phase 2: Grid Impacts* at 65.

15 See 80 *Fed. Reg.* at 40,158.

16 See *id.*

17 See *Delta Construction Co. v. EPA*, 783 F.3d. 1291 (D.C. Cir. 2015).

18 80 *Fed. Reg.* at 40,159.

19 *Id.*

20 In past vehicle standards rulemakings, NHTSA has failed to provide upstream analyses addressing petroleum or natural gas. EEI notes that NHTSA's Draft EIS in support of the proposed Phase 2 Program contains a discussion of the upstream emissions related to the production and transmission of natural gas and some discussion of the upstream emissions related to petroleum production and transportation. This Draft EIS, unlike those for standards for passenger cars and trucks, does not address upstream emissions related to electricity production and transmission, likely because NHTSA does not rely on EVs as the basis for any of the proposed Phase 2 Program standards and does not expect many EVs to be deployed in these vehicle classes. Similarly, the Preamble to the proposed Phase 2 Program

discusses lifecycle emissions for natural gas and diesel vehicles, as does the draft Regulatory Impacts Analysis. See 80 *Fed. Reg.* at 40,503-10.

21 See 80 *Fed. Reg.* at 40,389.

22 See 80 *Fed. Reg.* at 40,158; see also, 75 *Fed. Reg.* 25,324, (May 7, 2010).

23 See 75 *Fed. Reg.* at 25,436-37.

24 See EIA, *Electric Power Annual 2013* (Mar. 2015) available at: <http://www.eia.gov/electricity/annual/>.

25 See EPA, *Clean Power Plan Fact Sheet* available at: <http://www2.epa.gov/sites/production/files/2014-05/documents/20140602fs-overview.pdf>.

26 See EIA, *Analysis of the Impacts of the Clean Power Plan* (May 2015).

27 Further, failure to acknowledge and account for the reductions associated with regulations that address electricity generation is inconsistent with the approach that EPA and NHTSA have taken with respect to regulations addressing fuels. In the Preamble, the agencies note that it is appropriate to focus on tailpipe emissions because of the existence of “Clean Air Act programs that encourage the use of renewable fuels.” 80 *Fed. Reg.* at 40,189. The Clean Power Plan does not just encourage GHG emissions reductions from electric generating units, but will require them during the MYs covered by the proposed Phase 2 Program.

**Organization:** Electric Drive Transportation Association (EDTA)

We support the proposed rule’s tail-pipe focus and zero emission status for electric vehicles as appropriate for this rulemaking.<sup>3</sup> We reiterate our support as provided in comments on the most recent light duty rule, 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, that any future regulatory regimes that seek to incorporate upstream emissions associated with vehicles should apply upstream metrics to all fuels.<sup>4</sup> Regarding electricity, upstream modeling must be sufficiently granular to recognize regional variations in power profile and sufficiently dynamic to measure and project the rapidly evolving regulation and operations of the nation’s power sector. [EPA-HQ-OAR-2014-0827-1217-A1 p.2]

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3 80 Federal Register 40158, July 13, 2015

4 See EDTA Comment #80fb45ce at <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2010-0799-9449>

## Response

We are applying the Phase 2 standards at the vehicle tailpipe. That is, compliance is based on vehicle fuel consumption and GHG emission reductions, and does not reflect any so-called lifecycle emission properties. The agencies have explained why it is reasonable that the heavy duty standards be fuel neutral in this manner and adhere to this reasoning here. See 76 FR 57123; see also 77 FR 51705 (August 24, 2012) and 77 FR 51500 (August 27, 2012).

NHTSA notes that the fuel efficiency standards are necessarily tailpipe-based, and that a lifecycle approach would likely render it impossible to harmonize the fuel efficiency and GHG emission standards, to the great detriment of our goal of achieving a coordinated program. 76 FR 57125/1-2; (similar finding by EPA); see also Sections I.F. (1) (a) and XI of the FRM preamble.

The agencies received mixed comments on this issue. Many commenters supported the proposed approach, generally agreeing with the agencies' arguments. However, some other commenters opposed this approach. Opposing commenters generally fell into three categories:

- Commenters concerned that tailpipe-only standards ignore the GHG benefits of using renewable fuels.
- Commenters concerned that upstream emissions of methane occurring during the production and distribution of natural gas would offset some or all of the GHG emission reductions observed at the tailpipe.
- Commenters concerned that ignoring upstream emissions overstates benefits for certain technologies.

These and other factors are discussed below. These factors were considered in the context of EPA's engine and vehicle emission standards and NHTSA's vehicle fuel consumption standards (including those for light-duty vehicles), which have been in place for decades as tailpipe standards. The agencies find no reasonable basis in the comments or elsewhere to change fundamentally from this longstanding approach.

Although the final standards do not account for life cycle emissions, the agencies have estimated the upstream emission impact of reducing fuel consumption for heavy-duty vehicles. As shown in Sections VII and VIII of the Preamble to the final rule, these upstream emission reductions are significant and worth estimating, even with some uncertainty. In addition, NHTSA has conducted a life-cycle impact assessment as part of its final environmental impact statement, including an assessment of an examination of medium- and heavy-duty vehicle materials and technologies.<sup>[1]</sup> Because the standards in today's final rule are performance-based and not attribute-based standards, NHTSA's analysis features a literature synthesis of existing credible scientific information relevant to evaluating the potential environmental impacts from some of the fuels, materials, and technologies that may be used to comply with the standards. However, while the agencies considered life-cycle impacts during the rulemaking process, the inability to quantify those impacts limits the agencies' ability to incorporate life-cycle considerations into the standards themselves.

#### *Renewable Fuels*

With respect to fuel effects, EPA notes that there is a separate, statutorily-mandated program under the Clean Air Act which encourages use of renewable fuels in transportation fuels, including renewable fuel used in heavy-duty diesel engines. This program considers lifecycle greenhouse gas emissions compared to petroleum fuel. The agencies are not issuing rules that effectively would turn the Phase 2 rules into a fuel program, rather than an emissions reduction and fuel efficiency program, and thus will continue to measure compliance at the tailpipe, for the reasons just stated. See also response to POP Diesel in Section 1.3 above.

#### *Methane Emissions*

Issues relating to whether to consider in the emission standards upstream emissions related to natural gas exploration and production are addressed in detail in Section XI of the FRM and in Section 12 of

this RTC. It is sufficient to state here that the agencies carefully investigated the potential use of natural gas in the heavy-duty sector and the impacts of such use. We do not believe that natural gas is likely to become a major fuel source for heavy-duty vehicles during the Phase 2 time frame. Thus, since we project natural gas vehicles to have little impact on both overall GHG emissions and fuel consumption during the Phase 2 time frame, the agencies see no need to make fundamental changes to the Phase 1 approach for natural gas engines and vehicles.

EPA further notes that it is directly addressing the issue of methane emissions relating to production, transport and distribution activities upstream of vehicular applications. The EPA-promulgated 2012 New Source Performance Standards (NSPS) will reduce emissions of ozone precursors from natural gas facilities and have methane and hazardous air pollutant reduction co-benefits. The NSPS standards require that emissions from natural gas wells that are hydraulically fractured be controlled using flaring or reduced emission completion (REC) technology from completions and workovers starting in 2012. RECs used by natural gas well drillers capture the natural gas emissions that occur during well completion, instead of venting or flaring the emissions. Starting in January 2015, RECs are required for natural gas well completions and workovers. The NSPS also regulates the emissions from certain new natural gas production equipment, including dehydrator vents and condensate tanks. EPA is taking additional steps to reduce the emissions of methane from natural gas and oil production facilities. On May 12, 2016, EPA finalized regulations (2016 NSPS) which, among other things, include methane standards for oil and gas equipment used across the oil and gas sources currently only regulated for VOCs, and require the use of reduced emissions completions at hydraulically fractured oil wells.<sup>26</sup> In March of 2016, the U.S. EPA and Canadian ECCC announced plans to regulate emissions from existing oil and gas sources.<sup>27 28</sup> The goal of these various actions is to achieve an aggregated 40 to 45 percent reduction in methane emissions relative to methane emissions in 2012. The lifecycle analysis presented here and in RIA Chapter 13 does not take into account the 2016 NSPS, or a future action that would address existing sources, thus, it likely overestimates methane emissions from natural gas facilities. EPA believes that is the more reasonable approach than to use the vehicle program to indirectly seek to affect upstream emissions.

#### *Technology-Specific Life Cycle Emissions*

In a very practical sense, the agencies cannot accurately address life-cycle emissions on a technology specific basis at this time for two reasons:

1. We lack data to address each technology, and see no path to selectively apply a life cycle analysis to some technologies, but not to others.
2. Actual life cycle emissions are dependent on factors outside the scope of the rulemaking that may change in the future.

With respect to the first reason, even if we were to accept the AISI comments, this would not allow us to address life cycle emissions for other technologies. For example, how would the agencies address potential differences in life cycle emissions for shifting from a manual transmission to and AMT, or the life cycle emissions of aerodynamic fairings? If we cannot factor in life cycle impacts for all technologies, how would we do it for weight reductions? Given the complexity of these rules and the number of different technologies involved, we see no way to treat the technologies equitably.

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<sup>26</sup> Oil and Natural Gas Sector: Emission Standards for New and Modified Sources; 40CFR 60, May 12, 2016.

<sup>27</sup> <https://www.whitehouse.gov/the-press-office/2016/03/10/us-canada-joint-statement-climate-energy-and-arctic-leadership>

<sup>28</sup> <https://blog.epa.gov/blog/2016/03/epa-taking-steps-to-cut-methane-emissions-from-existing-oil-and-gas-sources>

Commenters do not provide the information necessary to address this challenge, nor are the agencies aware of such information.

The second reason is potentially more problematic. This rulemaking is setting standards for vehicles under specific statutory provisions. It is not regulating manufacturing processes, distribution practices, or the locations of manufacturing facilities. And yet each of these factors could impact lifecycle emissions. So while we could take a snapshot of lifecycle emissions at this point in time for specific manufacturers, it may or may not have any relation to lifecycle emissions in 2027, or for other manufacturers. Consider, for example, two component manufacturers: one that produces its components near the vehicle assembly plant, and relies on natural gas to power its factory; and a second that is located overseas and relies on coal-fired power. How would the agencies equitably factor in these differences without regulating these processes? AISI, in its comments, does not address the issue much less offer potential solutions.

Given these challenges, as well as the other factors already mentioned, the agencies are not adopting lifecycle-based standards in this rulemaking.

#### *Electric Vehicles*

The agencies note further that a consequence of the tailpipe-based approach is that the agencies will treat vehicles powered by electricity the same as in Phase 1. In Phase 1, EPA treated all electric vehicles as having zero emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O (see 40 CFR 1037.150(f)). Similarly, NHTSA adopted regulations in Phase 1 that set the fuel consumption standards based on the fuel consumed by the vehicle. The agencies also did not require emission testing for electric vehicles in Phase 1. The agencies considered the potential unintended consequence of not accounting for upstream emissions from the charging of heavy-duty electric vehicles. In our reassessment for Phase 2, we have found only one all-electric heavy-duty vehicle manufacturer that has certified through 2016. As we look to the future, we project limited adoption of all-electric vehicles into the heavy duty market. Therefore, we believe that this Phase 1 provision is still appropriate. Unlike the 2017-2025 light-duty rule, which included a cap whereby upstream emissions would be counted after a certain volume of sales (see 77 FR 62816-62822), we believe there is no need to establish a cap for heavy-duty vehicles because of the small likelihood of significant production of EV technologies in the Phase 2 timeframe. Commenters specifically addressing electric vehicles generally supported the agencies' proposal. However, some commenters did support accounting for emissions from the generation of electricity in the broader context of supporting full lifecycle analysis.

## 2 Vehicle Simulation Model

### 2.1 General Comments

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

#### Vehicle Simulation, Engine Standards and Test Procedures

**Greenhouse Gas Emissions Model (GEM) outputs** [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

As in the Phase 1, the output files of the GEM executable distributed with the Phase 2 proposal display only the composite fuel consumption and emissions results and not the individual cycle results. Basing the fuel efficiency standard on a weighted average of cycle-specific fuel consumption results makes sense. However, there is no justification for not providing these cycle-specific results to the GEM user, for whom the individual cycle results clearly constitute valuable information about vehicle performance. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

Furthermore, the individual cycle results for each model should be reported in a publicly accessible electronic database. The variation in duty cycles experienced by heavy-duty vehicles, even within a vehicle category, is among the challenges to creating a sound and equitable program of standards. Knowing how vehicles compare on individual cycles can be much more valuable information than the composite results for some purchasers, especially those for whom the relevant duty cycle involves much more or much less transient and idle operation than is reflected in the weighting assumed for purposes of the standards. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

Recommendation: GEM outputs [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

-The GEM executable should be revised to report sufficient fuel efficiency performance data to permit buyers to assess fuel consumption over customized duty cycles. In particular, outputs should include fuel efficiency results over each discrete test cycle. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

- **Full vehicle integration.** The proposal takes very important steps toward making the standards full-vehicle standards. In Phase 2, tractor and vocational vehicle certification levels will reflect the efficiency of the engine sold with the vehicle, rather than a default engine, and how that engine operates in the vehicle. Transmission efficiency, which allows for several additional percentage points savings, will be recognized and credited for the first time. Integration of engine and transmission can be captured through a powertrain test, an important option introduced in the proposal. The greenhouse gas emissions model (GEM), which is used to calculate vehicles' fuel efficiency, will become more sophisticated and allow many more technologies to contribute to certified fuel efficiency. The vehicle certification protocols will promote integration of engine, transmission, and vehicle components. [EPA-HQ-OAR-2014-0827-1280-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.54-55.]]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

*Improved functionality*



In the MATLAB version of the model, it is possible to obtain detailed outputs for the 55-mph, 65-mph, and transient modes that include average engine speed and torque; crankshaft, transmission, and axle work; number of shifts; and grams fuel, grams CO<sub>2</sub>, and grams CO<sub>2</sub> per ton-mile. This “detailed output” option is a change noted in the documentation for GEM P2v2.1,<sup>11</sup> and we expect this functionality to be available in the final, executable version of GEM. We support this addition to GEM output options. The ability to view these results for individual modes will allow end users to better understand the benefits of technologies for their own duty cycles, which may be better represented by weighting the three drive cycles differently than they are weighted for certification purposes. [EPA-HQ-OAR-2014-0827-1896-A1 p.4]

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11 EPA-HQ-OAR-2014-0827-1626/NHTSA-2014-0132-0181, “Summary\_GEM\_P2v2.1\_Updates”

**Organization:** Autocar, LLC

### GEM

The GEM program comprises a complex emissions simulation tool, which heretofore Autocar has not utilized. However, to identify and address any potential issues with GEM P2v2.1, EPA and DOT must allow stakeholders a sufficient opportunity to perform their own simulations. Yet EPA has not posted the new version for download from the Web, instead requiring that people request a copy on a CD, thereby delaying receipt of the updated (version 2) model with the known bugs removed. [EPA-HQ-OAR-2014-0827-1869-A1 p.2]

Only through these simulations can interested parties such as Autocar assess whether EPA’s claims about the effectiveness of various compliance measures matches what data from the field shows, and provide the agencies appropriate commentary on its proposed rule. This is especially true for small manufacturers such as Autocar that were exempt from Phase 1 and have no prior experience with GEM modeling. To further the agencies’ efforts at developing an appropriate compliance model, Autocar requests an extension to run full and simplified GEM simulations (as contemplated by the Memorandum referenced in Section 2 below) with the goal of identifying any issues with, or limitations of, the model. That “simplified model” is not yet available for parties to use and review, making commentary on that approach even more difficult. [EPA-HQ-OAR-2014-0827-1869-A1 p.2]

**Organization:** California Air Resources Board (CARB)

### Neutral/Provide Additional Information Comment

#### **Comment – Overall Phase 2 GEM**

The GEM was developed by U.S. EPA for demonstrating compliance with U.S. EPA’s GHG emissions and NHTSA’s fuel consumption vehicle standards, applicable to class 7 and 8 combination tractors, trailers, and class 2b-8 vocational vehicles. In Phase 1 GEM, most of the simulation parameters were predefined and there were only very limited number of user input parameters. The proposed Phase 2 GEM (GEM P2v1.0) was substantially improved to better model real-world impacts of various fuel efficiency technologies. GEM P2 allows more user input simulation parameters including engine-specific fuel maps, transmissions, and drive axle ratios, which will increase accuracy. The model was validated using approximately 130 vehicle variants, using both chassis and powertrain dynamometer tests. [EPA-HQ-OAR-2014-0827-1265-A1 p.122]

CARB staff commends U.S. EPA for taking significant steps to improve the model. [EPA-HQ-OAR-2014-0827-1265-A1 p.122]

**Organization:** Caterpillar Inc, et al.

The GEM simulation, fed by appropriately representative vehicle and component characteristics and operational duty cycles, is the best way to compare real-world performance of vehicles. We fully support this approach, but remain concerned that the regulatory measurements and duty cycles must be firmly grounded in engineering principles and a thorough survey of how these vehicles are used. Otherwise, the assessments of technology impacts will not match real-world results. Our assessment is that the proposed rule needs significant improvements to aerodynamic measurement and analysis, audit margins, duty cycles, and other areas in order to meet this objective. Indeed, the provisions as proposed have the effect of increasing real-world stringency requirements by as much as 50% beyond the intended improvements. [EPA-HQ-OAR-2014-0827-1215-A1 p.4]

**Organization:** Cummins, Inc.

The Greenhouse Gas Emissions Model (GEM) is applied to demonstrate compliance for vocational vehicles and combination tractors. GEM is a more practical solution compared to chassis dynamometer testing for the abundant variations of vehicles in this market segment. Full vehicle testing is costly considering test facilities and the large proliferation of vehicles that would need to be tested. However, the agencies must recognize that a vehicle modeling approach significantly impairs the ability of the agencies to verify and enforce emissions control at the vehicle level in use. Engine standards are based on direct, experimental measurement and verification of performance, unlike model-based vehicle standards. Hence, it is imperative that use of GEM at the vehicle level is complemented with a separate engine standard to ensure compliance and real-world CO<sub>2</sub> reductions. [EPA-HQ-OAR-2014-0827-1298-A1 p.7]

**Organization:** Daimler Trucks North America LLC

**Regulations are correct in not requiring GEM inputs be finalized before vehicle build** - Although no portion of the regulation requires a GEM number in advance of the vehicle build, 1037.520(a)(2)(ii) with its reference to the calibration identifier (an item not associated with a vehicle until the engine is installed, at the vehicle build) might lead someone to mistakenly think that all of the GEM inputs including engine inputs will be known prior to building a vehicle. That is not the case. Engines are pulled from inventory and may have calibrations that are a few weeks or months old. The engines may be in inventory with newer engines usable in the same vehicles but with newer calibrations. To vehicle manufacturers, either calibration is acceptable. Only after the vehicle manufacturer pulls the engine from the inventory does the vehicle's engine calibration get decided: was the engine the older one or a newer one? Plus, engines fuel maps can be reflashed during vehicle manufacturing, if an engine's programming (e.g., selection of map and torque curve) contains inconsistencies. As a result, the EPA cannot expect us to have an exact GEM value until the vehicle and its engine are united. This should not matter to the EPA, and the EPA's regulations do not require a priori knowledge of the calibration. But we wish to make clear, in order to avoid any misunderstanding, that a priori knowledge of the calibration that will be associated with a vehicle is not possible. 1037.520(a)(2)(ii). [EPA-HQ-OAR-2014-0827-1164-A1 p.108]

**Organization:** Eaton Vehicle Group

Ensure the standards are performance-based: The EPA has adopted a computer model simulation approach to vehicle certification that in principle drives performance-based standards. However, we recognize that it is impossible to simulate all technologies that contribute to fuel efficiency and that at some point, a limit is reached between the accuracy of physics-based models coded in GEM, their fundamental modeling assumptions, and the quality of measured data in the lab. We believe the powertrain test can be used to quantify the benefits of many technologies. In rare cases, such as predictive powertrain management [Verma 2015]<sup>1</sup>, post-processing the GEM results is appropriate with a “slightly conservative” offset based on industry best practice (sometimes referred to as “Drop-down menus”) is recommended. However, these should be used conservatively so they do not compete unfairly with technologies that should be recognized through a powertrain test. [EPA-HQ-OAR-2014-0827-1194-A1 p.4]

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1 Verma, R., Patanwala, N., Tang, Z., Saltsman, B., (2015) ‘An intelligent driver assistance system for improving commercial vehicle fuel economy’, Int. J. Powertrains, Vol. 4, No. 3, pp. 208-224

**Organization:** Environmental Defense Fund (EDF)

#### **D. Modify the engine inputs in GEM to reflect all GHG emissions; not just CO2**

As it is currently designed, the engine inputs into GEM only reflect emissions of carbon dioxide. This is a significant oversight when certifying alternative fueled vehicles. Methane emissions from natural gas trucks greatly exceed the proposed methane standard. As EPA noted in the proposed rule, “for the initial natural gas engine certifications that EPA received for 2014, the truck manufacturers chose to continue to emit high levels of methane.” The final standard must ensure GEM engine inputs accurately reflect emissions from NGVs and other vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.42]

**Organization:** Ford Motor Company

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, pp. 29-30.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 159-160.]

Ford has some concerns with the accuracy of the greenhouse gas emissions model used to determine compliance for vocational vehicles, particularly in the case of vehicles with heavy duty gasoline and light heavy duty diesel engines. Ford recommends that data is used to validate the model for these engines and vehicles. Ford will provide detailed written comments on this subject once we have fully evaluated the model. We'll continue to cooperate with EPA and NHTSA requests for data to support the refinement of the GEM model.

**Organization:** International Council on Clean Transportation (ICCT)

*Data sharing.* We commend the agencies for continuing to conduct rigorous analysis and share detailed data that underpins their regulatory development work. The level of testing, analysis, and data sharing by regulatory agencies within the regulatory process, as exemplified in the NODA, is commendable. For example, the data on the engine maps, model development, powertrain procedures, aerodynamics testing

is all very helpful in describing important underlying factors related to the agencies' movement from the proposal and final rule. [EPA-HQ-OAR-2014-0827-1876-A1 p.2]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Ensure an Adaptable Greenhouse Gas Emissions Model (GEM)** [EPA-HQ-OAR-2014-0827-1274-A1 p.8]

MEMA recognizes the scope and scale of the agencies' endeavors to conduct a significant amount of research and data to offer a proposal that is more representative of real-world applications. Suppliers are the key innovators, developers and manufacturers of many of the technologies and systems recognized in the GEM program (e.g. lightweight materials, automatic tire inflation systems, advanced cruise control systems, improved aerodynamics, workday idle reduction systems, integrated drivetrains and transmissions). As such, MEMA supports the proposed expansion and modification of the Phase 2 greenhouse gas emissions model (GEM) because it recognizes a wider variety of systems and technologies in its menus and calculations compared to Phase 1. That notwithstanding, once the technology choices in GEM are finalized, they are essentially locked-in and making changes will be difficult. The result is the consequence of creating technology "winners and losers" unless a mechanism is created to assure the GEM remains a robust tool throughout the length of the standard. Therefore, MEMA proposes the agencies consider an approach to make the GEM a "living and breathing" tool to measure, include and credit future technologies that have quantifiable efficiency benefits. Such a process would be a streamlined, efficient and cost-effective way to drive adoption of fuel efficient technologies via the GEM. [EPA-HQ-OAR-2014-0827-1274-A1 p.8-9] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.195.]]

Certainly MEMA supports and appreciates the need for long-term certainty in these standards for investments, product planning and research and development. Yet, over the length of the standards, it is plausible and inevitable that breakthroughs in technologies will happen; some breakthroughs are on the horizon but not yet commercialized and some are not yet discovered. Future developments in current technologies or creation of new ones, would be essentially locked-out of the GEM menus once this rule is finalized. Adding technologies that approach commercialization during the course of Phase 2 to the credit menu allows for adjustment of an existing credit if evidence emerges to better quantify benefits. [EPA-HQ-OAR-2014-0827-1274-A1 p.9]

Therefore, as technologies evolve and become commercially available, MEMA asks the agencies to consider a streamlined mechanism as part of the rule's structure that would also allow for GEM to evolve. Such an approach would allow for the future inclusion of technologies that have verifiable benefits at defined/designated milestones. [EPA-HQ-OAR-2014-0827-1274-A1 p.9]

It is important that such a process be public, transparent, data driven and have defined milestones. Perhaps this process could take the form of public government-industry workshops or forums announced in the Federal Register, in a manner similar to those held by the California Air Resources Board. Here industry stakeholders – including suppliers – can petition to amend the GEM either with new technology additions or modifications to existing GEM values. The petitioners' evidence must be robust with data to support amendments to the GEM. It will further allow the GEM to account for adjustments if evidence emerges that there are quantifiable, verified improved benefits. Such a process would have to be demonstrable, rigorous, transparent and well-managed (i.e. accurate tracked changes and GEM version control). This proposed process offers an approach not only for industry stakeholders, but also government entities to benefit from having as robust a model as possible that reflects what is

available and of benefit in the marketplace that can be properly accounted for during the length of the rule. [EPA-HQ-OAR-2014-0827-1274-A1 p.9]

Consequently, a “living, breathing” and flexible GEM will increase market penetration and commercialization of these important technologies as well as drive continuous innovation and improvements. OEMs and engine manufacturers will be incentivized to always look beyond the horizon. Suppliers will be encouraged to continue to innovate new and creative technologies to take the next generation of commercial vehicles to another level of efficiency and performance. [EPA-HQ-OAR-2014-0827-1274-A1 p.9]

**Address Technical Problems with Phase 2 GEM Executable File** [EPA-HQ-OAR-2014-0827-1274-A1 p.9]

Certainly such a complex compliance tool must be ensured to be accurate, consistent and reliable. Unfortunately, some of our members that have been running the publicly released GEM executable file have encountered some problems (e.g. errors with coding and algorithms). Other stakeholders testified in the public hearings that they have experienced problems running the GEM executable files and expressed serious concerns. MEMA urges the agency to resolve these “bugs” before issuing a final rule and to utilize the administrative law tools available to ensure that this compliance mechanism is failsafe. [EPA-HQ-OAR-2014-0827-1274-A1 p.9-10]

**Organization:** Navistar, Inc.

Navistar feels the following are key areas the agencies must address: [NHTSA-2014-0132-0094-A1 p.2]

- The Greenhouse Gas Emission Model (GEM) must be accurate, flexible and fully developed. [NHTSA-2014-0132-0094-A1 p.2]

**Organization:** PACCAR, Inc.

### **Greenhouse Gas Emissions Model (GEM) Issues**

EPA and NHTSA have acknowledged that there are a number of issues with the GEM model as it currently configured, and therefore have outlined some revisions during the public comment period. PACCAR and EMA have worked with staff from the agencies after GEM revisions were made public. The EMA comments reflect these discussions. Furthermore, PACCAR has performed substantial testing with the GEM tool and have encountered a number of issues that remain unaddressed. A discussion of each of these remaining issues follows. [EPA-HQ-OAR-2014-0827-1204-A1 p.17]

**Organization:** SABIC Innovative Plastics US LLC

SABIC also encourages EPA to release a 32-bit version of the software, in addition to the currently available 64-bit version, so that more users may evaluate the software. SABIC urges the agencies to resolve any technical issues before issuing the final rule. SABIC also points out the need to keep the software current to reflect changes in the truck marketplace in coming years. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

However, SABIC notes the critical need to improve the publicly released GEM software and respectfully requests that technical issues be resolved prior to the final rule. [EPA-HQ-OAR-2014-0827-1207-A1 p.7]

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2 R. McCallen et al., DOE's Effort to Reduce Truck Aerodynamic Drag: Joint Experiments and Computations Lead to Smart Design, presented at AIAA Fluid Dynamics Conference, June 28, 2004.

13 Testimony of Debbie Gordon, Allison Transmission, U.S EPA Public Hearing on Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 6, 2015.

**Organization:** Truck Renting and Leasing Association

We also support: (1) the use of more robust models to more accurately simulate the work done by vocational vehicles; (2) greater weighting of emission benefits from currently available and commercially viable components and technologies in the GEM model [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Organization:** Volvo Group

Volvo Group was pleased to be an early test site for the GEM simulation and we have fed back findings that have been corrected or are in process of being corrected. Unfortunately every change in GEM has potential to impact the outputs for vehicle GHG emissions and fuel consumption. Combining GEM changes with other regulatory changes (aerodynamic method, duty cycles, vocational vehicle segmentation, alternative engine certification, highway grades, etc.) we are working against a constantly moving target in trying to assess where our technology plans put us against the proposed standards that are also subject to change. None-the-less, we offer our input on changes still needed in GEM. [EPA-HQ-OAR-2014-0827-1290-A1 p.50]

The NoDA proposes an updated version of the Greenhouse Gas Efficiency Model (“GEM”) and associated protocol for determining inputs. Many of the changes represent important improvements to earlier versions of GEM. There are, however, some critical elements that are not representative and risk driving designs and specifications that do not align with real world gains. We have provided details in our comments, and will continue to support effective resolution, though we are very concerned about the ability to appropriately resolve these matters within the agencies’ rulemaking timeline. [EPA-HQ-OAR-2014-0827-1928-A1 p.2-3]

**Organization:** Waste Management (WM)

However, EPA asked us to provide our thoughts on the assumptions used in the GEM model 2.0 relating to heavy-duty refuse trucks in the vocational category, and we have included comments on those assumptions as well. [EPA-HQ-OAR-2014-0827-1214-A2 p.2]

### **WM Supports a Vehicle Testing Approach that Best Measures Real World Vehicle Performance**

We understand that EPA is continuing to evaluate alternative engine mapping tools to assess vehicle fuel efficiency and GHG emissions performance. Our primary concern as a major fleet operator and

purchaser is that the investments we make in new vehicles will continue to allow us to meet our customers' needs and our operational requirements. Towards that end, we support engine and vehicle assessment tools and approaches that most accurately reflect the fuel efficiency and emission reduction performance achievable by a refuse vehicle operating in real world scenarios. [EPA-HQ-OAR-2014-0827-1214-A2 p.7]

### **WM Urges Further Review of the Handling of Natural Gas Engines in GEM**

Based on our discussions with vehicle and engine OEM partners, we are concerned that GEM does not account for the lower carbon content of natural gas when calculating GHG emissions rates. We strongly urge the agencies to review this aspect of the GEM model and make the appropriate corrections to the model. [EPA-HQ-OAR-2014-0827-1214-A2 p.7]

#### **Response:**

While the agencies received many comments supporting the Phase 2 improvements to GEM, we also received comments supporting additional changes to GEM. The more general comments are addressed here, while the more specific comments are addressed in Sections 2.2 through 2.6 below.

We have made significant marginal improvements to GEM based on comments. For example, we have revised the way in which GEM treats natural gas and other alternative fuels.

#### *Technical Accuracy of GEM*

Some commenters stressed the importance of the technical accuracy of GEM. The more specific comments are addressed in Section 2.3 below. See Chapter 4 of the RIA for a broader discussion of GEM's accuracy.

While we share the goal to have GEM accurately simulate overall vehicle performance in an absolute sense, it is actually more important that GEM is accurate in relative comparisons. This is because the agencies used the same version of GEM to calculate the stringency of the standards as was used to evaluate baseline performance for this rulemaking. The ultimate purpose of the FRM version of GEM will be to evaluate changes or additions in technology, and compliance is demonstrated on a relative basis to the numerical standards that were also derived from GEM. The importance of relative comparisons can be further explained with the following simplified example.

Assume you have two simulation models: one that says a baseline vehicle with Bin 3 aerodynamics and a conventional automatic transmission would be 90 g/ton-mile, and another that said the same vehicle would be 95 g/ton-mile. Assume also that there was a similar vehicle that was the basis of the new standards that had Bin 4 aerodynamics and a dual-clutch transmission. If both models simulated the second vehicle as being 10 g/ton-mile better than the baseline vehicle, then the models would work equally well for compliance as long as they were also used to set the standards. With the first model, we would set the standard at 80 g/ton-mile. And with the second, we would set the standard at 85 g/ton-mile. In both cases, manufacturers adding Bin 4 aerodynamics and dual-clutch transmissions would meet the standard. In other words, the two models would be equivalent in terms of measuring the effect of the change in technology on emissions, even though the absolute values were significantly different.

We largely agree with Eaton's comment that it is appropriate in some cases for GEM to be conservative, especially where manufacturers have the option to more accurately reflect the technology by performing

powertrain testing. Nevertheless, we have done sparingly, and generally avoid intentionally introducing significant inaccuracy into the model to be overly conservative.

### *Usefulness of GEM*

Some commenters, such as ACEEE, suggested ways to broaden the usefulness of GEM. While we have tried to make the FRM version of GEM relatively user-friendly, we note that the purpose of GEM is as a compliance tool. Thus, our focus to date has been on making GEM both technically sound and equitable, so that it will accurately and fairly represent the various technologies. We believe the FRM version of GEM meets these criteria. Having said that, we understand the comments supporting the broader perspective, and we may consider developing more user-friendly versions for broader purposes in the future. Should we do so, we would intend maintain the same numerical outputs as the FRM GEM so as to not create issues related to stringency.

### *Using GEM to Estimate Methane Emissions*

EDF supported modifying GEM to simulate methane emissions and factor those emissions into the vehicle standards. We are not doing so for several reasons:

- The FTP-based controls are adequate.
- The Phase 1 and Phase methane standards are anti-backsliding or cap standards. Thus, a more complicated treatment is not warranted.
- Since measuring methane is somewhat more challenging than for most other exhaust pollutants, requiring methane measurements for all fuel maps would increase test burden, without significant additional benefit
- GEM is used for both EPA's standards and NHTSA's fuel consumption standards. Addressing methane in the vehicle standards would create disharmony between the programs.

### *Future changes to GEM*

The purpose of this rulemaking is to achieve in-use emission and fuel consumption reductions by requiring manufacturers to demonstrate that they meet the promulgated emission standards. Thus, it is important that GEM simulations be reasonably representative of in-use operation. Testing that is unrepresentative of actual in-use operation does not necessarily tell us anything about whether any emission reductions occur. However, we recognize that certain simplifications are necessary for practical simulations. In the past, EPA has addressed this issue by including in our testing regulations a process by which EPA can work with manufacturers to adjust test procedures to make them more representative of in-use operation. For engine testing, this provision is in 40 CFR 1065.10(c)(1), where EPA requires manufacturers to notify us in cases in which they determine that the specified test procedures would result in measurements that do not represent in-use operation. That provision states:

*The objective of the procedures in this part is to produce emission measurements equivalent to those that would result from measuring emissions during in-use operation using the same engine configuration as installed in a vehicle. However, in unusual circumstances these procedures may result in measurements that do not represent in-use operation. You must notify us if good engineering judgment indicates that the specified procedures cause unrepresentative emission measurements for your engines. Note that you need not notify us of unrepresentative aspects of the test procedure if measured emissions are equivalent to in-use emissions. If you notify us of unrepresentative procedures under this paragraph (c)(1), we will cooperate with you to establish whether and how the procedures should be appropriately changed to result in more representative measurements. While the provisions of this paragraph (c)(1) allow us to be*



*responsive to issues as they arise, we would generally work toward making these testing changes generally applicable through rulemaking. We will allow reasonable lead time for compliance with any resulting change in procedures.*

Although we are not adopting an equivalent provision for GEM at this time, we expect similar principles to apply. To the extent that GEM fails to represent in-use emission, we would expect to work with manufacturers to address the issue – under the existing regulations where possible, or by promulgating a new rulemaking.

In some respects, powertrain testing can be considered to be a reference method for this rulemaking. Because manufacturers have the option to perform powertrain testing instead of engine-only fuel mapping, the stringency of the final standards can be traced to powertrain testing. In other words, methods that can be shown to be equivalent to powertrain testing can be considered to be consistent with the testing that was used as the basis of the final Phase 2 standards. Thus, it may be useful in the future to consider equivalency to powertrain testing as an appropriate criterion for evaluating changes to GEM to address new technologies. Consider, for example, a new technology that is not represented in GEM, but that is reflected in powertrain testing. The agencies could determine that it would be appropriate to modify GEM to reflect the technology rather than to require manufacturers to perform powertrain testing. In such a case, the agencies would not consider the modification to GEM to impact the effective stringency of the Phase 2 standards because the new version of GEM would be equivalent to performing powertrain testing.

Similarly, the agencies may revise GEM in the future to reflect technologies otherwise being recognized as off-cycle technologies. In other words, the agencies could determine that it would be appropriate to modify GEM to reflect the technology rather than to require manufacturers to go through the off-cycle process, and could do so without impacting the effective stringency of the Phase 2 standards because the new version of GEM would be equivalent to the off-cycle approach.

#### *Opportunity to Comment on Phase 2 GEM*

Some commenters maintain that they did not receive sufficient notice to provide informed comment on the GEM. The agencies disagree. As described in Section II.C of the Preamble and Section 15.5 of this RTC, the agencies have provided numerous opportunities for comment on GEM, and its iterative development. Even at proposal, Phase 2 GEM provided nearly all of the essential features of the version we are promulgating in final form. These include: (1) the reconfiguration of the engine, transmission, and axle sub-models to reflect additional designs and to receive manufacturer inputs; and (2) the addition of road grade and idle cycles for vocational vehicles, along with revised weighting factors. Moreover, the changes the agencies have made to GEM in response to public comment indicate that those comments were highly informed by the proposal. The agencies thus do not accept the contention that commenters were not afforded sufficient information to provide meaningful comment on GEM.

## **2.2 Proposed Modifications to GEM**

**Organization:** Alcoa

As it is currently written, the proposed GEM methodology creates two lightweighting categories. The first category is unloaded and partially loaded. In lightweighting, this equates to the emissions reduction benefit. On trucks and trailers, the GEM assumes a light weighted vehicle will realize an emissions reduction for 66% of the vehicle usage. On vocational vehicles, the GEM assumes a light weighted

vehicle will realize an emissions reduction for 50% of vehicle usage. [EPA-HQ-OAR-2014-0827-1216-A1 p.1]

The second category is when the vehicle is fully loaded. In lightweighting, this is the emissions avoidance benefit. The GEM calculates trucks and trailers run fully loaded for 34% of their usage and that vocational vehicles run fully loaded for 50% of their usage. [EPA-HQ-OAR-2014-0827-1216-A1 p.1]

Currently, the GEM only recognizes benefits in the first category, emissions reductions, while disregarding the benefits in the second category, emissions avoidance. [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

Alcoa believes this is a serious oversight. Although emissions reduction is a critical component in an overall emissions strategy, it can never fully ameliorate the problem of greenhouse gases and environmental particulate matter. Rather, the only realistic path to a goal of zero emissions is through emissions avoidance. [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

Alcoa appreciates the difficulty in measuring real world benefits of some emissions avoidance technologies like logistics Improvements. However, Alcoa hopes this difficulty will not impede the agencies from recognizing easily calculated emissions avoidance benefits of technologies like lightweighting. [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

For example, if an OEM reduces the weight of their vocational vehicles by 1,000 lbs, the fleets will be able to use that weight to increase the payload, reducing the total number of needed trips in fully loaded applications. Since vocational applications run fully loaded for 50% of their usage, we can see that the 1000 lbs weight reduction results in emissions avoidance of 3.3% through reduced trips by simply dividing the weight reduction by the baseline payload, then multiplying by the duty cycle (For vocational applications, this would be  $0.5 * [\text{weight reduction} / 15,000]$ ). [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

Fleets can see similar emissions avoidance benefits on their trucks. According to research conducted by Ricardo Consulting Engineers, fleets can realize 3,300 lbs of light weighting benefits on 'aluminum intensive' class 8 tractor trailers. Using the EPA's assumption that tractors and trailers run fully loaded for 34% of their usage, an 'aluminum intensive' class 8 tractor trailer will realize an emissions avoidance benefit of almost 3% through reduced trips. [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

Every day, fleets and OEMs work to maximize their efficiency. One very real benefit of these efficiency efforts is the avoidance of emissions In the first place. In addition to maintaining the current lightweighting credits for emissions reductions, Alcoa requests the agencies make adjustments to the final rule that will incorporate an appropriate recognition of the role of lightweighting plays in fleet efficiency, allowing fleets and OEMs to be credited for a portion of their activities which avoid the generation of emissions. [EPA-HQ-OAR-2014-0827-1216-A1 p.2]

**Response:**

The commenter misunderstands the functioning of lightweighting in GEM and the metric of the standards. Because the metric is grams (or gallons) per ton-mile, both types of benefits described by the commenter – emissions reductions and emissions avoidance -- are applied. When a user enters a positive value in the GEM input field for weight reduction, GEM allocates this reduced weight as described by

the commenter both ways: both increased payload and avoided emissions. In this way, manufacturers get full credit for every pound they certify as being reduced.

**Organization:** Allison Transmission, Inc.

The Greenhouse Gas Emission Model (“GEM”) used in this rulemaking has been improved from Phase 1, but still requires several changes in order to properly credit emission reduction technology such as Neutral-Idle and Stop-Start technologies. To the extent GEM is revised, the agencies must allow for sufficient public review and comment. Some of the areas that need to be addressed include: [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

- o Better representation of torque converter lock up engagement. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

- o Automatic Neutral at Stop should be included in GEM for tractors. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

- o Drive cycles used in GEM should be reweighted to include additional transient operation. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

- o Variable Power Accessory Load should be included in GEM. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

- o Road grades should be better represented to reflect real-world highway conditions. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

EPA and NHTSA should not include DCTs within GEM or through post simulation adjustment. There is not a sufficient basis in the record for this rulemaking to support crediting DCTs. Moreover, recent testing indicates that transient and idle operation of DCTs utilize more fuel than an Allison 2000 Series™ transmission. [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

## **VI. GEM Should Account for Differences in Vehicle Configurations That Cannot Meet Required Drive Cycles**

After reviewing the Proposed Rule and the NODA, it is apparent that EPA and NHTSA have not addressed an underlying issue in GEM’s modeling of emission results. That is, GEM does account for engine/transmission/vehicle configurations that cannot meet duty cycles utilized. This means that vehicles configurations that cannot maintain the prescribed vehicle speed during the GEM cycle will receive a GHG benefit from GEM since aero drag decreases along with decreasing speed. [EPA-HQ-OAR-2014-0827-1892-A1 p.10]

To simulate the effects of underperformance over an entire cycle, one can build a family of engines of different HP and Torque ratings to simulate a range of vehicle performance in GEM. Using this family of curves, a general approximation of aero drag benefit can be determined. For example, using the GEM 455 HP heavy duty engine to build a family of curves from 455 HP down to 215 HP, a series of identical vehicle (Sleeper Cab, High Roof, Tractor) configurations with the following torque curves were simulated to judge the impact on meeting the cycle and creating a GHG measure. [EPA-HQ-OAR-2014-0827-1892-A1 p.10]

[Chart of torque curves can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1892-A1]

Using these torque curves, as expected, Allison simulations show that lower rated engines were less likely to track the cycle. See the chart below. [EPA-HQ-OAR-2014-0827-1892-A1 p.10]

[Chart of simulations can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1892-A1]

The grams of CO<sub>2</sub>/ton-mile generated for each segment of the GEM run is plotted on the next graph. For lower rated engines that cannot maintain the drive trace, a benefit is seen from GEM, and the overall GEM measure of grams of CO<sub>2</sub>/ton-mile closely tracks with the benefit seen on the 65 MPH segment of the cycle where the underperformance is most. Based on this result, Allison believes the bulk of the benefit is from reduced aero drag due to the lower speeds on the high speed cycles. [EPA-HQ-OAR-2014-0827-1892-A1 p.11]

[Chart of CO<sub>2</sub>/ton-mile can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1892-A1] Unless the aero benefit from underperformance is captured and compensated, vehicles that cannot maintain the vehicle speed trace could receive GHG benefits from GEM. Allison suggests that EPA track the difference in speed between the trace and the simulated configuration vehicle speed during each phase of the test cycle, and then compensate for underperformance to the trace by applying an offset to the CO<sub>2</sub> emissions result during that underperformance period. [EPA-HQ-OAR-2014-0827-1892-A1 p.11]

In addition to technical accuracy, there are policy concerns which should also drive this result. If this matter is not addressed, manufacturers may build vehicles that cannot meet HD performance requirements for the work required (as evidenced by not meeting the cycle). In an extreme case, an end user fleet may need to purchase additional vehicles to get jobs done because the original purchased vehicles could not meet the performance requirements. More vehicles means more CO<sub>2</sub> emitted. In a less extreme case, an end user fleet would have the underperforming vehicles on the road more hours per day to get the same amount of work done as vehicles that can meet the prescribed cycles. This again would result in additional GHG emissions. [EPA-HQ-OAR-2014-0827-1892-A1 p.12]

### **EPA and NHTSA Must Include Road Grade in Certification Duty Cycles**

EPA and NHTSA have proposed to revise the urban and rural highway duty cycles to incorporate changes in road grade. The agencies rely on various analyses to derive road grade profiles, including profiles recommended by the National Renewable Energy Laboratory (“NREL”). A memorandum supporting the proposed incorporation has been placed into the docket<sup>50</sup> as has the NREL Analysis.<sup>51</sup> As the agencies note, utilizing flat road grade profiles over constant speed tests not only does not reflect real world operation of vehicles, but also may result in unjustified crediting of underpowered vehicles or excessively downsped drivetrains. [EPA-HQ-OAR-2014-0827-1284-A1 p.31]

Allison supports incorporation of road grade profiles into the certification process. We agree with the agencies that incorporation of road grades into the 55 mph and 65 mph cycles is needed to better represent the actual use of vehicles and to account for differences in vehicle performance, emissions and fuel efficiency. Based on testing at Oakridge National Laboratory (“ORNL”) with the TC10 (represented by the chart below), the 55 and 65 mph cycles result in an engine being forced to operate over a wide torque band and speeds, from zero to full torque; the transmission is forced to downshift and upshift to maintain cycle speed. This better represents actual vehicle operation. [EPA-HQ-OAR-2014-0827-1284-A1 p.31]

[Chart, 'Datalog showing 65 mph drive cycle (with EPA proposed grades)' can be found on p.32 of docket number EPA-HQ-OAR-2014-0827-1284-A1]<sup>52</sup>

Indeed, if EPA and NHTSA seek to make changes to road grade profiles in the final rule, Allison would only support increasing grades from the currently proposed grades. The proposed grade profile in GEM favors lower grades than the national average. Ideally, the grades should reflect the national average. The proposed alternate grades being developed by EPA for the 55 and 65 mph cycles are constructed from a series of mathematical “half hill” elevations. The half hills all have the same shape and are simply scaled vertically and horizontally. Thus, the grades simply do not look like grade profiles that would be encountered in the real world and the synthetic shapes may impact the transmission shifting algorithm in a manner which does not reflect real world use. The synthetic grades only achieve max grade for a short period of time, where real world grades have a longer duration at a grade which allows the transmission time to obtain the desired gear, stabilize and maintain acceptable performance. While we recognize that part of the agencies’ evaluation and purpose is to “compress[ ] a large, real-world, drive cycle dataset into a single, statistically representative cycle,”<sup>53</sup> the current GEM profile favors lower grades than the national average. Allison therefore believes that a more aggressive grade profile should be incorporated into the final rule which would ideally reflect the U.S. average grade. [EPA-HQ-OAR-2014-0827-1284-A1 p.32]

[Chart, 'Grade plotted against percent of miles for US interstate highways', can be found on p.33 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

The agencies are also specifically seeking comment on whether or not these duty cycles should also simulate driver behavior in response to varying traffic patterns. Allison’s analysis of TC10 testing at ORNL indicates that the addition of grade causes sufficient changes in throttle as to induce upshifts and downshifts. Given the difficulty in obtaining a representative driver model, Allison believes that the currently proposed grades are sufficient to utilize a full range of engine torques and thus largely achieves the intended testing result. Allison would note, however, that GEM P2v1.0 does not downshift correctly on grade; correcting this defect is necessary to ensure that GEM has proper shifting when grade profiles are applied. Specifically, Allison has observed this defect in GEM simulations, particularly with lower numerical axles, in which engine speeds dipped as low as 768 rpm at 100% throttle on positive grades. Meanwhile, the vehicle lagged behind the 55 mph duty cycle. Even with real world fuel economy type shift schedules, this degree of downshift reluctance is unrealistic. [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

On Page 9 of Memo to Docket- GEM new release (GEM P2v1\_1).docx (which accompanied the latest GEM release), the agency acknowledged this defect as follows: [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

Issue: Late downshift after losing speed on cruise cycles with high grade and vehicles with low torque to weight ratios. [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

Workaround: None, needs to be addressed as a calibration change to the shift schedule. [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

Notes: Several solutions are available, we just need to pick one and implement it for the FRM. [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

This matter should be addressed in the final rule after allowing for public comment. [EPA-HQ-OAR-2014-0827-1284-A1 p.33]

We are pleased that EPA and NHTSA agreed with our public testimony and provided the opportunity for additional review of the GEM in this NODA. We also appreciate the willingness of both agencies to

work with affected industry to refine the GEM and to address lingering technical issues with the operation of the model. The additional material and analysis placed in the docket for the NODA is also helpful in understanding the direction of EPA and NHTSA's thinking regarding several other important aspects of the Phase 2 program. [EPA-HQ-OAR-2014-0827-1892-A1 p.1]

At the same time, Allison believes that additional improvements and alterations to GEM, as well as additional technical information, must be reviewed by staff prior to issuance of a final rule. Specifically, EPA and NHTSA should: [EPA-HQ-OAR-2014-0827-1892-A1 p.1]

- Revise the engine stop-start delay time downward to better reflect the actual operation of existing and planned systems. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]
- Correct certain aspects of the Southwest Research Institute ("SwRI") report, including its assessment of hybrid vehicle manufacturing and barriers to market entry. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]
- Revise GEM's methodology to estimate transmission losses which unduly favors some transmission types over others. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]
- Address issues in GEM related to vehicle configurations that cannot meet duty cycle speeds. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]
- Correct calculations concerning maximum engine speed. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]

Allison looks forward to continuing to work with EPA and NHTSA as the final rule moves forward. As we indicated in Chicago, to the extent possible, GEM must reflect real world vehicles and their operation. While no model will ever be perfect, EPA and NHTSA must strive to improve the accuracy of the current model and continue to review relevant data. As we indicated in our testimony - since GEM affects the stringency of the standards and largely provides the compliance mechanism for the Phase 2 rules - any inaccuracies in GEM could result in unjustified benefits and detriments to different transmission architectures as well as counter-productive effects in the marketplace. Further improvements are therefore needed. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]

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50 Development of an Alternative, Nationally Representative, Activity Weighted Road Grade Profile for Use in EPA GHG Certification of Medium- and Heavy-Duty Vehicles, May 13, 2015.

51 EPA GHG Certification of Medium- and Heavy-Duty Vehicles: Development of Road Grade Profiles Representative of US Controlled Access Highways, May 2015.

52 Data from Oak Ridge National Lab test cell, Cummins ISX15 engine, Allison TC10 10-speed transmission, weight 67,000 lb, July 2015. A larger version of this chart is also provided as Attachment 5.

53 EPA GHG Certification of Medium- and Heavy-Duty Vehicles: Development of Road Grade Profiles Representative of U.S. Controlled Access Highways, National Renewable Energy Laboratory, May 2015 at 27.

**Response:**

We have made significant improvements on GEM based on many constructive and helpful comments from public. Those major changes can be summarized as follows:

- Modified road grade profile for 55- and 65-mph cruise cycles
- Revised idle cycles within the vocational vehicle duty cycles, and new vocational cycle weightings

- Made significant changes on the input file structures. Examples includes additions of columns for axle configuration (“6x2”, “6x4”, “6x4D”, “4x2”), and additions of a few more technology improvement inputs, such as “Neutral Idle and Start/Stop.”
- Made significant changes on output file structures. Examples include an option to allow the user to output detailed results on average speed, average work before and after transmissions, and the numbers of shift for each phase (55 and 65mph cycles and ARB cycle).
- Added input file for axle power losses (function of axle output speed and torque) and replaced single axle efficiency in model with lookup table of torque loss
- Added simulation of engine torque response with fast response region defined by engine displacement, and slower torque increase in boosted region with fast falloff on available torque
- Added regression models for all certification cycles to allow the user to simulate vehicle with cycle average approach
- Added different fuel properties according to 1036.530.
- Significantly improved shift strategy based on testing data
- Adjusted transmission loss & inertia scale factors per regulatory subcategory
- Added optional input table for transmission power loss data
- Added minimum torque converter lock-up gear input for AT
- Retuned the default transmission mechanical efficiency based on the testing data
- Added neutral idle and start/stop features during simulation
- Adjusted shift and torque converter lockup strategy
- Added neutral idle as a technology for tractors.

The agencies agree with the comment from Allison that DCT should not be explicitly modeled in GEM at this time. Instead automated manual transmission can be selected for vehicles with DCTs, if good engineering judgment indicates that the DCT can be accurately represented in GEM as an automated manual transmission. See 40 CFR 1037.520 (g).

The agencies agree with the comments from Allison that the road grade profile should be nationally representative. Due to this the agencies have used the data from the NREL analysis along with in-use vehicle and engine data from manufactures in creating the final road grade profile. See chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took in creating the road grade profile. However, we do not agree that we should penalize vehicles that cannot maintain the GEM speed cycles. Allison expressed the concern that “manufacturers may build vehicles that cannot meet HD performance requirements for the work required,” but we do not share this concern. Any benefit over the GEM cycle is likely to be too small to justify producing vehicles with insufficient power to perform the work. To the extent that this aspect of GEM has any impact on the vehicles, it is more likely to provide a small disincentive to design vehicles with significantly more power than needed, which could provide an in-use benefit.

The agencies agree with the comments from Allison on not including traffic in the cycles, and have finalized the rule without including traffic in the drive cycles.

In regard to the following comment from Allison:

*“Revise the engine stop-start delay time downward to better reflect the actual operation of existing and planned systems.”*

Engine stop-start is recognized in two of the five duty cycles in GEM for vocational vehicles. The first is in the transient cycle where the engine will shut down, 5 seconds after the vehicle speed has reached zero mph. Since the amount of drive idle time is not fully represented in the transient cycle the agencies

have finalized a separate cycle. If stop-start is selected, GEM determines the fueling for this cycle by assuming the engine is running for 10% of the time and is off for the remaining 90%. The assumptions for both of these cycles was determined, to account for not just the time the vehicles is in drive and at zero speed, but to also account for the overrides that are allowed in 40 CFR part 1037. If a manufacture designs a system that shuts down in less than 5 seconds after reaching zero speed or is operational during some of the exclusions defined in 40 CFR part 1037 the manufacturer can use the off cycle provisions to get credit for the system.

**Organization:** American Automotive Policy Council

**Vocational Vehicles and GEM Model** – AAPC supports the intended direction of the Phase 2 GEM approach. However, the execution of Phase 2 GEM is not complete and does not accurately reflect vocational vehicle performance and physical characteristics. AAPC has numerous recommendations related to these concerns and recommends establishing an industry/agency working group to address them. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

[EPA-HQ-OAR-2014-0827-1238-A1 p.32]

### **Phase 2 GEM Road Grade**

EPA has proposed (EPA-HQ-OAR-2014-0827-1032) changing the GEM 55 mph road grade profile to include additional road grades up to 5%. While AAPC supports the inclusion of road grades in Phase 2 GEM, the VMT traveled on grades as well as the duration and frequency of the grades proposed for the Phase 2 GEM cycle is disproportionate to actual in-use operation. AAPC recommends lengthening or modifying the cycle to reflect the correct proportion and frequency of positive and negative road grades relative to VMT traveled. [EPA-HQ-OAR-2014-0827-1238-A1 p.32-33]

### **§ 1037.560 BASF EMGARD FE 75W-90 Fuel Efficient Synthetic Lubricant**

While AAPC agrees with the agencies intent to incentivize advanced low friction lubricants in Phase 2 GEM, the reference to the BASF EMGARD FE 75W-90 specification in its entirety and comments about reducing frictional losses at every test point relative to EMGARD are too specific and should be generalized. 1037.510 should be revised to include a generic Viscosity Index Specification per ATSM D2270 and Viscosity cSt requirements per ASTM D-445 that meet or exceed the BASF EMGARD FE 75W-90 specifications. Furthermore the requirement about exceeding the EMGARD FE 75-90 at every test point should be removed and replaced by a cycle average friction reduction requirement. As proposed, a new lubricant could exceed the BASF EMGARD lubricant at every test point except one and manufacturers would be denied a GEM credit. [EPA-HQ-OAR-2014-0827-1238-A1 p.34]

Additionally, the agencies should incentivize other technologies that accomplish the same friction reduction vs. other mechanisms. For example, active axle lubricant heating with a standard mineral oil base lubricant and/or perhaps active axle cooling with a very low transmission oil type lubricant could achieve the same results. [EPA-HQ-OAR-2014-0827-1238-A1 p.34]

### **AAPC suggests technical corrections to various aspects of GEM:**

- **Fuel property adjustments and reference fuels:** Gasoline test fuel adjustments per 1036.530 and 1036.535 introduce a significant new source of unneeded variability in the phase 2 HD FTP and GEM measurement requirements. With adoption of Tier 3 fuels into this segment in 2021MY, these adjustments are no longer required. The gasoline ethanol blending specification



required by 1065.710 tightly controls the test fuel heating value and carbon weight fraction and renders the 1036.530 and 1036.535 post-test corrections an unneeded source of variation. AAPC recommends removing the 1036.503 and 1036.535 criteria for gasoline engines tested with Tier 3 1065.710 fuel.

- **Fuel mapping adjustments to account for engines that run negative brake torques:** GEM fuel mapping requires fuel flow to be measured at 0 n-m brake torque and various engines speeds. GEM then uses this value to linearly interpolate 0 n-m brake torque fuel rates to zero as determined by operating point relative to the motoring friction curve. While this approach will work to assess light load and near motoring fuel flow conditions, AAPC recommends that OEMs be optionally allowed to map engines at conditions less than 0 nm brake torque to minimize interpolation errors.

AAPC suggests technical corrections to various aspects of GEM, including: [EPA-HQ-OAR-2014-0827-1898-A1 p.2]

- o Fuel property adjustments and reference fuels; and
- o Fuel mapping adjustments to account for engines that run negative brake torques.
- GEM 2 road grade assumptions are not aligned with U.S. road grade profiles and could drive manufacturers to implement technologies with adverse on-road CO<sub>2</sub> impacts. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]
- AAPC suggests improvements to various procedures and methods associated with GEM inputs including: [EPA-HQ-OAR-2014-0827-1898-A1 p.2]
  - o Neutral/light load fuel measurements;
  - o Fuel mapping procedures; and
  - o Accounting for measurement variability.

#### **Response:**

We have made significant improvements to GEM based on many constructive and helpful comments from the public, which improvements should address their concerns.

Based on AAPC's comments and others like it, the agencies are finalizing 40 CFR 1037.560 ("axle efficiency test") which provision recognizes improvements to the axle or the lubricant or both instead of a fixed improvement based just on the lubricant. Using a procedure that tests the full axle system allows GEM to weight the losses across the axles operation for the vehicle that the axle is installed in. In addition to having a more complete way of looking at the axle as a whole by bringing the loss table into GEM ties the cycle average losses to the vehicle the axle is installed in. Lastly by testing the full axle system, there is a robust way recognize improvements to lubricants beyond BASF EMGARD FE 75W-90 Fuel Efficient Synthetic Lubricant.

Regarding fuel property adjustments and reference fuels, the agencies have performed testing at Southwest Research Institute utilizing both Tier 2 and Tier 3 certification test fuels. These results show that post-test correction of the  $e_{CO_2}$  results back to the reference fuel as required in 40 CFR 1036.530 does not result in a statistically significant difference in the Tier 2 and Tier 3 fuel results. In other words, the specified correction adequately accounts for test fuel effects. Thus there is no effect on stringency and the agencies will not be developing a Tier 3 E10 gasoline factor for Tier 3 certification fuels.

Regarding fuel mapping adjustments the agencies can see the value in adding additional points to the fuel map and would be interested in discussing with AAPC how 40 CFR 1036.535 could be modified to achieve this.

We also made adjustments relating to road grade, which are more representative to the real world driving routes. This was achieved by limiting the change in grade versus change in distance to rates of change seen in-use. In addition to this we also added additional distance with grade between  $\pm 0.5$  percent to better align engine operation in GEM with engine operation in-use. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took in creating the road grade profile.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

#### **Updates to the Greenhouse Gas Emissions Model (GEM P2v2.1)**

Significant changes have been made to the GEM model release that accompanies the NODA. These improvements enable more accurate modeling of the behavior of heavy-duty trucks and therefore can more readily capture technology improvements that were left on the table in the proposal. We support the changes to the GEM model and recommend that the standards be strengthened to reflect the additional fuel savings opportunities captured by the improved GEM. [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

##### *New drive cycle weightings*

As noted in the vocational vehicle section of these comments, the updated certification cycles both are more representative of vocational vehicle duty cycles and highlight further opportunities for fuel consumption reduction at high-speed (e.g., from aerodynamic improvements) and at low-speed through idle reduction (including automatic shut-down for parked idle). [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

##### *Cycle-average map*

Perhaps the biggest change to GEM is the replacement of the transient cycle modeling with the cycle-average mapping procedure to assess a vehicle's fuel consumption over the transient cycle. Most importantly, this replaces the "transient adjustment factor" of 1.05 with a value that more accurately captures the vehicle's transient behavior. [EPA-HQ-OAR-2014-0827-1896-A1 p.4]

##### Impact on the proposal

The agencies used a transient adjustment factor of 1.05 so that leading engines with better transient response on a powertrain test would not receive undue advantage as a result of the test procedure. However, eliminating this factor would appropriately reward manufacturers who can prove better real world transient response. Replacing the transient adjustment factor may result in slightly higher baseline fuel consumption if the baseline reflects average performance, but it should allow the standards to drive leading-edge transient operation in the later years, creating a greater transient performance improvement from 2018 to 2027 than in the proposal. [EPA-HQ-OAR-2014-0827-1896-A1 p.4]

#### **Response:**

We appreciate ACEEE's positive comments on GEM, drive cycle, and cycle average mapping. Regarding the transient correction, the agencies have removed the fixed 1.05 correction now that the cycle average engine test procedure has been finalized as part of the engine fuel map. One of the main advantages of the cycle average mapping procedure is that transient engine fueling is measured during the test, so improvements to transient fueling can be recognized in GEM without performing powertrain testing. The agencies believe that using the 1.05 multiplier to define the baseline and requiring the cycle average fuel map will give the proper recognition to technologies that improve transient engine fuel efficiency.

**Organization:** American Gas Association (AGA) et al.

#### **We Recommend that the Agencies Include Additional Inputs to the Greenhouse Gas Emissions Model (GEM)**

We commend the agencies' efforts to modify the GEM in the Phase 2 Proposal by requiring that tractor and vocational chassis manufacturers provide their own engine, transmission, drive axle(s) and tire radius inputs.<sup>32</sup> This expands the GEM to better account for a wide range of technological improvements. We support the expansion of GEM to enable certain advanced technologies that are not yet widely used and that are not otherwise incorporated into the GEM to generate off-cycle credits, such as improvements to the driver controller, engines, transmissions, and axles; lightweight thermoplastic materials; automatic tire inflation systems; advanced cruise control systems; engine stop-start idle reduction systems; and axle configurations that decrease the number of drive axles.<sup>33</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.8-9]

However, we are concerned that the GEM assessment of natural gas-fueled vocational trucks may be overestimating the CO<sub>2</sub> emissions of natural gas due to the GEM treatment of the relative carbon content of diesel and natural gas fuels and other GEM components. We encourage EPA and NHTSA to investigate this further, and correct any shortcomings that are found, and request opportunities to discuss these issues further with the agencies before the Rule is finalized. [EPA-HQ-OAR-2014-0827-1223-A1 p.9]

In addition to the carbon content issue, we disagree with the Proposal's assignment of a fixed weight increase to natural gas-fueled vehicles.<sup>34</sup> While we agree with the Proposal's assertion that natural gas fuel tanks are heavier than diesel and gasoline tanks, we raise two concerns with the Proposal as written: [EPA-HQ-OAR-2014-0827-1223-A1 p.9]

- The Proposal does not include weight penalties for other weight-increasing technologies, such as hybrids, Rankine cycle engines, and non-engine technologies that add weight. [EPA-HQ-OAR-2014-0827-1223-A1 p.9]
- The proposed weight increases that are assigned to natural gas vehicles do not take into account the real-world weight differences among natural gas fuel systems.<sup>35</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.9]

With respect to our first concern, we request that the agencies assign weight increases to hybrid and Rankine cycle engines and non-engine technologies that add weight. There are numerous technologies used by both conventional and alternative fuel vehicles that will increase the weight of the vehicle. For instance, auxiliary power units, waste heat recovery systems, and refrigerated trailer units ("reefers") add weight to the overall system. However, these technologies do not receive weight penalties in the GEM. We appreciate that all-electric and fuel cell vehicles generate zero GHG tailpipe emissions and are thus not requesting weight penalties for these specific alternative fuel types. [EPA-HQ-OAR-2014-0827-1223-A1 p.9]

With respect to our second concern, we request that the agencies decrease the proposed weight increases that apply to natural gas-fueled vocational vehicles. We believe that the agencies' proposed use of a fixed weight increase for both tractors and vocational vehicles fueled by natural gas does not reflect the weight differences between the fuel tanks in these vehicles, and thus unfairly penalizes vocational vehicles. [EPA-HQ-OAR-2014-0827-1223-A1 p.9]

The amount of fuel storage required varies considerably with the class and type of the vehicle. As a result, natural gas fuel storage systems installed on vocational vehicles typically are smaller and weigh less than those installed on Class 7 and 8 tractors. This is because vocational vehicles themselves weigh less and often run less mileage, thus requiring less fuel. Class 5 vocational vehicles may be fitted with as little as 25 – 32 gasoline gallon equivalent (GGE) natural gas fuel storage systems.<sup>36,37</sup> Refuse trucks (a type of vocational vehicle) may operate with a 60 – 80 diesel gallon equivalent (DGE) natural gas fuel

storage system.<sup>38</sup> By comparison, Class 8 tractors may occasionally operate with a natural gas fuel storage system of up to 120 DGE.<sup>39</sup> These examples demonstrate the need for differentiated weight increases among the various classes of natural gas vocational vehicles and tractors. [EPA-HQ-OAR-2014-0827-1223-A1 p.10]

The need to decrease the proposed weight increases for natural gas-fueled vocational vehicles also plays out in the GEM's payload calculations. For the tractor-trailer calculation in the GEM, one-third of the weight reduction (or increase) is added (or subtracted) to the available payload number in the denominator while two-thirds of the weight reduction (or increase) is subtracted (or added) to the overall weight of the vehicle.<sup>40</sup> However, the calculation for vocational vehicles is different: one-half of the weight reduction (or increase) is added (or subtracted) to the available payload number in the denominator while the other one-half of the weight reduction (or increase) is subtracted (or added) to the overall weight of the vehicle.<sup>41</sup> This difference in calculation means that the weight increase is much more significant for natural gas-fueled vocational vehicles because it assigns a larger tank weight relative to the size of the vehicle. [EPA-HQ-OAR-2014-0827-1223-A1 p.10]

In sum, we commend the agencies' efforts to update the GEM to better reflect real-world driving conditions and technologies. We believe that the recommendations listed above further advance those efforts. [EPA-HQ-OAR-2014-0827-1223-A1 p.10]

**Response:**

With regard to natural gas fuel properties, GEM contains the reference fuel properties for all fuels defined in Table 1 of 40 CFR 1036.530. For natural gas the reference fuel carbon-mass-specific net energy content was carried over from the Phase 1 rule and the reference fuel carbon mass fraction was determined based on a fuel composition consistent with Table 1 of 40 CFR 1065.715 and the carbon mass fraction of the pure compounds (methane, ethane, etc).

Consistent with AGA's comment about weight for natural gas vehicles, we have removed all weight penalties from the weight reduction tables included in 40 CFR part 1037. The tables only recognize weight reductions. The final Phase 2 GEM does not contain any weight penalties.

**Organization:** NGVAmerica

**Weight Penalty for Natural Gas Vehicles. The agencies have proposed specific weight penalties to be assigned to natural gas trucks. These default figures would be used as part of the GEM modeling of emissions and fuel economy.** [EPA-HQ-OAR-2014-0827-1270-A1 p.3]

NGVAmerica believes that the weight penalties included in the proposal for vocational vehicles are too high and are not reflective of fuel systems in use today. We would welcome the opportunity to discuss this issue further with the agencies. We note that the comments submitted by Gladstein and Neandross on behalf of the American Gas Association, Clean Energy and Westport Innovations also address this issue and we support their remarks on this issue. [EPA-HQ-OAR-2014-0827-1270-A1 p.3]

**Response:**

We agree with NGVA's comment about weight for natural gas vehicles and have revised the regulation to remove the proposed fixed weight penalties. The agencies are not finalizing a weight penalty for any components since this would require detailed information on conventional and light-weight vehicle components to establish a baseline and the weight reduction potential for each component. Although we are not requiring a weight penalty in GEM at the time of certification for any technology, the agencies

have accounted for increased weight due to projected adoption of some technologies (i.e. for vocational vehicles we accounted for added weight in subcategories where hybrid systems are projected) as part of our inventory modeling with the MOVES model.

**Organization:** California Air Resources Board (CARB)

### **Support Comment**

#### **Comment – Reflecting weight decreases for lightweight components, and weight increases for natural gas fuel tanks versus gasoline or diesel tanks**

CARB staff supports the Phase 2 proposal to give weight reduction credit for the use of lightweight components, and a weight increase (i.e., negative credit) for natural gas vehicles to reflect the increased weight of natural gas fuel tanks versus gasoline or diesel tanks. The weight reductions or increases translate into decreased or increased CO<sub>2</sub> emissions in GEM. The weight increases would be 600 lbs for a compression ignition LNG tractor, 525 lbs for a spark-ignited CNG tractor, and 900 lbs for a compression ignition CNG tractor; those same weight increases would also apply to vocational vehicles. The weight reductions (credits) for lighter components range from 4 lbs to 588 lbs. [EPA-HQ-OAR-2014-0827-1265-A1 p.163-164]

#### **Response:**

We appreciate CARB's support regarding reflecting weight of lightweight components in GEM. The agencies are not finalizing a weight penalty for any components since this would require detailed information on conventional and light-weight vehicle components to establish a baseline and the weight reduction potential for each component. Although we are not requiring a weight penalty in GEM at the time of certification for any technology, the agencies have accounted for increased weight due to projected adoption of some technologies (i.e. for vocational vehicles we accounted for added weight in subcategories where hybrid systems are projected) as part of our inventory modeling with the MOVES model.

**Organization:** California Air Resources Board (CARB)

### **Oppose/Requested Change Comment**

#### **Comment – Phase 2 GEM improvements**

CARB staff has evaluated and run GEM P2v1.0 and has several suggestions and recommends for clarification: [EPA-HQ-OAR-2014-0827-1265-A1 p.122]

While GEM for Phase 1 included a graphical user interface (GUI), GEM P2v1.0 does not. CARB staff still prefers GUI for data input. We believe that GUI makes it easy for users to select or input data without the need to see behind the scenes information. We understand that GUIs are not simple to make or upgrade. However, we encourage U.S. EPA to develop a GUI for GEM P2 that can integrate the added Phase 2 technology information. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

In the GEM user manual, it is not clear on how to input or edit parameters. We recommend adding clarification regarding how to create new input files and how to use the 'Sample Input Files'. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

The proposed GEM was generally designed for diesel engines. We recommend that natural gas engines be treated separately in GEM because their specifications are significantly different from the diesel engines. Please see page 148 for detailed comments on natural gas requirements. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

In the future, we encourage U.S. EPA to consider linking GEM to the VERIFY database to make analysis of GHG and criteria pollutant data more convenient. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

### **Oppose/Requested Change Comment**

#### **Comment – Phase 2 GEM technologies included**

We appreciate U.S. EPA and NHTSA including additional technologies such as low friction axle lubricant in GEM P2's pull-down menus that were not included in GEM for Phase 1. We recommend U.S. EPA and NHTSA also add to GEM P2 potential aerodynamic improvements and electrified accessories for vocational vehicles and solar control for heavy-duty pickups and vans in the pull-down menu as well. We believe that both technologies must be considered in the overall stringency to further improve emissions in the vocational sector. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

Please see detailed comments on vocational vehicles, vocational aerodynamics, and BEVs on pages 36, 44, and 84 respectively. [EPA-HQ-OAR-2014-0827-1265-A1 p.123]

#### **Response:**

CARB recommended a graphic user interface (GUI) for Phase 2 GEM. After consulting all the major vehicle manufacturers, however, it appears there is consensus against a GUI. In particular, GUI is viewed as an impediment for batch operations – the industry norm. Consequently, we decided not to develop any GUI.

CARB also commented that GEM should include all other engines instead of diesel engine alone. The response to this comment is that we have modified GEM to allow gasoline and natural gas engines as input to GEM.

The GEM user's manual issued with the final Phase 2 rule includes sample input and output files.

Regarding the comments on aerodynamic improvements and electrified accessories for vocational vehicles, we have taken actions to implement these two things into GEM as inputs. See RTC Section 6.3 for a discussion of comments and responses related to applying aerodynamic improvements and electrified accessories on vocational vehicles. In general, heavy-duty pickups and vans are chassis-certified and do not use GEM, therefore, ARB's suggestion is not applicable to GEM.

**Organization:** Clean Air Task Force et al.

Modifications made to the compliance model (GEM) help ensure that we are driving real-world performance improvements and capture even more of the fuel consumption reductions possible from future technology, especially to the powertrain. In addition, the new analysis put in the docket shows that vocational trucks idle much more than the agencies realized. Therefore the agencies should do more to incentivize idle reduction technologies, which result not only in lower fuel use but also improved

health outcomes for communities. The improved analysis of how vocational trucks operate also underscores the importance of moving towards more advanced technologies as we look beyond this rule towards continued reductions in fuel use and emissions from the freight sector. [EPA-HQ-OAR-2014-0827-1925-A1 p.2]

**Response:**

We have made significant improvements on idle reduction, which includes neutral idle, start/stop, and automatic engine shutdown, thus greatly incentivizing the idle related technologies. See RTC Section 6.1 for a discussion of comments and responses related to vocational vehicle duty cycles including the appropriate test cycle weighting of idle. See RTC Section 6.3 for a discussion of comments related to applying workday idle reduction technologies on vocational vehicles.

**Organization:** Daimler Trucks North America and Detroit Diesel Company

- GEM's latest version (EPA-HQ-OAR-2014-0827-1626, NHTSA-2014-0132-0181):

Although the agencies have made all of the changes to GEM that they said they would, we cannot repeat and verify the agencies' stringency analysis. Despite the changes to GEM, there remain problems with the program. First, it incorporates a drive cycle (Drive Cycle D) that diverges significantly from real world driving, as we have discussed with the EPA. In particular, the driving appears very binary: full torque and zero torque are over represented, while medium torque is underrepresented, relative to actual on-road driving—either based on Daimler's internal simulation or based on in-vehicle data collected by other manufacturers. We commend the EPA for recognizing the problem and seeking a solution. But we fear that the proposed solutions, allowing over- and under-shoot in vehicle speed as well as slight modifications of the Profile D, will not fully resolve the problem. It is very important for the drive cycle to line up with real-world driving, so that manufacturers can design for on-road fuel savings and do not erroneously design to a mismatched cycle. So we need to reach a good solution, perhaps even revising the drive cycle or scrapping Drive Cycle D altogether, to ensure GEM improvements translate to the real world.

- **Adding road grade to the GEM Duty Cycles for Tractors and Vocational Vehicles** - The agencies propose to add road grade to the 55 mph and 65 mph drive cycles. We strongly agree, as this is necessary to show the full powertrain operation and engine map (as opposed to showing the operation at one point in a map). [EPA-HQ-OAR-2014-0827-1164-A1 p.35]
- **Basic Philosophy Behind the Choice of Road Grades** - The agencies request comment on the proposed road grade profile, other ways in which the proposed 55 mph and 65 mph duty cycles could be enhanced, whether a more aggressive road grade profile would induce a more realistic and representative number of transmission gear shifts, and whether to apply a workday idle cycle to certain tractor types like day cabs that could experience more significant amounts of time stopped or parked as part of an urban deliver route. We have had discussions with the agencies about what constitutes a proper regulatory drive cycle, how we characterize drive cycles (including the speeds, hilliness factor, and coast factor), and how the agencies' initially proposed drive cycles compare to several representative cycles. Our underlying philosophy is that the agencies should try to match the regulatory cycles as closely as possible to nationwide average driving, not to (for example) enhance the aggressiveness of the drive cycles beyond the average in order to test the impact of an increased number of gear shifts. Similarly, we believe the agencies should try to match the vehicle speed and torque that would be observed for the average vehicle, so that manufacturers designing for on-road fuel savings will also do well in

the regulatory arena (as opposed to making one arena differ from the other). [EPA-HQ-OAR-2014-0827-1164-A1 P.35]

- **Originally proposed road grades** – Following the philosophy stated above, we voiced concerns that the agencies' originally proposed topography differed from real-world driving by having too high of torques. [EPA-HQ-OAR-2014-0827-1164-A1 P.36]

[The graphics, illustrating GEM drive cycle and nationwide average on-road drive cycles, can be found on p.36 of EPA-HQ-OAR-2014-0827-1164-A1]

Left is the GEM drive cycle, right is the nationwide average on-road drive cycles. The circles show the areas of highest frequency—clearly in different areas of torque and speed. As we have done more study of this road grade profile and the agencies' newly proposed one (discussed below), we think that either profile is generally sufficient, although neither is perfect. The original one might be better than the new. In any case, we welcome the opportunity to discuss the drive cycles further with the agencies? Newly proposed road grades - Near the end of the comment period, we learned that the agencies are working on revised drive cycles with NREL. The agencies request comment on the new road grades. We have begun to analyze the drive cycles but are not yet finished. As we look at the new road profile, again compared to a nationwide average, we find that the new profile has a lot of up and down-grades with a lot less flat ground driving than experienced on the road in the US, as shown in the charts below:

Left is the GEM drive cycle, right is the nationwide average on-road drive cycles. The circles show the areas of highest frequency—clearly in different areas of torque and speed. As we have done more study of this road grade profile and the agencies' newly proposed one (discussed below), we think that either profile is generally sufficient, although neither is perfect. The original one might be better than the new. In any case, we welcome the opportunity to discuss the drive cycles further with the agencies. [EPA-HQ-OAR-2014-0827-1164-A1 p.36]

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[Graphics, a series of illustrations of on-road drive cycles versus new proposed GEM drive cycles, indicated a lack of alignment, can be found on p.37-39 of EPA-HQ-OAR-2014-0827-1164-A1]

This is the nationwide average of seven major on-road drive cycles. The darkest red shows the areas of highest frequency. As can be seen, most of the activity takes place in the center of the torque band, representing flat roads or gentle grades. Note that we present more detail, showing individual routes, in the Appendix. [EPA-HQ-OAR-2014-0827-1164-A1 p.37]

These, by contrast, are the agencies' newly proposed cycles, showing that the cycles still do not line up with the on-road driving. Unlike the cross country routes, for which most of the activity is at the center of the torque range, representing flat roads or gentle grades, the agencies' proposal focuses on the highest and lowest torques with very little operation in the center of the operating map. In other words, the agencies' route is predominantly hilly—either up or down with nothing in between—while we find that many routes contain flat ground not represented by the agencies' route. Note that we used two assumed final drive ratios [redacted] for comparison purposes as these are ratios that we think might represent the 2027 fleet. [EPA-HQ-OAR-2014-0827-1164-A1 p.39-40]



Whichever drive cycles the agencies choose, the original ones, the new ones, or still some newer ones, we need to discuss the drive cycles further with the agencies to ensure that these properly characterize actual vehicle operation. [EPA-HQ-OAR-2014-0827-1164-A1 p.40]

Suggestion for choosing a final road grade profile - The best way to create drive cycles is to work with NREL and manufacturers to mine on-vehicle data collection during fleets' driving, then to create an aggregate that matches this driving in vehicle speed and torque (in other words, making the histograms of speeds and torques from the regulatory cycle line up as closely as possible with those from the real-world driving). We strongly advocate for the agencies to use a route profile that is representative of the ton-mile freight national average. Considering that 1) for practical purposes the regulatory high speed cycles can only have a limited length yet 2) short cycles can overemphasize minor components of those cycles, it is vital that the profile that is ultimately chosen is a true representation of average real world driving conditions with no unrepresentative portions. Otherwise a significant disconnect between regulatory and real world driving could have the unintended consequence of OEMs having to focus too much on regulatory requirements instead of what the customers really need in order to do their job in the most fuel efficient manner. In the same vein, we think that the amount of idling for both vocational vehicles and day cab vehicles should align with the data collected from real-world vehicles, including the idle time data that can be downloaded from engine control modules. (For sleeper cab vehicles, the ECM idle time would be misleading as most customers these days opt for idle shutdown timers, such that their engine-off hoteling time--the time that the agencies want to reflect with the idle portions of the cycles--would not be accurately captured by the ECM data). 80 FR 40188. [EPA-HQ-OAR-2014-0827-1164-A1 p.40]

**Response:**

We appreciate DTNA's comments on the road grade. Since we released the earlier proposal on road grade profile called Profile D, we received many constructive comments from stakeholders. Consistent with DTNA's suggestion, the agencies obtained comprehensive data from NREL and based the final road grade simulation in GEM largely on those data (as well as reflecting comments the agencies received in response to the NODA setting out those data for comment). The agencies made many changes to the road grade as proposed. Examples include adding flat road and  $\pm 0.5$  percent road grade at the beginning and end of cycle, and shrinking the peak grades. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took in creating the road grade profile.

**Organization:** Daimler Trucks North America LLC

**Other Structures Considered, Alternative aka Cycle Average Mapping Approach** – The agencies discuss the complex cycle average approach of engine-only testing over the GEM duty cycles over a range of simulated vehicle configurations, which then gets used in GEM through interpolation based on cycle-average N/V and cycle work. And the agencies request comment on whether to replace the steady-state operation representation of the engine in GEM with the alternative cycle mapping approach. 80 FR 40176. DTNA strongly urges the agencies not to replace the proposed steady state map engine representation with the cycle average approach. Given the fact that there is not enough time in this rulemaking to adequately familiarize ourselves with this concept we believe this concept should stay outside of this rule altogether. While we do not dismiss the possible technical merits of this idea outright, there are just too many unknowns left at this point to support its immediate adoption in the GHG Phase 2 rule. Having said that, after finalizing this rule we are open to collaborate with the agencies in a future industry – agency cooperative effort to further investigate this approach in order to thoroughly weigh its pros and cons and if the approach is found to be viable and equitable, aid in development of procedures to ensure that regulatory stringency is not compromised. As it stands, the

lack of definition of the process and requirements are such that there is an unquantified risk that the cycle average mapping procedure will provide an “easy path” to certification and circumvent the stringency that the agency intends for Phase 2. [EPA-HQ-OAR-2014-0827-1164-A1 P.34-35]

- **Distance-based drive cycle:** DTNA welcomes the agencies' proposed approach to ensure a distance neutral simulation for all vehicle configurations. In our opinion using a distance-based road profile definition in conjunction with a time-based speed profile that includes a distance correction is an important/integral improvement to GEM for Phase 2. 80 FR 40187. [EPA-HQ-OAR-2014-0827-1164-A1 P.35]

• **Adding GEM Inputs** – The agencies request comment on the inclusion of new proposed technologies into GEM in Phase 2. Although, as we stated above, DTNA fully supports the proposed additional inputs to GEM, we recommend adding still further inputs—for example OEM measured transmission efficiencies and a pulldown credit for neutral coast technology like eCoast. [EPA-HQ-OAR-2014-0827-1164-A1 p.42]

Detailed proprietary transmission shift logic omitted from GEM as too complicated: DTNA agrees that in a regulatory context it makes sense to use a generic shift strategy in GEM as oppose to using a manufacturer's actual shift strategy. Especially for long-haul applications DTNA simulations have shown that a generic shift algorithm can sufficiently reflect real world shift behavior (absent a neutral coast feature like our eCoast). In case of more transient operation the differences between simulated and actual shift behavior are admittedly larger, but avoiding the implications of implementing actual shift strategies in GEM (i.e., definition of a generic GEM interface, maintaining a level playing field between OEMs, IP concerns) by far outweighs the loss of simulation accuracy. [EPA-HQ-OAR-2014-0827-1164-A1 p.42]

[Table is redacted, showed results of an analysis presented earlier to EPA]

This table, above, shows the results of an analysis that we presented the EPA earlier, an analysis of several vehicle types simulated over several drive cycles with several shift strategies. The leftmost column is the drive cycle. The next column is the vehicle configuration. The columns labeled “Shift strategy” show the results of the analysis using DTNA’s proprietary strategy, simulated using Software In the Loop (SIL), and ACEA’s “polygon approach.” Although the agencies have advanced their shift logic in GEM since using a strategy like the polygon approach, the polygon approach is representative of what would result with any non-SIL strategy, including the agencies’ new one. (Note that these fuel consumption values in l/100 km are simulation values for specific vehicles under specific boundary conditions and do not indicate that a DTNA customer should see the same values). The columns labeled “Difference” show the difference in results with the different shift strategies. [EPA-HQ-OAR-2014-0827-1164-A1 p.42-43]

As can be seen from the columns labeled “Difference,” there is negligible difference in the results using the simpler and the more complex shift logic. The reason is that there is so little gear shifting occurring. So the agencies’ use of a generic shift strategy for tractors is valid. [EPA-HQ-OAR-2014-0827-1164-A1 p.43]

Idle Fuel Consumption Inputs - The agencies request comment on the inclusion of two idle points from the engine test for use in GEM for purposes of calculating emissions during vehicle idling over the vocational vehicle test cycles. We think that this is appropriate and will help to quantify idle fuel saving technologies like neutral at idle. We do, however, want to make sure that the agencies properly use

those idle fuel consumption rates: if a transmission has neutral idle or a clutch, it should get the lower fuel consumption rate during any GEM idle time step. [EPA-HQ-OAR-2014-0827-1164-A1 p.45]

Steady state to transient correction factor (1.05) – The agencies seek comment on whether the single value multiplier (1.05) is an appropriate way to correct between steady-state and transient engine fuel consumption and CO<sub>2</sub> emissions, specifically over the ARB transient duty cycle. 80 FR 40184. The agencies propose that a multiplicative factor of 1.05 be applied to the steady state map for transient simulation. Firstly, DTNA believes that inputting the actual engine data in GEM is an important and necessary step to improve the fidelity of simulations in Phase 2. Use of a default or assigned fuel map in GEM restricts a manufacturer from showing in GEM any benefits from improvements to engine systems or their unique integration with the drivetrain and vehicle. It is critical in Phase 2 that manufacturers be enabled and encouraged to seek fuel efficiency improvements through innovative engine and drivetrain integration and optimization. Use of the actual engine data in GEM facilitates manufacturers to seek improvements in this manner. That said, there is a question as to the use of a map or a cycle-averaged approach. [redacted] [EPA-HQ-OAR-2014-0827-1164-A1 p.45]

This results from differences in engine combustion and controls and the performance of the aftertreatment system under generally lower operating temperatures. Applying the steady state fuel map in GEM without some level of adjustment to reflect this difference could be interpreted as overstating or misrepresenting the actual vehicle efficiency which would be detrimental to the integrity and objectives of the Phase 2 program. That said, use of the cycle averaged approach is problematic, because of (among other things) the differences between the shifting and emissions profile of the children relative to the parent—which the agencies claim not to be an issue but which has not yet been demonstrated. This is not a problem with a fuel map approach. So we recommend the map approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.45]

DTNA's investigation of the transient vs. steady-state efficiency difference leads us to believe the EPA's suggested 1.05 multiplier is generally conservative in that it overestimates the actual difference between modes of operation, and clearly should mitigate concerns that the GEM simulation is overstating a transient cycle performance. EPA asks for comment regarding whether the multiplier should be higher considering that its investigation showed that the 1.05 factor represented the mean difference observed for the population of engines that it tested and that a higher factor could encourage manufacturers to pursue powertrain testing in order to establish a less punitive factor. DTNA shares EPA's concern that a higher multiplier, for example 1.07 would force some manufacturers to implement costly and burdensome powertrain testing to "provide credits for many current powertrain designs." In DTNA's view it does not make sense to set an artificially high factor that would result in extraordinary expenses for most manufacturers to prove that their nominally average systems do not perform poorly. Rather, setting the level at 1.05 is sufficiently conservative to meet the needs of avoiding overestimation of transient performance and providing room for manufacturers to demonstrate better performance. [EPA-HQ-OAR-2014-0827-1164-A1 p.45]

DTNA believes that both powertrain testing and the "alternative" approach are, at the least, overly burdensome and complex methods for engine manufacturers to represent powertrain performance in GEM. We suggest a simpler approach: if EPA seeks to improve the fidelity of the adjustment factor, as opposed to using a "fits all" 1.05 factor, EPA should allow manufacturers to establish an engine family specific factor that more accurately reflects the effect of the manufacturer's control strategies. The manufacturer would conduct testing a representative rating of their engine family by running the ARB Transient Cycle on the engine dyno (using an EPA defined generic representative vehicle configuration) and comparing the resulting CO<sub>2</sub> emissions level against the result of a simple simulation of the same test cycle (speed – torque sequence) using the steady state map that is defined for GEM input. The

results of the test and simulation would be used to derive the unique multiplier for the engine family. This approach essentially reflects the methodology used by EPA to derive its recommended factor of 1.05, additionally, such a manufacturer derived factor would be simple to audit or evaluate during confirmatory testing since only one additional test (the engine dyno test on the ARB Transient Cycle) and a simple simulation would be required. 80 FR 40184. [EPA-HQ-OAR-2014-0827-1164-A1 p.45-46]

Default engine maps - The EPA and NHTSA request comment on whether the agencies should provide default generic engine maps in GEM for certain vehicle sub-categories, albeit allowing manufacturers to optionally override these generic maps with actual maps measured in the normal manner (the agencies' proposed engine dynamometer steady-state test procedure). 80 FR 40184. We think that this is unnecessary. Engine manufacturers will have to generate fuel maps for engines, so the only time a vehicle manufacturer would choose not to use the optional, actual map is when that actual map is worse than the generic one--thus giving a credit for use of bad engines. Since manufacturers will have the actual maps, they should use those maps. [EPA-HQ-OAR-2014-0827-1164-A1 p.46]

Simulating Accessories for Vehicle Certification - The agencies request comment on several aspects of simulating accessories for vehicle certification: whether to allow some manufacturer input to reflect the installation of accessory load reduction in GEM, how to distinguish advanced accessories that would qualify for load-reduction credits, how to unambiguously distinguish these from other similar components that do not decrease accessory loads, and how much credit to give. 80 FR 40186. We recommend that the agencies follow an approach similar to that used by ACEA in Europe: taking different literature values (for example) for fans that are 1) crankshaft mounted, 2) belt driven with a transmission, 3) hydraulically driven, and 4) electrically driven, with each variant given a value representative of the actual energy consumed. This would give manufacturers incentive to use the most efficient accessories without putting a large burden on manufacturers to demonstrate the relatively small energy savings from each individual accessory. With such an approach, it will be easy to distinguish the advanced accessories, as it is easy to tell just by sight whether (again using the same example) a fan is mounted off the crankshaft, mounted by a belt with a transmission, and so on. With accessories that are more difficult to see, like water pumps or steering pumps, the manufacturer can declare the pump type in the end-of-year report; if the agencies wish to audit, then the agencies can see part numbers on any particular vehicle's pumps and compare these too broadly available descriptions of the part by part number. The process for certifying to the agencies that the accessories are fuel saving accessories would be simple: it would simply be a declaration that the accessory works as described, for example, is a hydraulic fan. And the amount of credit should be similar to that tabulated by ACEA for the same accessories. We would be happy to work further with the agencies on how this would work. Refer to Appendix C, Truck Auxiliaries for more details of the ACEA approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.50]

Tire Revs Per Mile is the Correct GEM Input - GEM should use either dynamic tire radius (meaning, not the static loaded radius but the radius during motion) or better tire revs per mile, from the tire manufacturer. This information is routinely collected by tire manufacturers and should be supplied as part of the tire manufacturer information in 1037.520(c) and 1037.650. Using such data will improve GEM fidelity by aligning GEM engine speeds with real engine speeds. 80 FR 40187, the agencies ask for comment on whether the proposed test procedure should be modified to measure tires' revolutions per distance directly, as opposed to using the loaded radius to calculate the drive axle rotational speed from vehicle speed. We recommend tire manufacturers' stated tire rev per mile numbers. 1037.520(a)(2)(vii), 1037.520(c), and 1037.650. [EPA-HQ-OAR-2014-0827-1164-A1 p.53]

GEM needs a way for manufacturers to input different Crr's for vehicles with different tires on each axle, 1037.520(a)(1)(iv) - The agencies have not clarified how we enter into GEM the Crr's for vehicles with different tires on each axle or with lift, tag, or pusher axles having different Crr's than the drives. There are many such vehicles. GEM should allow for such entry, or a manufacturer should be explicitly allowed to enter the numerical average of the axles' Crr's. [EPA-HQ-OAR-2014-0827-1164-A1 p.53]

Tire Test Procedures – The agencies request comment on whether the proposed test procedure should be modified to measure the tires' revolutions per distance directly, as opposed to using the loaded radius to calculate the drive axle rotational speed from vehicle speed. 80 FR 40187. As we note elsewhere, the agencies should. The agencies should use tire manufacturers' measurements of tire revolutions per mile, in order to get correct GEM results. [EPA-HQ-OAR-2014-0827-1164-A1 p.62]

Vehicle Manufacturers Receiving Tire Data from Tire Manufacturers – In Phase 1, the agencies established a procedure by which vehicle manufacturers could rely on tire data measured by tire manufacturers. The agencies propose to carry over this procedure for Phase 2. This is an invaluable procedure, and we strongly agree with the agencies' proposal. We as vehicle manufacturers, not tire manufacturers, do not routinely test tire rolling resistance, static loaded radius, or tire revolutions per mile. Therefore we agree with the agencies' proposal for vehicle manufacturers' getting tire data from tire manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.62]

**ePTO Test Procedures** – We have several concerns with the ePTO procedures. The procedures are written to test the PTO by ensuring that the engine produces all of the energy with no net change in stored energy. But plug-in electrified PTOs are already on the market, so there should be a provision for vehicles which can charge up fully from the grid, perform the prescribed PTO duty cycle, and are then recharged from the grid. There are other sections in this procedure which seem to ignore this possibility as well. [EPA-HQ-OAR-2014-0827-1164-A1 p.64]

In § 1037.540(b), the agencies prescribe the duty cycle based on target pressures that a hybrid vehicle must hit, insinuating that the hybrid vehicle spins a PTO pump constantly just as an idling truck would. However, an electrified PTO doesn't operate in this manner at all; the pump can stop completely if there is zero demand, which would be used in practical use to maximize engine-off time and overall efficiency. While a typical conventional vehicle does idle constantly during PTO use, creating a mean minimum pressure greater than zero, the hybrid vehicle would have zero pressure with zero demand. It would make much more sense if the PTO duty cycle prescribed PTO power. [EPA-HQ-OAR-2014-0827-1164-A1 p.64]

There are only two duty cycles listed in Appendix II, but there are many different target customers for which any given ePTO system might be designed. The OEM should have the ability to propose alternative duty cycles to the EPA for approval if other duty cycles are more appropriate in the future, but we do not see this as a possibility the way the regulation is currently worded. Subsection (e) also says that all cycles should be used (refuse and utility), even though the hydraulics required for these applications might be quite different. Again, this highlights that power (pressure\*flow) required for the job should be used rather than only pressure, and only systems designed for refuse vehicles should use that duty cycle (likewise for utility vehicles using utility duty cycle). If a multi-cycle system is intended to be used as a catch-all to create a single, more simplified certification, power vs. time should be the expected measurement method rather than pressure vs. time. [EPA-HQ-OAR-2014-0827-1164-A1 p.64]

• **Post-processing technology credit values not given for fuel saving accessories like variable speed water pump or clutched air compressor.** The agencies propose to give credits for electrified accessories but not for equally fuel saving alternatives like [redacted]. 80 FR 40304. First, we think that

if the accessory is active in the engine cert test, then its benefit should not be included in post-processing drop down. For example the [redacted] water pump is actually active during the RMC. But, second, if it is not active in the test cycle, such as a [redacted] feature, then it should get post-processing credits whether it saves fuel through electrification or through some alternative. [EPA-HQ-OAR-2014-0827-1164-A1 p.80]

- **TPMS and Alternative Tire Pressure Systems Should Be Sufficient for Credits** - We disagree with the EPA's approach of not crediting tire pressure monitoring systems (TPMSs) in GEM. Several studies have been performed on fleets of vehicles which demonstrate an FCR of 1-2% for TPMS without any special intervention to ensure the operators act on the notifications. One such study was FMCSA-RRT-13-021 published in February 2014 which showed an average 1.4% FCR attributed to TPMS. Similarly, there are systems that need not be carried around on vehicles, which measure tire pressure as a vehicle is driven over them. These can be placed in a fleet's truck yard to catch vehicles with low tire pressure. There is no reason to credit vehicles with systems that prevent low tire pressure only if the systems must be carried on the vehicle; these systems add weight. Rather, there should be a method to get credit for these alternatives that add no vehicle weight. If the agencies' concern is that the systems might not catch a low tire pressure immediately and might allow a vehicle to operate with low pressure for some time, then the agencies can give a slightly reduced FCR benefit. [EPA-HQ-OAR-2014-0827-1164-A1 p.80]

- [entire bullet redacted]

- **Electric Accessories Given GEM Credits But [redacted] Ones Not Given Credit:** The agencies propose to treat differently accessories that have similar FCR benefits. 1037.520(f)(6). Electric accessories get their power from the engine, albeit through the electrical system (with the inefficiency associated with energy conversion to and from electrical energy), while the [redacted] accessories do the same thing--reduce energy consumption and save fuel--but they do it without the energy conversion losses. DTNA testing indicates that [redacted]. Therefore, these accessories should get credit too. We can support this claim with data, in a confidential setting. [EPA-HQ-OAR-2014-0827-1164-A1 p.81]

#### **Response:**

We understand DTNA's concerns regarding the cycle average approach. However, we initiated this approach in the fall of 2014. Since then, we have received strong support for most of the major industry manufacturers. More importantly, significant progress has been made in both the engine dynamometer tests and the test procedure development. Six different engine platforms, including Cummins ISX, ISB, ISL engines, Navistar N13 engines, Volvo D13 engines and Ford Gasoline engine, some of which were conducted at manufacturers site. Parent and child ratings were also extensively tested. All the results point to the same conclusion – cycle average approach is more accurate than the steady state map approach, specifically in transient cycle even with a transient correction factor. As a result of that, we believe that use of cycle average approach would be justifiable. With this change, we completely removed the transient correction factor proposed in NPRM. Many of these activities were conducted through the industrial group regular meetings that have been put into the memo docket (Docket EPA-HQ-OAR-2014-0827). See RIA Chapter 3.1.2.6 for further discussion on the cycle average test procedure.

We appreciate the DTNA's support on our decision to use the agency's auto-shifting for transmission model. We also modified idle fueling to update our idle fueling maps based on many constructive comments from manufacturers, including DTNA.

Regarding simulations on accessories for vehicle certifications, we decided not to model these features. Model validation would be very difficult given the range of potential accessories. Similarly, each manufacturer may have unique accessories, which are virtually impossible to capture in a simulation tool. Consequently, we decided to use the same principle as in Phase 1: to use constant accessory power in GEM. In addition, Phase 2 GEM does provide additional opportunity to recognize advanced accessories through the mechanism of technology improvement input from the main GEM input file.

We agreed with DTNA's comments on tire input using tire revs per mile. We also allow the user the input different Crr for vehicle with different tires on each axle.

#### *ePTO Test Procedures*

Based on DTNA and others' comments, the agencies have expanded 40 CFR 1037.540 for Phase 2, to test PHEV PTO systems in charge depleting mode in addition to charge sustaining mode. With this change and with the utility factor curve that we developed jointly with National Renewable Energy Laboratory, the procedure can now account for the full benefit of plug-in hybrid PTO systems. See Chapter 3.7.4 of the RIA.

The PTO cycle is deformalized by zero PTO demand and maximum PTO demand. If an ePTO system has zero pressure with zero demand then the ePTO system will not run during the 0% points, which is consistent with how the systems run in-use.

Just like the vehicle duty cycles that are used in this rule, the agencies have defined the PTO duty cycle but manufactures have the opportunity to ask for approval for a different cycle under the off-cycle provisions.

The systems we test for the development of the PTO procedure in the first heavy-duty greenhouse rule, the flow was generally independent of the pressure, so the pressure determined the power output of the PTO system. Because of this the agencies defined the cycle in terms of normalized pressure. We appreciate the DTNA comments on TPMS. In the final rule, the agencies defined an effectiveness for both TPMS and ATIS and each is allowed for as a technology improvement input of the GEM input file. Those accessories that can be recognized through engine certification tests, such as variable water pump and oil pump, are not included as part of technology improvement inputs. Accessories that cannot be measured from engine tests can be either recognized in GEM as a technology improvement input or through off cycle credit.

**Organization:** Dana Holding Corporation

Simulating axles for vehicle certification

Dana offers various products related to the entire scope of the proposed rule (Class 2b – Class 8 trucks); however, we see the most significant impact of the proposed rule in relation to the class 7 and 8 line haul application. Within this heavy-duty class 7 and 8 market, Dana has made several significant technology advancements. In fact, our company continues to develop our latest technology offerings that are scheduled to be released in advance of the implementation of the new standards proposed by EPA and NHTSA in Alternative 3 of the proposed rule. [EPA-HQ-OAR-2014-0827-1138-A1 p.2]

Dana's current portfolio of technology offerings that would support the proposed Phase 2 improvements in fuel efficiency include the Spicer® AdvanTEK® heavy-duty (40,000 lb. GAWR) tandem axle that is currently offered at a rear-axle ratio as low as 2.26:1. This latest axle development was designed to

operate with the increased torque loads experienced through engine down-speeding. The new fast ratios below 2.64:1 is one key enabling factor to support reducing the engine speed toward 1150 rpms at 60-65 mph cruise speeds. Given the generally accepted principle that every 100 rpm reduction in the engine (at cruise speeds) accounts for a 1% fuel-efficiency improvement, Dana is pleased that the EPA and NHTSA have recognized the need to include axle-ratio as an input in the proposed Phase 2 GEM simulation. [EPA-HQ-OAR-2014-0827-1138-A1 p.2]

In addition to enabling engine down-speeding, a reduction in the axle ratio at highway speeds provides further efficiency improvement within the axle. Dana's efficiency testing clearly indicates that a reduction in axle ratio (i.e. a lower numerical ratio) improves the efficiency of the axle. Therefore, the ratio reduction will provide two forms of efficiency improvement: first, engine efficiency due to engine down-speeding and secondly, drive axle efficiency through the inherent efficiency gain with the reduction of the axle input speed. [EPA-HQ-OAR-2014-0827-1138-A1 p.2]

In fact, there are several other axle features in addition to axle-ratio that influence axle efficiency and can be visually verified during an in-use compliance audit. Such features include pinion gear offset (spiral beveled, hypoid, or amboid gearing), axle lube quantity, dual-range, and axle weight. Based on these easily verifiable features, Dana believes that the proposed 95.5% fixed axle efficiency rating (while lower than Dana's reported efficiency in most axle families) is reasonable and additional credit should be provided for specific improved axle features. It is Dana's opinion that the dynamometer testing proposed as an alternative in Section II.C.1.(c) (pg. 40185) of the proposed rule would result in excessive complexity and documentation for fractions of a percent improvement in efficiency, while easily identified features (such as the ones noted above) can serve as a less complicated checklist of credits with prescribed efficiency improvement values as used in the post-simulation approach. [EPA-HQ-OAR-2014-0827-1138-A1 p.2-3]

With regards to the emission reduction for fuel-efficient synthetic lubricants (40 CFR 1037.520(f)(2), pg. 40631 of the proposed rule), Dana fully supports the 0.5% efficiency credit offered towards the use of BASF FE 75 W90 lubricant. BASF FE 75 W90 qualifies as a Dana SHAES 256 Rev. C. approved lubricant. As a further advantage, Dana promotes the use of a BASF XFE 75 W90 as an extreme high-efficiency lubricant. Based on internal testing at Dana, we propose that the agencies offer a 0.7% minimum credit for the use of the XFE 75 W90 lubricant as a 6x4 tandem drive axle lubricant. [EPA-HQ-OAR-2014-0827-1138-A1 p.3]

#### Modeling CO2 emissions to show compliance with the proposed rule

As truck manufacturers take steps to comply with the proposed Phase 2 GHG and fuel-efficiency standards, Dana believes there will be a continued need to further down-speed the engine. To facilitate this "extreme" engine down-speeding need, Dana is currently developing technologies that will support our customers' ability to reduce engine speeds to 1050 rpm or below (at cruise speeds). This new level of extreme down-speeding can provide an estimated 3% (with a 300 rpm engine-speed reduction from current state) of additional GHG and fuel-efficiency improvement. However, this aggressive down-speeding can result in a series of trade-offs, such as: compromised low-speed vehicle maneuverability and performance; increased noise, vibration and harshness; higher torque through the drivetrain of the vehicle. [EPA-HQ-OAR-2014-0827-1138-A1 p.3]

To overcome these issues, Dana has developed a dual-range, "disconnectable," tandem axle. This new axle innovation will operate as a traditional axle in 6x4 configuration with a higher numerical rear axle ratio to support the low-speed vehicle performance and safety. While approaching cruise speeds the tandem axle will "disconnect" and no longer turn the inter-axle driveshaft, rear-rear pinion and ring-



gear, therefore, operating fully on the forward of the rear axle. During this disconnected configuration, the axle operates at the equivalent efficiency of a 6x2 arrangement offering an additional 2.5% of improved GHG and fuel-efficiency. [EPA-HQ-OAR-2014-0827-1138-A1 p.3]

It is our interpretation of the proposed rule that the Phase 2 GEM accounts for additional technologies and vehicle configurations that are applied after the simulation is completed. Within the post-GEM simulation the proposed rule and the GEM Phase 2 user manual (Table 6, pg. 16, of the user manual) list a series of technologies that reduce GHG emissions and fuel consumption in Class 7 and 8 tractors but are not easily captured in GEM. The proposed rule allows Class 7 and 8 tractor manufacturers to take a further post-simulation “reduction value” if their vehicles contain these technology improvements. Given our latest disconnecting axle innovation noted above, Dana further interprets that the proposed post-GEM simulation includes provisions for 6x2 configurations (noted as “permanent 6x2 configuration”) and disconnecting axles (noted as “part-time 6x2 configuration”). [EPA-HQ-OAR-2014-0827-1138-A1 p.3]

If we are interpreting the proposed rule correctly, Dana supports both having these axle arrangements listed as a post-simulation technology and providing a 2.5% reduction value for permanent and part-time drive axles. Dana further suggests including an additional efficiency improvement value for dual-range axle configurations as it enables slower engine speeds and faster axle ratios at highway speeds, boosting the vehicle’s efficiency performance. [EPA-HQ-OAR-2014-0827-1138-A1 p.3]

#### Tires and tire inflation systems

In addition to driveline systems (steer axles, driveshafts and drive axles), Dana offers tire pressure management systems that can be used on the full range of vehicles associated with the proposed rule (class 2b – 8). The Spicer® Optimized Tire Pressure System is designed for use with steer and drive axles, ensuring that tires in all tractor positions are at their target inflation without dependence on human intervention. Dana’s automatic tire inflation (ATI) solution is one of a number of available systems in the commercial vehicle space that automatically keep tires at the appropriate inflation to reduce rolling resistance, and provide significant fuel economy benefits. [EPA-HQ-OAR-2014-0827-1138-A1 p.4]

Dana’s independent studies support the findings in Section II.C.1.(f) (pg. 40187) of the proposed Phase 2 rule, highlighting that tire pressure monitoring systems cannot sufficiently guarantee the proper inflation of tires. These studies are supported by substantial fleet testimonials suggesting that monitor-only systems are too dependent on driver intervention to be effective, and even when used in combination with telematics, fleet managers typically only direct a truck in for unscheduled service if tires are at dangerously low pressures and at risk of blowout. Until tires reach this point, the benefits of reduced rolling resistance are typically not realized. [EPA-HQ-OAR-2014-0827-1138-A1 p.4]

While Dana supports the agency’s findings as it relates to providing post-simulation adjustments for class 7 and 8 tractors, the fuel economy benefits of reduced rolling resistance can be realized for all vehicles spending time on highway. As a result, Dana proposes that credit for automatic tire inflation systems be granted for all vehicle classes (2b-8) included in the rule, including credit for vocational vehicles as these vehicles tend to be on-highway between 40-60% of their life. [EPA-HQ-OAR-2014-0827-1138-A1 p.4]

Finally, the proposed rule grants a 1% “reduction value” as a post-simulation adjustment for the use of ATI systems on drive axles in tractors (40 CFR 1037.520(f)(7), pg. 40631 of the proposed rule). Maintaining proper tire inflation of the front tires on the steer axles can also contribute to reduced

rolling resistance, and improved fuel economy. Dana proposes an additional 0.25% credit be granted for tractors with ATI systems equipped on both steer and drive axles, for a total credit of 1.25 percent. [EPA-HQ-OAR-2014-0827-1138-A1 p.4]

**Response:**

We made appropriate changes relating to axle efficiency. Unlike the NPRM, where a fixed efficiency with 95.5% was used, the final rule uses the default power loss to represent the axle. The default power losses are derived from CBI data from two major axle manufacturers. The manufacturer has an option to override the default losses using the specified test procedure in 40 CFR 1037.560. With full axle testing, the benefits resulting from lubricants can be recognized as well. We also provide a mechanism to account for Dana's disconnectable axle defined 6x4D. However, only one axle ratio can be selected, requiring the OEM to select the axle ratio that is expected to be engaged for the greatest driving distance. The main reason for this decision is that we believe that disconnectable axle is primarily used in tractor applications, where cruise speeds are predominate. The cycle weighing on transient cycle is small compared to the weighting of the two cruise cycles. We also recognize either ATIS or TPMS through the technology improvement input of the GEM input file (see Preamble Section III.D.1.b.iv).

**Organization:** Eaton Vehicle Group

**Drive cycles**

We have seen the briefly analyzed proposed new drive cycles. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

**New high speed cycles in GEM have a significant grade.**

- We understand that the steeper grades in the cycles mimic national statistics of road grade and we have seen that the steeper grades exercise more shift control and other features, such as neutral coasting. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]
- We believe the Agency may want to revise actual profiles to mimic realistic roads, eg. piece-wise constant grade, besides the national statistics. The unrealistic hill shapes not realistic will distort shifting algorithms, especially significant when exercising the powertrain test. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]
- With higher grades, the simulated truck will also lose road speed while climbing. Thus it is important that these cycles should be distance-based and throttle demand should be 100% during the entire speed loss [EPA-HQ-OAR-2014-0827-1875-A1 p.3]
- Neutral coasting is "witnessed" by this test. There is a potential "double counting" with pull-down option. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]
- Eco-Roll like techniques are also credited by the powertrain test version, however these may clash with constant speed requirement and there is potential double counting the benefit with pull-down option. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]
- The grade sensor must be active in powertrain test mode and grade data set from the simulation. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

**Transient drive cycles proposed by NREL**

We fully support the transient drive cycles proposed by NREL. In our experience, these are more representative of how trucks are being driven and thus we use very similar cycles to calibrate our shift controls. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

**Value of transmissions in GEM-based certification:** Advanced transmissions, deeply integrated powertrains and the powertrain test option deliver a significant part of the compliance burden without significant incremental product cost, complexity, weight or vehicle architecture changes. We have provided data to the EPA showing that 25-33% of the line haul tractor compliance gap between

MY2017 and MY2027 can be covered through such technologies, and 33-50% of that gap can be covered in the vocational segment. [EPA-HQ-OAR-2014-0827-1194-A1 p.3]

**A consistent approach to manual drivers:** Fleet data indicates that automation introduces a 2% or more fuel economy advantage through human factors that go beyond technology -- making vehicles shift at the correct conditions and drive more efficiently. We caution the EPA that this behavior is already coded in GEM -- manual transmissions are shifted at higher engine speeds, with longer shift times -- as well as a 2% “automation bump” given in post-processing. A consistent set of assumptions should be adopted, carrying over to both GEM simulations and powertrain tests. [EPA-HQ-OAR-2014-0827-1194-A1 p.4]

### **Consistent approach to manual drivers**

The NPRM suggests that GEM accounts for the fuel economy benefits of automation realized in line haul and some vocational applications. We agree with the EPA assessment that based on fleet reports, the impact of automation is around 2% fuel reduction or better. These efficiencies are realized primarily through human factors that go beyond technology: making vehicles shift at the correct conditions and drive more gently. They also do not apply to any particular driver but rather hold in a statistical sense. Due to these considerations, the EPA opted for a 2% automation benefit to be given to automated powertrain technologies as a post-GEM simulation of the fuel consumption. [EPA-HQ-OAR-2014-0827-1194-A1 p.15]

We caution the EPA that some driver behavior is already coded in GEM (manual transmissions are shifted at higher engine speeds, with longer shift times in GEM simulations), as well as a “2% automation bump” given in post-processing of GEM simulations. Furthermore, the fleets tend over time to configure AMT trucks for more engine downspeeding by deploying faster axles. We have CBI data that shows the trend toward higher final drive ratios as AMTs penetrate fleets. Thus, part of the 2% fuel benefit is in fact an artifact of the engine downspeeding enabled by automation that is already captured in GEM. [EPA-HQ-OAR-2014-0827-1194-A1 p.15-16]

We prefer that GEM codes the manual driver as a higher shift point and longer shift because in that case, we are able to run manual transmissions on powertrain tests using their AMT versions. As the AMT also uses some power from fuel to perform shifts, the test will in fact slightly overstate the manual transmission fuel economy benefit, in the spirit of always being “slightly conservative.” [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

**Recommendation:** The EPA should consistently adopt one of the following hypothesis: either A) the AMT shift strategy is already programmed to emulate a normal driver (and hence the manual transmissions should be simulated identically to an AMT) in which case a uniform “automation bump” should be maintained, B) or B) the poor efficiency manual drivers shift late and at higher speeds (as in current GEM), but then the benefit of automation was already encoded in the manual shift schedule so that no “automation bump” is necessary. [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

**Recommendation:** Should the EPA decide to treat manual transmissions identically to AMTs from a shifting perspective and provide a post-GEM simulation “2% automation bump,” then the GEM simulations using powertrain results should benefit from the same treatment when implemented in GEM (currently it seems that if powertrain data is used, there is no means to alert GEM to an automated transmission). [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

### **Higher grade drive cycles**

We support the existing grade profiles for the 65 mph and 55 mph cycles with up to +/-2% grades. We do understand those road grades correspond to actual highway conditions in a relatively flat part of the country. However, we are not opposed to steeper grades in the cycles shown recently by the EPA and developed by NREL to mimic the national grade distribution. In fact, we believe the steeper grades will exercise more shift control features and other features, such as neutral coasting. [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

We do caution that the actual road profiles recently discussed, also called “half-hills,” need some re-thinking. Although we have not yet run either GEM simulations or powertrain tests by the end of the comments period, we are concerned with the rapidly changing slope that is unrealistic and may confuse the grade sensor. Should the actual profiles be revised to mimic realistic roads (with the potential consequence of a longer drive cycle), then we would have no objection to steeper grades. [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

However, it is important to realize that the steeper grades can exceed the grade-ability of some configurations. Thus, not only will the shift controls be exercised significantly more, but the simulated truck will also lose road speed while climbing. For GEM simulations, this is not a significant issue, but for powertrain testing it may be. It is imperative that a constant speed cycle is not only distance-based (which is the current GEM setting) but that it also demands that the throttle be open 100% during the entire speed loss. Otherwise, the slower truck will look more fuel efficient but in reality it would be an artifact of reduced aerodynamic loads at lower speed, even if the route is completed in a longer time. [EPA-HQ-OAR-2014-0827-1194-A1 p.16]

The EPA asked if it should consider speeds other than 65 mph and 55 mph vs other speeds. We see no significant benefit to other highway speeds, although we have had a situation where the 55 mpg at zero grade happened to be a worst and relatively unique operating point on the engine. However, as soon as variable grades were introduced, that problem ceased to exist because the engine is still exercised at multiple points due to the changing grade. [EPA-HQ-OAR-2014-0827-1194-A1 p.19-20]

## **Eaton comments on the EPA MD/HD Greenhouse Gas Phase II NODA**

### **Background**

The Agency has provided the industry with several opportunities to monitor and provide input into the development of the Phase II regulations. Recently it has requested comments around several issues. Eaton will comment and share experiences around the technical implementation and updates of GEM, which we view as core to the rule and its success. [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

GEM has improved significantly since its early Phase II version was released in 2015. We believe that the powertrain technology is now well represented in GEM. We believe that the following are characteristics are critical to the success of GEM as a tool and to realizing the improvements envisioned by the rule in an efficient way for the industry: [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

- GEM predictions need to be “slightly conservative” versus real-life applications, so that GEM does not either create a bias or drive “paper-only” improvements. [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

Eaton has noted significant improvement in GEM along the directions outlined above and we have a high degree of confidence that GEM will be ready and effective by the time of rule finalization. [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

### **Conclusions**

The improvements to GEM have improved significantly the quality of the predictions, making us believe that the Agency is on track to have a good and robust regulatory tool. We appreciate the open manner which the Agency solicited feedback from stakeholders and provided status updates and we believe it was a key factor in improving GEM. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

Based on hardware data and powertrain tests, we feel the Agency has achieved the following: [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

- GEM results capture correctly the fuel consumption differences based on transmission architecture and fuel reduction technologies. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

- The GEM predictions are “slightly conservative” when compared to non-optimized, commercially available transmissions [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

- GEM has robust and accurate means to overwrite default loss models and default control logic, and thus account for advanced technologies and transmissions optimized for fuel efficiencies. [EPA-HQ-OAR-2014-0827-1875-A1 p.3]

- GEM predictions using the powertrain-based model reflect the real-life fuel efficiencies tested for optimized transmissions, and thus is reasonably future-proofed for new technology. [EPA-HQ-OAR-2014-0827-1875-A1 p.4]

- The high-speed test cycles exercise fully the powertrain and are statistically representative of national roads. However, the hill shape could be improved to mimic more realistic road grades and thus more realistic shifting. [EPA-HQ-OAR-2014-0827-1875-A1 p.4]

- The transient cycle proposed by NREL is better matched to what the industry uses to optimize fuel efficiency regardless of regulations. Its adoption will only increase the consistency between real-life design practices for fuel consumption reduction and the regulatory drive to reduce CO<sub>2</sub>. [EPA-HQ-OAR-2014-0827-1875-A1 p.4]

GEM offers manufactures the ability to quantify significant CO<sub>2</sub> reductions in both line haul and vocational segments, especially with the options to overwrite defaults with transmission loss data and/or powertrain test-based models. This enables manufacturers significant flexibility in achieving stringent standards with technologies that do not significantly add weight, complexity or cost. [EPA-HQ-OAR-2014-0827-1875-A1 p.4]

**Response:**

We appreciate Eaton’s various constructive and positive comments, specifically on the NODA version of GEM. We provide 2% benefits for automated manual transmission (AMT) as opposed to manual transmissions (MT). See RIA Chapter 2.8.2.5.

We seriously considered many constructive comments on the road grades. Consequently, we made quite a few changes to the road grade. Examples include adding flat road and  $\pm 0.5$  percent road grade road at the beginning and end of cycle, and shrinking the peak grades of the shortest hills by capping the change in grade per change in distance to rates seen from in-use CBI data provided by manufacturers. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took to create the road grade profile.

In addition to modifying the road grade profile the agencies have also conducted many powertrain tests with the profile to see how actual powertrains responded to the cycle. From this testing the agencies not only believe that the road grade profile is representative but it also fully exercises the powertrain. With regard to the road grade of the cycle exceeding the grade-ability of the vehicle, GEM already handles this, because the drive model in GEM will go to 100% pedal position if the vehicle falls off the trace significantly. As for powertrain testing this is handled by the requirements of 40 CFR 1037.550 (g) that require the pedal to be at 100% if the vehicle speed is lower than the lower speed tolerance. The agencies understand the comment that the shape of the half-hills are synthetic and do not look like typical hills, but with regard to the shift strategy the agencies have not found that the synthetic hills

cause the transmissions that were powertrain tested at Oakridge National Laboratory<sup>29</sup> or Southwest Research Institute<sup>30</sup> to shift in an unrepresentative way. We agree with Eaton that the cycles should be distanced based and that the throttle demand should be 100% when the vehicle is not able to meet the demand of the cycle.

The agencies do not agree that that there is double counting of neutral coasting and eco-roll technologies in the pulldown input and in the actual simulation of the vehicle on the cruise cycles. This is because the allowance for the vehicle speed to overshoot the cycle speed by 3 mph when going downhill is to simulate how conventional cruise-control algorithms run. The “Intelligent controls” pulldown is designed to give credit for technologies that use predictive control to adjust current operator demand based on future vehicles demands for example reducing operator demand even when going uphill, knowing that the vehicle will be going downhill in a short distance.

The agencies agree that grade or other sensors that allow the powertrain to operate in a way that is more representative of in-use operation should be used or should be simulated in another way. That is why we added change to 40 CFR 1037.550 (i) to allow this.

The agencies thank you for your comments regarding the transient drive cycles proposed by NREL, but since the agencies did not have enough time to fully evaluate the cycles the agencies finalized the cycle we proposed for the transient phase of the duty cycle.

**Organization:** Electric Drive Transportation Association (EDTA)

## **Models and Testing**

To capture the full benefits of electric drive, compliance pathways should also recognize its diverse contributions to efficiency, particularly in the duty cycle of vocational vehicles. The EPA’s Greenhouse Gas Emissions Model (GEM) model should better model fuel efficiency improvements for hybrid and plug-in hybrid systems. Vocational vehicles, as defined by the EPA, represent about one fifth of the total medium- and heavy-duty fuel consumption and include numerous vehicles types: “delivery trucks, refuse haulers, public utility trucks, transit, shuttle, and school buses. This segment also includes very specialized vehicles such as emergency vehicles, and cement and dump trucks.”<sup>6</sup> [EPA-HQ-OAR-2014-0827-1217-A1 p.3]

The varied nature of the vocational vehicle fleet calls for a more comprehensive accounting of efficiency and emissions reductions in the full duty cycle. Specifically, the rule should establish compliance pathways that recognize the efficiency and emissions contributions of electrification including Power Take Off systems, which are increasingly being integrated into fleets’ vocational vehicles. [EPA-HQ-OAR-2014-0827-1217-A1 p.3]

These systems could be recognized in the testing procedures for vocational vehicles or in off-duty cycle credits. In the former scenario, lessons can be learned from CARB’s modeling of the full day vocational duty cycle. In the latter, establishing off-duty credits based on clear criteria and eligibility will increase certainty and uptake in this area. [EPA-HQ-OAR-2014-0827-1217-A1 p.3]

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<sup>29</sup> Oakridge National Laboratory July 2016, “Powertrain Test Procedure Development for EPA GHG Certification of Medium- and Heavy-Duty Engines and Vehicles.”

<sup>30</sup> Southwest Research Institute July 2016, “Validation Testing for Phase 2 Greenhouse Gas Test Procedures and the Greenhouse Gas Emissions Model (GEM) for Medium- and Heavy-Duty Engines and Powertrains.”

**Response:**

The agencies agree with EDTA that hybrid and plug-in hybrid systems should have a pathway to recognize the benefits of the technology in GEM and because of this have modified 40 CFR 1036.540, 40 CFR 1037.540 and 40 CFR 1037.550 to allow for testing of these systems. 40 CFR 1036.540 and 40 CFR 1037.550 can be used to test hybrids and PHEV that use the stored energy to propel the vehicle. For electrified and PHEV PTO systems 40 CFR 1037.540 can be used to recognize the benefits of these systems. Even though GEM does not model hybrid or plug-in hybrid systems, GEM has been designed to use the output of these tests to account for the benefits of the systems.

**Organization:** Hino Motors, Ltd.

2. Balancing of Battery SOC (State of Charge) for HEV Configurations

Vehicle fuel efficiency is measured as the efficiency of the energy supplied from external sources to the vehicle (i.e., diesel fuel for diesel vehicles). In this sense, HEV electric batteries energy for vehicle drive should not be included in the fuel efficiency measurement. If this energy is included in the calculation, the fuel efficiency value calculated will not represent the real-world fuel efficiency of the vehicle. For this reason, the energy from vehicle drive batteries must have an energy balance of 'zero' between start and end of the test. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

Yet, it is quite rare that the energy balance settled down at zero during actual tests without paying any attention to having the balance. Therefore, generally we conduct 3 or 4 tests with different SOC level to determine the balanced SOC level by interpolation from test result. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

Consequently, HEV fuel efficiency test by cycle average map will necessitate engine manufacturers to conduct three to four times more tests. This is extremely heavy burden for manufacturers to conduct GHG certification test for HEV. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

Request:

Hino would like to keep the discussion with EPA on the most practicable way of testing of hybrid system to reduce a number of test on SOC balance. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

3. Torque at Regeneration

Fundamentally, HEV fuel efficiency improvement is generated from the regeneration of vehicle energy. Therefore, it is necessary to use the correct regeneration energy in the HEV fuel efficiency calculation. [EPA-HQ-OAR-2014-0827-1877-A1 p.3]

In the proposed GHG Phase 2 regulation, the GEM program is used to convert the vehicle speed and traction force on propeller shaft, based on vehicle specifications and road grade data. The traction force to drive the vehicle is output from GEM, but it seems that negative traction force generated during vehicle deceleration (regeneration) did not output in GEM. [EPA-HQ-OAR-2014-0827-1877-A1 p.3]

Request:

Please confirm if GEM program takes into consideration regeneration force conversion. [EPA-HQ-OAR-2014-0827-1877-A1 p.3]

4. GEM Negative Torque Calculation during HEV Regeneration

Also we would like to know if the GEM correctly calculates the engine torque based on the grade data on a downward slope because a torque map (see the map below) in the EPA document does not show the negative value less than 0. [EPA-HQ-OAR-2014-0827-1877-A1 p.3]

Request:

Please confirm if GEM correctly calculates the negative engine torque based on the grade data on a downward slope. [EPA-HQ-OAR-2014-0827-1877-A1 p.3]

[Figure can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1877-A1]

#### 5. Equivalent Opportunities for Various Hybrid Systems

There are several types of hybrid system, such as parallel hybrid system, series hybrid system, split hybrid system, etc. As represented by series hybrid system, there are some types of system which have several power sources. In such a system, motor to drive vehicle and engine to generate electric energy are not connected mechanically. Therefore two test dynamometer is required for such system. [EPA-HQ-OAR-2014-0827-1877-A1 p.4]

Generally speaking, this way of test equipment setup is practically difficult on the ordinary test bench. Because of this difficulty, equal opportunities for the hybrid system are disadvantaged compared with the conventional diesel engine from a certification standpoint. [EPA-HQ-OAR-2014-0827-1877-A1 p.4]

Request:

Provide a standard GEM improvement for hybrid systems and do not make powertrain testing a requirement for hybrid systems to accommodate various type of hybrid system. [EPA-HQ-OAR-2014-0827-1877-A1 p.4]

#### **Response:**

We share the same concern with Hino on the test burden for HEV systems. To help address this the agencies have extended the cycle average mapping procedure to HEV and PHEV systems. To do this we updated the definition of the motoring torque curve to include the braking torque of the hybrid. With this change GEM will calculate the braking torque that is required by the hybrid during the test. With regard to your comment on SOC balancing, the agencies would also be interested in continuing discussion on further ways to reduce the test burden on hybrid vehicles.

**Organization:** International Council on Clean Transportation (ICCT)

#### **Testing and compliance protocols**

##### **Test procedures, cycles, and simulation modeling**

We support the agencies decision to maintain the Phase 1 regulatory structure of including a separate engine standard for the reasons outlined in Sharpe, Delgado, Muncrief (2014). In summary, it was found that the benefits of a certification protocol that include a separate engine standard while simultaneously enhancing the GEM certification with improved inputs outweigh any potential disadvantages. Key advantages include acknowledging the market structure, promoting improvement in all technology areas, and linking to criteria pollutant emissions. We also raise several issues that could help strengthen the agencies' regulatory design and testing procedures. [EPA-HQ-OAR-2014-0827-1180-A4 p.12]

There is a predefined list of off-cycle technologies that are not captured by GEM simulation but are recognized via post-simulation adjustment factors. The agencies set fixed default effectiveness values for such technologies. For example, automatic tire inflation systems effectiveness was set at 1.0%, and 6x2 axles was set at 2.5% (Table III-7 of NPRM). The following issues were identified with such technologies and adjustment factors. [EPA-HQ-OAR-2014-0827-1180-A4 p.13]

Drivetrain. An adjustment factor of 1.8% from downspeeding was set (Table III-7 of NPRM). There is no need for such an adjustment factor since the downspeeding of the engine through transmission gear ratio, drive axle ratio, and tire diameter is already captured by GEM. Also, a reduction in friction due to low viscosity axle lubricants is set to 0.5%. It is not clear how the agencies would verify the use of such



lubricants and there is the risk of giving 0.5% without any real-world fuel savings. [EPA-HQ-OAR-2014-0827-1180-A4 p.13]

Transmission. The benefits for automated transmissions (automated manual, automatic, and dual clutch transmissions) are set at 2.0%. This number seems high, taking into account that part of the benefit of such transmissions come from downspeeding and those benefits are already captured by GEM. Such high number may discourage the use of powertrain testing. We recommend setting the adjustment value to 1%. [EPA-HQ-OAR-2014-0827-1180-A4 p.13]

Accessory improvements. An adjustment factor of 0.5% is set for improved air conditioning systems. It is not clear in the rule how one would determine if an air conditioning has improved, but based on Reinhart (2015a), an improved air conditioning system would reduce power demand by 600 W. A 600 W reduction in power demand only represents 0.33% fuel consumption reduction in GEM simulation. Also, the air conditioner system is not used all the time so the real-world benefits will be even lower. We recommend setting the adjustment value to 0.3%. Also, an adjustment factor of 1% is set for electric accessories. It is not clear if these refer to all of any of the accessories that have potential to be electrified (e.g. water pump, oil pump, power steering pump). Note that the effect of some of these accessories (e.g. water pump, oil pump) is already captured in the engine mapping process and therefore would be captured by GEM simulation and there is no need for adjustment factor. [EPA-HQ-OAR-2014-0827-1180-A4 p.13]

The off-cycle technologies' adjustment factors are additive, implying that there is not negative or positive interactions among technologies. We recommend that multiplicative aggregation of technologies' effectiveness—similar to the one conducted for engine technologies—be applied in order to better quantify these effects. Also, these adjustment factors inherently assume that all the technology variants within a technology category provide the same fuel consumption benefits. Not all the models and brands of a certain technology feature would provide the same fuel consumption benefits. There is the risk of giving artificial credits to products that perform at a lower level than the value that is selected from the drop-down menu, thus rewarding poor performers. The default values ideally would be set to the minimum values of the ranges. The users have the option to use off-cycle credit proposed by the rule (similar to innovative credits in Phase 1) to quantify the additional benefits of individual technologies. [EPA-HQ-OAR-2014-0827-1180-A4 p.13]

GEM Simulation. The fact that the user can input specific powertrain parameters but does not have the option to input or modify the simulated payload could create the situation in which some simulated vehicles, the ones with low power-to-weight ratios, will show high deviations from the target speed-distance trace. This affects the simulation results since these underpowered vehicles will take more time to complete the assigned route and will show a lower average speed. This could lead to underpowered vehicles being improperly credited. We recommend that a performance criterion that captures the trace-following capabilities of the simulated truck (e.g. percent difference between target speed and simulated speed) is used and be a part of the output of the tool. Ideally, the allowed deviations from the target trace should be minimized for the simulations to be considered valid and allow comparisons between them. [EPA-HQ-OAR-2014-0827-1180-A4 p.13-14]

There are opportunities for fuel savings from mechanical accessories and electric accessories but the agencies decided to keep with the Phase 1 approach of having pre-defined and not customizable power from accessories. If these parameters are assigned default values, there are no incentives to implement new technologies that could have greater impact. Allowing accessories' power consumption to be user-defined inputs in GEM can be used to promote developments in technologies that currently are not

considered in the proposal (e.g. power demand reductions from the alternator and cooling fan). [EPA-HQ-OAR-2014-0827-1180-A4 p.14]

### **Powertrain test**

The ICCT supports the use of a powertrain test to ensure that transmission and integrated engine-transmission efficiency technologies are acknowledged and promoted within the regulation. To make sure the powertrain provisions serve that objective, the default credits (e.g., for automated manual transmissions) would ideally be established at the lowest potential improvement level that any company might reasonably achieve, such that any additional benefits would require data from the powertrain test submitted to the agencies. It would appear that the 2-3% automated manual transmission (AMT) benefit (for tractors and vocational) may be too high, considering that many AMTs based on company and fleet input may offer limited benefits compared to manual transmissions (Lutsey et al, 2014). We would recommend considering an AMT default at 1% to better reflect the range of transmissions in the marketplace and their various potential final drive ratios. Also, a 1% AMT default would encourage manufacturers to utilize the powertrain test. Greater potential exists to promote more powertrain technology, and the agencies could consider significantly more technology penetration and greater CO<sub>2</sub>-reduction effectiveness from integrated powertrain approaches that include shifting strategies and integrated controls directly in the stringency determination (Stoltz and Dorobantu, 2014; Jackson and Palazzo, 2015; ongoing Bosch track test results). In order to ensure that the GEM result reflects a slightly conservative value that does not unduly credit powertrain technology and that promotes the appropriate utilization of the powertrain test option, we suggest that the agencies conduct powertrain versus GEM testing on the most common integrated powertrains and adjust the GEM model appropriately. [EPA-HQ-OAR-2014-0827-1180-A4 p.14-15]

### **Response:**

We thank ICCT for many constructive comments.

ICCT is correct in their assessment that the effectiveness of downspeeding is accounted for through the transmission gear ratio, drive axle ratio, and tire size. The downspeeding value listed in Table III-7 of the NPRM highlighted the approximate effectiveness of the change in axle ratios modeled for setting the proposed stringency levels. The agencies did not apply a separate adjustment factor for downspeeding in the NPRM. For the final rule, the agencies removed this row of the table and added a better description of how downspeeding is modeled through the use of axle ratios in GEM and used in setting the tractor standards.

The agencies determined the effectiveness of automated transmissions based on literature values, comments, and CBI of transmission suppliers. We believe that automated manual transmissions lead to a two percent reduction in CO<sub>2</sub> emissions and fuel consumption compared to manual transmissions in real-world driving conditions. See Preamble Section III.D.1.b.vi.

The agencies have refined the definitions and the effectiveness of accessories in the final rule. See 40 CFR 1037.520. The agencies are only allowing the predefined accessories to be included in GEM. We are not allowing customizable power inputs for accessories because we do not have test procedures developed to quantify what the power requirement is for each subcategory of HD vehicle over each test cycle.

The agencies defined the curb weight of the HD vehicles and the associated payloads for each subcategory. This is necessary because allowing a variable payload would result in different numerical

standards. If a vehicle configuration, such as under-power engine vehicle, is not able to keep up with the drive cycle trace during the simulation, the vehicle will go to 100 percent pedal position when the vehicle speed is significantly below the cycle speed and the simulation will continue until the vehicle completes the entire cycle.

On powertrain testing, again we believe that an AMT is two percent more effective than manual transmissions in the real world driving and it is appropriate based on the information we received. We do believe that powertrain testing will still be the appropriate mechanism to evaluate shift schedules and other integrated controls, as noted by the commenter.

**Organization:** Meritor, Inc

### **Expand GEM to Foster More Innovation**

Meritor is supportive of the proposal “to significantly expand GEM” from Phase 1 “to account for a wider range of technological improvements that would otherwise need to be recognized through some off-cycle crediting approach.” Furthermore, Meritor believes that the inclusion of distinct GEM inputs “to represent the engine, transmission, drive axle(s) and loaded tire radius,” as opposed to the default value approach in Phase 1, incentivizes the development of fuel efficient individual and collaborative power/drivetrain technologies. In short, it supports competition and collaboration; both of which are needed to meet the proposed Phase 2 rule on greenhouse gas emissions and fuel efficiency. [EPA-HQ-OAR-2014-0827-1254-A1 p.3]

#### **Response:**

We very much appreciate the positive comments on GEM from Meritor.

**Organization:** Navistar, Inc.

We note that GEM inputs add static loaded radius to inputs in GEM. Navistar does not oppose the addition of static loaded radius. However, we believe that the tire manufacturers are in the best position to make this measurement in a consistent manner. Static loaded radius should come from a tire manufacturer using their methodology and tire manufacturers should provide this information along with rolling resistance data. We agree with the EMA comments in this regard. [EPA-HQ-OAR-2014-0827-1199-A1 p.41-42]

## **IV. Revisions to GEM**

### **a. Grade**

The agencies released a new version of the Greenhouse Gas Emission Model (“GEM”) and sought comment in the NODA. A major change to the assumptions surrounding grade distribution and transitions is incorporated in the new version of GEM. The modeling framework that the NPRM is built around has had much time, effort and discussion around the specific inputs and the processes of generating these inputs. The grade profile is a topic that did not receive much attention from the vehicle manufacturers during the original NPRM phase due to the understanding that the grade profile would be revisited and a new one would be put forth for consideration. There were some concerns expressed by the industry during the initial release of the NPRM focused on the original grade profile which resulted in the engine being driven in an uncharacteristic manner. The root cause of this was not fully known at the time, but it was thought to be due to an unrealistic grade distribution. The expectation was that the

new grade profile the EPA was working on would be an improvement. [EPA-HQ-OAR-2014-0827-1919-A2 p.5]

The EPA proposed Grade D profile has been shown to match the grade histogram generated by the EPA-commissioned study, as well as lining up with manufacturer's customer data, and the associated development cycles. With a brief look one would think the problem would be alleviated. However, upon more detailed analysis of the output of the recently released NODA GEM version it was quickly recognized that the original concerns are still not fully addressed. Even with the inclusion of the new grade profile the engine operation is still being incorrectly represented within the regulatory framework. [EPA-HQ-OAR-2014-0827-1919-A2 p.5-6]

[Figure, 'Grade Profile D: Nav Cruise', can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1919-A2]

To rehash, the main problem that Navistar has with the grade profile in the revised GEM is that it results in engine operation that is uncharacteristic, and misrepresentative of what actually occurs in the real world. It is unrealistic to the point that the simulation of vehicles on the Grade D Profile could (and already does) pose a risk for adverse consequences in the future. Information shared with the EPA provided evidence that customer data shows that there is significantly less time spent at WOT in the real world than the 40% shown above when using the Grade D profile. One way to alleviate this issue is to make changes to the driver model within the GEM simulation. The driver model improvements that are recommended are that the logic be updated such that for the highway cycles trucks be allowed to over speed the speed set point by an allowable amount when the vehicle is traveling downhill. This is a common driving behavior utilized by drivers and cruise controllers alike to increase fuel economy and productivity. Given the way in which the Grade D cycle is built, in that the road has repeated and discontinuous transitions from downhill to uphill segments, the improved driver model will allow the vehicle to carry more speed into the uphill section and thereby reduce need for WOT operation. The total effect of this is on the order of about 10% reduction in fuel used at WOT. [EPA-HQ-OAR-2014-0827-1919-A2 p.6]

The main reason for the unrealistic engine behavior is that although the grade profile distribution, aligns well in 1-D domain, it does not align well with the real world in how it transitions the grade profiles. This, as demonstrated in the two figures below, is found to be an artifact of trying to represent the national grade profile in a condensed length of road. These charts are the differences in the transition probability of the grade profiles and they show that, when compared to data collected from the real world, the Grade D profile is not very representative. [EPA-HQ-OAR-2014-0827-1919-A2 p.6-7]

[Figure, 'Transition Probability Matrix Differences', can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1919-A2]

The chart on the left represents grade profile that does not exist in the real world, and the one on the right shows places where there is a lack of grade information in the Grade D profile. [EPA-HQ-OAR-2014-0827-1919-A2 p.7]

The impact of this will be felt by both OEMs and customers alike and could negate the penetration rates and costs predicted by the agencies for the implementation of the rule. Certain technologies such as down speeding will be under represented in their impact which will result in other technologies being incentivized to meet the regulation versus this lower cost and potentially more suitable option. There is also the impact to technologies such as predictive cruise (should an OEM desire to do additional testing for a higher effectiveness number), and mild hybrids to name a few. There is also always the potential

risk due to the misalignment of regulatory and real world operation that other technological and/or certification issues present themselves in an adverse manner that is detrimental to either customers, OEMs, or regulatory agencies. The new grade in GEM could, thus, lead to the kind of distortions that the agencies should seek to avoid. [EPA-HQ-OAR-2014-0827-1919-A2 p.7]

#### **b. Other Issues in GEM**

Navistar has been attempting to evaluate GEM beyond the issues identified above with grade so that it may adequately comment on this latest version. However, given the very tight timeframe for comment we have been unable to fully assess whether GEM contains changes other than those specifically addressed. Navistar's NPRM Comments addressed extensively what we felt was the lack of adequate opportunity to comment on GEM.<sup>9</sup> Those issues with respect to adequate notice and comment still exist, and are not fully addressed by the short period with which impacted parties have to analyze the GEM. [EPA-HQ-OAR-2014-0827-1919-A2 p.7]

Moreover, the GEM version provided with the NODA did not contain any information as to the baseline values, which Navistar discussed at length in the NPRM Comments.<sup>10</sup> Without that information, there is virtually no way to adequately determine, with reference to the agencies' data, whether GEM is performing correctly or not. [EPA-HQ-OAR-2014-0827-1919-A2 p.7-8]

To create the hypothetical engine that forms the baseline for the vocational engine in GEM, the agencies constructed a hypothetical engine map. This was not derived from an actual in-use engine. Our current analysis of this hypothetical map shows a shift in the baseline from actual, real-world engines. That is, the theoretical starting point, the MY17 standards, changed. The baseline engine maps within GEM for the vocational vehicle are not aligned with current 2017MY compliant engines and hence, set up an unrealistic baseline for the vocational vehicle standard. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

Navistar took one of its MY2017 CO2 compliant engine families and created an engine map for use in the Phase 2 version of GEM. Comparing the tested engine map to the 2018MY baseline maps the tested engines showed differences ranging between 1 to 5% in the cruise part of the map and around 10% in the "acceleration" part of the map for the 345hp engine map to 10% to 15% differences for the 350hp engine map. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

The problematic areas of the hypothetical vocation baseline engine include the following: [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

- The EPA 345 hp HD generic engine map has an uncharacteristic shape where the minimum BSFC points is at 9% of maximum power. Other hypothetical engines show 80% of maximum power. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]
- The 270 hp MD hypothetical engine is flawed as well. Comparison with actual compliant MY2017 engines show that the hypothetical engines were 10% higher in fuel consumption than the real-world engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

Ultimately, this discrepancy must be corrected. Navistar will separately provide proprietary information to EPA showing this concern in greater detail. All manufacturers should begin from the same starting line, the actual MY2017 emission performance of the engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

2 NPRM Comments at 31.

<sup>9</sup> NPRM Comments at 4-5.

<sup>10</sup> NPRM Comments at 24-25.

**Response:**

With respect to Navistar's comment on adequate notice, please see the agencies' response in RTC Section 15.5.

The agencies have changed the tire input to GEM from loaded radius to revolutions per mile because this is the value more often used by tire manufacturers. We have considered many constructive comments on the road grades. Consequently, we made quite a few changes to the road grade. The examples include adding flat road and  $\pm 0.5$  percent road grade road at the beginning and end of cycle, and shrinking the peak grades. The changes to the road profile were made to better align the engine operation in GEM with the engine operation of in-use vehicles. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took to create the road grade profile.

All the agencies' baseline engines are developed based on real life in-use engines. In the final rule, we have combined a 345hp engine with a 350hp engine as one engine, which will be applied to both tractor and vocational vehicles. We also made changes to the 270hp baseline engine fuel map. However, it should be pointed out that the engine for the baseline 270hp rating engine was 7 liter based, and is much smaller than Navistar 9 liter engine. As a result, the engine sweet spot and the rated speed are also appreciably different. On the other hand, the 350hp engine used by the agencies is 11 liter based, and is bigger than Navistar's N10 engine. Depending on the vehicle configurations, such as transmission, and axle ratio, the engine operating points in terms of engine speed and load can be so different between two different engines, resulting in different values of CO<sub>2</sub> g/hp-hr. Although we did not provide the baseline values, we made the best efforts to supply those vocational vehicle baseline values in the later power user release version.

**Organization:** Odyne Systems LLC

Odyne works closely with Allison and would like to echo their concerns on the need for better modeling since our system is integrated via the PTO interface on their transmissions. Not all hybrid systems are physically located in existing powertrain components; some systems can include external components added and integrated with powertrain components, which is the case with our system. So any issues that would impact the transmission could also impact our hybrid system. [EPA-HQ-OAR-2014-0827-1239-A1 p.19]

Allison Comments from public hearing in Chicago on August 10th

*"Allison fully supports EPA's ongoing efforts to make GEM more accurate and more representative of real world vehicles. We also support the use of GEM as the primary certification methodology -- but we have some significant concerns with the quality of GEM software and EPA technical and policy choices regarding GEM. [EPA-HQ-OAR-2014-0827-1239-A1 p.20]"*

*First, GEM does not run well. When GEM was delivered, there were missing files and then when we got it to run, there were a number of coding errors identified. Secondly, the model produces unrealistic operation over the duty cycles. The lockup shift strategy and the neutral loading and automatic neutral*

*functionality are inappropriate. And, finally, there are major deficiencies in the base control algorithms. Some production vehicle configurations would not shift out of first range. Others do not downshift at highway speeds when a load is encountered. We have also seen the GEM controller release lockup at highway speeds which would never happen. [EPA-HQ-OAR-2014-0827-1239-A1 p.20]*

*These examples do not reflect how fully automatic transmissions operate. And flaws in GEM will directly translate into flaws in the final rule. In short, GEM is not ready for “prime time” as the certification tool. Given this situation, we believe that EPA and NHTSA must be mindful of the procedural requirements of the Clean Air Act and the Administrative Procedure Act. Adequate opportunity for comment must be provided, especially with regard to a central element of the rulemaking, such as GEM. [EPA-HQ-OAR-2014-0827-1239-A1 p.20]*

*With regard to GEM, the devil really is in the details. It is impossible to understand and reasonably project the effect of any final rule without understanding precisely how GEM will operate, what it will measure and how it will assess different systems. This is especially true in the vocational vehicle market where there are hundreds of different vehicle types and is amplified where, as here, EPA and NHTSA intend to decrease greenhouse gases and improve fuel efficiency through the deployment of new technology. [EPA-HQ-OAR-2014-0827-1239-A1 p.21]*

*When GEM executable files will not run; when other errors are found in GEM, when delays occur in making changes to the model -- the very process of the public comment period is called into question. Without refinement, GEM results could be considered arbitrary.” [EPA-HQ-OAR-2014-0827-1239-A1 p.21]*

**Response:**

We understand the commenter’s concerns on the early version of GEM. Since then, significant improvements have been made, such as the following:

- Modified road grade profile for 55- and 65-mph cruise cycles
- Revised idle cycles into overall vocational vehicles with new vocational cycle weightings
- Made significant changes on the input file structures. Examples includes additions of columns for axle configuration (“6x2”, “6x4”, “6x4D”, “4x2”), and additions of a few more technology improvement inputs, such as “Neutral Idle and Start/Stop.”
- Made significant changes on output file structures. Examples includes an option to allow the user to output detailed results on average speed, average work before and after transmissions, and the numbers of shift for each phase (55 and 65mph cycles and ARB cycle).
- Added input file for axle power losses (function of axle output speed and torque) and replaced single axle efficiency in model with lookup table of torque loss
- Added simulation of engine torque response with fast response region defined by engine displacement, and slower torque increase in boosted region with fast falloff on available torque
- Added regression models for all certification cycles to allow the user to simulate vehicle with cycle average approach
- Added different fuel properties according to 1036.530.
- Significantly improved shift strategy based on testing data
- Adjusted transmission loss & inertia scale factors per regulatory subcategory
- Added optional input table for transmission power loss data
- Added minimum torque converter lock-up gear input for AT
- Retuned the default transmission mechanical efficiency based on the testing data

- Added neutral idle and start/stop features during simulation
- Adjusted shift and torque converter lockup strategy

It should be mentioned that all hybrid systems and technical features are not modeled by GEM. The benefits of a hybrid can be addressed through the powertrain test in 40 CFR 1037.550. The provisions will work for hybrids that are integrated into the transmission or that interface with the PTO shaft. Using the powertrain test eliminates any issues with GEM's ability to model the transmission because the powertrain test results effectively replace the engine and transmission in GEM. In addition to 40 CFR 1037.550, the agencies have also finalized changes to 40 CFR 1037.540 to quantify the benefits of hybrid PTO systems including plug-in hybrids.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

OOIDA appreciates the fact that the agencies decided to add road grade to Phase II's Greenhouse Gas Emission Model (GEM) simulation tool in order to better reflect real-world operation. However, while the addition of road grade is laudable, it is disconcerting that the agencies could propose Phase I standards without considering terrain, as the Oak Ridge National Lab found that the impact of a mild upslope of one to four percent led to a decrease in average fuel economy from 7.33 mpg to 4.35 mpg.<sup>9</sup> It is equally disturbing that while road grades were included for the urban and rural interstate driving cycles as part of the Phase II NPRM and Regulatory Impact Analysis (RIA), it was not included for the stop-and-go city driving. This fact coupled with the absence of considering LSFC, demonstrates the agencies' lack of understanding of the trucking industry and ultimately the customers who purchase the vehicle. In addition, these facts have caused OOIDA to question the legitimacy of the agencies' assertions. [EPA-HQ-OAR-2014-0827-1244-A1 p.9]

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9 80 Fed. Reg. 40247.

**Response:**

Although the Phase 1 standards did not seek to model road grade, the technologies on which the rule was predicated (chiefly tire and aerodynamic improvements) are not as sensitive to road grade as the driveline, transmission, and engine-based technologies that are included in the Phase 2 rule. Because the Phase 2 version of GEM uses data from the actual powertrain and driveline of the vehicle, the agencies added road grade to the cruise cycles. As described in Chapter 3.4.2.1 of the RIA, the agencies partnered with the National Renewable Energy Laboratory (NREL) to develop a nationally representative road grade profile. This was achieved by taking the half-hill road grade distribution of the limited access highways in each county in the United States and weighting it by the vehicle miles traveled in that county. The profile was further refined by limiting the change in grade per change in distance to the levels found on road and adding additional distance at zero percent and  $\pm 0.5$  percent grade, to better align engine operation in GEM with engine operation of in-use vehicles.

**Organization:** PACCAR, Inc.

**Automatic Engine Shutdown (AES) System Automatic Engine Shutdown (AES) System**

GEM currently does not account for the provisions in §1037.660 that allow the 5 percent reduction to be prorated as an input to GEM using the miles of expiration flexibility in the rule. This functionality was present in the Phase I GEM tool, but not carried over in the proposed Phase 2 GEM. The proposed GEM



only includes a “Y” or “N” input for this feature, which would indicate the technology must be set to be tamper-resistant for the full 1,259,000 miles. GEM needs to be corrected so that the proper calculated inputs can be utilized. Additionally, the examples for calculating the input to GEM for the expiration mileage option should all be updated to reflect the 5 percent reduction in addition to the 5 g/ton-mile reduction. [EPA-HQ-OAR-2014-0827-1204-A1 p.17]

### **Vehicle Speed Limiters (VSL)**

Similar to AES, speed limiters can be programmed to be tamper-resistant for a reduced expiration time frame and the vehicle score will receive partial credit. §1037.640(c)(2) states that the input to GEM must be calculated and rounded to the nearest 0.1 MPH. PACCAR’s use of the Phase 3 GEM shows that GEM is not recognizing the decimal places on the GEM input and is effectively rounding the input to the nearest whole number. Therefore, the results from GEM is the same for every tenth of a decimal depending on how the inputs round (up or down). Without correction to this, the benefit of incremental changes to speed, expiration, or soft top limits would not be accurately recognized in the vehicle scoring model. [EPA-HQ-OAR-2014-0827-1204-A1 p.17-18]

### **GEM Runtime Errors/Crashes**

Using the stand alone executable version of GEM, there are instances where GEM will not process the inputs and will crash, providing the user an error message. An example of an error message repeatedly received is:

```
Attempted to access result.phase_NV_ratio(2); index out of bounds because  
numel(result.phase_NV_ratio)=1. Error in => GEM_main.m at line 251
```

PACCAR provided the agencies examples of the configurations that failed to run and will work with them on testing and mitigation of the issues. [EPA-HQ-OAR-2014-0827-1204-A1 p.18]

### **NHTSA Phase 1 Stringency and Credits**

In addition to the GEM-specific features above, PACCAR brought to the agencies’ attention the issue that the NHTSA stringency values were not determined the same way that the NHTSA vehicle assessment values were from GEM. The stringency was the rounded output of GEM 2.0 and all vehicles are being reported with the rounded output of GEM 2.0.1. The difference in GEM output for NHTSA showed some vehicles to be above the NHTSA standard when the same vehicle was at or below the EPA standard, and vice versa. This caused credits and debits to be inconsistent between the two agencies. The agencies corrected the discrepancy through the modification of the NHTSA stringency calculation and by changing the precision of decimal places to be used for the NHTSA FEL scores. Previous to the amendment, the level of precision of the NHTSA standards was to one decimal place, and the amendment revised this precision to 4 decimal places. While this addresses the misalignment issue, it does not address retroactively correcting any credit balances accumulated since model year 2013. In order to do this, the agencies will need to issue a modified version of GEM 2.0.1 to account for this level of precision. Additionally, PACCAR strongly recommends that EPA and NHTSA clarify in the Final Rule documents that credit balances for all model years will be adjusted by the agencies in accordance with the proposal and the adjusted totals will be communicated to the regulated entities (vehicle OEMs). [EPA-HQ-OAR-2014-0827-1204-A1 p.18]

### **Tire Size Input**

PACCAR recommends that the agencies change GEM to utilize the tire manufacturers' stated tire revolutions per mile data as the tire size input to GEM. This is the data that is used to spec vehicles for customers and therefore it should be used to assess vehicles for GHG performance. Tire static loaded radius, which is currently used in GEM Phase 2, is only used for determining vehicle height, not powertrain performance. [EPA-HQ-OAR-2014-0827-1204-A1 p.19]

### **Road Grade Profile**

PACCAR has reviewed the updated road grade profile proposal that comes from the EPA commissioned NREL study. In general, the profiles appear to be an improvement over the road grades that were initially proposed in the NPRM. Additional time is needed to finish the assessment of the new profiles. PACCAR recommends that the agencies work with industry to make any needed modifications to the newly proposed road grades based on the assessments that all OEMs are now working on. PACCAR also requests that the agencies reissue GEM Phase 2 with the new road grades incorporated so that the assessment of the proposed regulation will include the correct performance of the technologies that the agencies are including in the stringency determination and that OEMs must use for compliance. [EPA-HQ-OAR-2014-0827-1204-A1 p.19]

For powertrain testing in a dyno cell, allowance should be made for any fuel-saving strategies that may result in a deviation from the desired vehicle speed during the 55 MPH and 65 MPH cycles. Strategies such as fuel cutoff while coasting, or even coasting in neutral, during slight down-grades show considerable potential for fuel savings especially if vehicle speed is allowed to deviate slightly below the set point (target speed of either 55 or 65 MPH). Additionally, if vehicle speed is allowed to be offset lower than target on uphill, and slightly above target on downhill, this could result in matching the considerable real world fuel savings during powertrain dyno testing. Furthermore, the inclusion of grade in the 55 and 65 MPH cycles will result in transmission gear shifts that may not be capable of allowing a  $\pm 1$  MPH tolerance band. [EPA-HQ-OAR-2014-0827-1204-A1 p.19]

It is recommended that the point-by-point tolerance be  $\pm 4$  MPH, with the requirement that average vehicle speed for the entire cycle (for 55 and 65 MPH cycles) be held to  $\pm 2$  MPH. [EPA-HQ-OAR-2014-0827-1204-A1 p.19]

### **Natural Gas Engine**

PACCAR investigated the GHG / fuel consumption impact of compressed and liquid natural gas (CNG and LNG, respectively) engines in GEM. The weight penalties for the CNG and LNG fuel tanks were properly reflected in the GEM output, giving a GHG emission increase versus a diesel engine fuel tank. However, GEM did not properly calculate the carbon content differences between CNG or LNG and diesel. Specifically, when the same fuel flow map was used in GEM with for all three fuel types, GEM calculated the exact same grams per ton-mile result for the vehicle. The GEM output should have been notably different for all three fuels under these test conditions. [EPA-HQ-OAR-2014-0827-1204-A1 p.19-20]

PACCAR has notified the agencies of this issue and requests that the agencies investigate the GEM assessment of CNG and LNG engines and corrects GEM to properly determine the CNG and LNG engine performance. [EPA-HQ-OAR-2014-0827-1204-A1 p.20]

### **GEM Integration**

Lastly, with the increased complexity in the GEM Phase 2 model, coupled with the increase in stringency of the proposed Phase 2 standards, the agencies should release a ".dll" executable version of GEM that can be integrated into manufacturer's business systems. This would allow for real-time processing of changes and impact to compliance. This solution would need to be fully capable for performing certification and compliance purposes, as well as being backwards compatible to Phase I GEM. The ".dll" version of GEM should be a certified version from the agencies that can be used for the certification process and end of year compliance reporting to the agencies. PACCAR, along with EMA, is willing to work with the Agency to define the necessary inputs and outputs for this solution. [EPA-HQ-OAR-2014-0827-1204-A1 p.20]

### **Off-Cycle Technologies**

PACCAR supports the concept of credits for reductions associated with off-cycle operation. At the present time, neither EPA nor NHTSA has outlined what technologies they believe should be eligible for such credits nor the amounts of any such credits. Some ideas for items that could be included are: solar reflective paints and glazing, workday idle reductions for day cab tractors, and any possible improvements in aerodynamics for vocational vehicles. Each of these involves significant research and may or may not have benefits. PACCAR also supports EPA considering the proposal advanced by the manufacturers of re-refined engine oil that credit should be provided for the use of such oil as original fill and service fill in vehicles used or sold by OEMs. The manufacturers of re-refined oil have peer reviewed studies showing that there are significant and quantifiable energy and GHG benefits to the use of such lubricants. [EPA-HQ-OAR-2014-0827-1204-A1 p.25]

PACCAR will work with the agencies to determine the process for evaluating such technologies and the proper credit amount. In no circumstances should early concepts such as those identified as examples be used as part of a stringency determination for Phase 2 standards. [EPA-HQ-OAR-2014-0827-1204-A1 p.25]

### **Transmission Efficiency**

Phase 2 GEM uses default transmission efficiencies that were determined by the agencies. These efficiencies for gear and pumping losses can be reduced by approximately 1% to 2% through design-specific actions to transmissions. Having an optional test to capture the product-specific performance and transmission efficiency inputs for GEM would allow OEMs to determine and utilize the engineered GHG / fuel consumption benefits in Phase 2. The EU and European manufacturers are working on a transmission efficiency test procedure for their GHG Declaration regulation that should be the starting point for the agencies in developing the Phase 2 option. EMA recommends that the same test procedure and data input formats as Europe be finalized for Phase 2. PACCAR joins in that recommendation. [EPA-HQ-OAR-2014-0827-1204-A1 p.25-26]

### **Response:**

We appreciate the many constructive comments from Paccar. Consequently, we have made many changes in the final GEM.

With regard to automatic engine shutdown, the agencies have modified Phase 2 GEM for the final rule to accommodate a percent input value to represent the emissions reduction due to various idle reduction technologies, as specified in 40 CFR 1037.520. The agencies are recognizing both tamper-proof and adjustable AESS in Phase 2, therefore, we are not applying the Phase 1 expiring mileage option to Phase 2. The Phase 2 AESS will either be tamper-proof for 1,259,000 miles or else it is deemed adjustable.

We also made the change to VSL, so that GEM accurately accounts for input values rounded to the nearest 0.1 MPH.

We recognized a few issues related to GEM runtime errors and crashes for the early released version of GEM, and all of these issues have been resolved by first identifying the bugs, and then correcting them, and finally testing them to make sure that GEM can produce the correct results.

Consistent with the recommendation of PACCAR and other manufacturers, the agencies have changed the tire size input to revolutions per mile.

In order to correct the misalignment noted by the commenter, NHTSA proposed to amend the existing fuel consumption standards and the method for calculating performance values for all compliance categories by increasing the significant digits in these conversion values. Increasing the significant digits in these values will result in more precise alignment between final compliance credit balances.

NHTSA proposed that the increased resolution would apply retroactively starting for the model year 2013 standard. However, because the Phase 1 fuel consumption standards created a difference in compliance margins which could potentially have an adversely impact for certain manufacturers who have already developed engineering plans considering previous credit balance, NHTSA sought comments on whether optional to allow manufacturer to continue using the Phase 1 standards.

NHTSA is finalizing its standards and method for calculating performance values for the Phase 1 and 2 programs with increased significant digits as the only option for compliance. Retaining the previous method would result in ongoing differences in credit plans and balances, and continue the associated burden on manufacturers. Since manufacturers already have and will continue to develop compliance strategies for the EPA GHG program, the change will enable those strategies to also directly comply with the NHTSA fuel efficiency program, creating a more aligned National Program. Compliance with the EPA GHG program is unaffected by the change. EPA will make the update to its system so that the NHTSA values with increased resolution can be applied retroactively.

With regard to the road grade profile of the cruise cycles the agencies shared the road grade profile in the NODA and continued to work with manufactures after the NODA to finalize a road grade profile that is nationally representative but also allows engine operation in GEM to match engine operation of in-use vehicles. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took to create the final road grade profile.

Regarding the recognition of technologies that allow the powertrain to not maintain the commanded 55mph and 65mph of the cruise cycles the agencies have updated the powertrain procedure so that the speed of the powertrain can overshoot the cycle speed by up to 3 mph when going downhill. This change has been added to the powertrain procedure as well as in GEM to better align with how vehicles are driven. The agencies did not change the lower speed tolerance for two reasons. The first is that GEM already has an input for vehicle speed limiters. Second, because changes in vehicle speed have a significant effect on the work the vehicle does per mile. If the powertrain procedure allowed for significant deviations from the cycle the results would not be representative. However, the procedure does allow for greater than 1 mph deviation from the cycle during shifts. In addition, the agencies have added neutral coast as an intelligent control technology that is recognized in GEM (see 40 CFR 1037.520).

On natural gas engine fuel properties, as noted in previous responses, we did make changes to GEM to include all the reference fuel properties defined in Table 1 of 40 CFR 1036.530. This change will allow GEM to accurately calculate the CO2 emissions from all fuel covered by 40 CFR 1036.530.

We appreciate Paccar's comments on a ".dll" executable version of GEM. We are considering the implement this feature into the GEM after the final rule is signed. Since this ".dll" only acts like an interface between GEM output and OEM's information system, it would not change the GEM results, and therefore, this can be done after the final rule is signed.

We have made changes to the off-cycle technologies as evidenced by the technology improvement inputs from the input files of both tractor and vocational vehicles.

Significant changes on transmission modeling has been made since the NPRM GEM. We now allow the OEMs to input their own power loss for each gear to replace the default power loss tables based on a transmission efficiency test.

**Organization:** Plastics Industry Trade Association (SPI)

Specifically, we support the inclusion of thermoplastic parts in the Green House Gas Emissions Model (GEM) lightweighting credit menu, and the agencies' efforts to better recognize parts and materials with superior aerodynamic performance. [EPA-HQ-OAR-2014-0827-1225-A1 p.1]

#### Thermoplastic Lightweighting

SPI strongly supports the inclusion of lightweight thermoplastic materials in the GEM lightweighting credit menu. Thermoplastics are a reliable way of reducing greenhouse gas emissions by improving fuel consumption rates. The credit menu includes thermoplastic hoods and front fender, day and sleeper cab roof fairings and the aerodynamic side extender. This grants OEMs another path to lightweight vehicles and comply with more stringent regulations. [EPA-HQ-OAR-2014-0827-1225-A1 p.2]

SPI also encourages EPA and NHTSA to include thermoplastics that are in development in the GEM credit menu. SPI members are currently developing plastics, and are working to transfer technologies that have been successful for lightweighting light duty vehicles to heavy duty vehicles. These technologies should be included in the menu because it will encourage further breakthroughs in lightweighting vehicles. [EPA-HQ-OAR-2014-0827-1225-A1 p.2]

#### **Response:**

We appreciate SPI's comments on lightweighting. The thermoplastic lightweighting is part of the weight reduction of the GEM input.

**Organization:** Rubber Manufacturers Association (RMA)

**The Agencies Should Clarify Terms When Referring to Loaded Radius** to avoid confusion and provide clarity for compliance. [EPA-HQ-OAR-2014-0827-1304-A1 p.2]

**The Agencies Should Allow a GEM Credit for Tire Pressure Monitoring Systems (TPMS)**, as they are proposing for Automatic Tire Inflation Systems (ATIS). [EPA-HQ-OAR-2014-0827-1304-A1 p.3]

## **Other GEM Input Issues. Tire Loaded Radius and Tire Revolutions per Mile**

### **i. The Agencies Should Clarify Terms When Referring to Loaded Radius – Static vs. Dynamic**

As an input into the GEM, clarification is needed as to what is intended, i.e. static or dynamic, for the GEM conversion of simulated vehicle speed into axle speed, transmission speed, and ultimately engine speed. Throughout the NPRM, the agencies refer to the static loaded radius measurement from the ISO 28580 tire rolling resistance test method, i.e. “rL” and in the NPRM, the terms “static loaded radius” and “loaded radius” are both used. After reviewing where the terms are used, it seems that the agencies refer to these terms for three purposes: when referring to the ISO 28580 test method for measuring tire rolling resistance, for use in measuring roof height and as an input into the GEM. The agencies may be intending to refer to terms with the same meaning for all three purposes, or not. The agencies should clarify the term intended for each of these purposes and provide unambiguous definitions for each terms used. [EPA-HQ-OAR-2014-0827-1304-A1 p.31]

When referring to the ISO 28580 test method for measuring tire rolling resistance, the proper term is dynamic loaded radius. In Section 7.5, subsection (e) of ISO 28580 (2009),<sup>35</sup> rL is defined as “the distance from the tire axis to the drum outer surface under steady-state conditions” and is expressed in meters. The term “steady-state conditions” indicates that this is a dynamic, rather than a static measurement of the tire’s radius. It is also important to note that this measurement is conducted on a curved wheel. Depending on the agencies’ needs, this may or may not be an appropriate measurement for use in calculating roof height or as a GEM input, without first adjusting from a curved surface to a flat surface. [EPA-HQ-OAR-2014-0827-1304-A1 p.31-32]

Table 1 below shows the various times similar terms are used in the NPRM. Interestingly, in the Department of Transportation proposed regulatory text, of all of the terms listed above, the only term defined in the definitions section is “static loaded radius arc.” [EPA-HQ-OAR-2014-0827-1304-A1 p.32]

[Table 1, 'List of References in the NPRM to Tire Loaded Radius or Similar Terms', p.32 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

### **ii. The Agencies Could Use Tire Revolutions per Distance or Use Dynamic Loaded Radius per ISO 28580 to Calculate the Drive Axle Rotational Speed from Vehicle Speed**

In the NPRM, the agencies propose for the vehicle manufacturers to “enter into GEM the tire manufacturer’s specified tire loaded radius for the vehicle’s drive tires,” but the agencies also ask for comments on “whether the proposed test procedure should be modified to measure the tire’s revolutions per distance directly, as opposed to using the loaded radius to calculate the drive axle rotational speed from vehicle speed.” RMA views both tire revolutions per distance, recognizing that this may require a separate test, and dynamic tire loaded radius, per ISO 28580, as candidates for this purpose. [EPA-HQ-OAR-2014-0827-1304-A1 p.33]

Truck tire revolutions per mile (RPM) can be measured separately on a flat road surface using for example SAE 1025-2012 “Test Procedures for Measuring Truck Tire Revolutions per Kilometer/Mile. It is important to note that the test methods may cause variations on both “loaded radius” and “RPM” among similar tires. Even if the similar tires have the same overall diameter, it does not mean that they will have the same tire RPM. Some factors that cause variations include load and pressure, tread wear, tread geometry, driving and braking torque, and type and condition (wet, dry) of the pavement. [EPA-HQ-OAR-2014-0827-1304-A1 p.33]

### **Trailer yaw at 0° vs the average yaw at 0° – 6° as a GEM P2 v1.0 input**

The NPRM states that tractor aerodynamic drag is determined by testing conducted over a range of 0° – 6° yaw and averaged for the GEM P2 v1.0 input. The NPRM requires only a trailer aerodynamic drag delta CDA for trailer aerodynamics using the zero-yaw, e.g. 0° (or head-on wind) values. For a realistic and complete assessment of the overall trailer aerodynamic performance, a range of yaw angles, e.g. 0° – 6°, needs to be included for an averaged aerodynamic drag delta CDA GEM input, i.e. effects of real world cross winds on such tractor-trailer combinations. [EPA-HQ-OAR-2014-0827-1304-A1 p.33]

### **b. The Agencies Should Consider Subcategorizing Vocational Vehicles to Address the Wide Diversity of Configurations and Applications**

Referencing the proposed updates to the GHG Phase 2 GEM, outlined in EPA-HQ-OAR-20140827-DRAFT-1768, the agency is recognizing that varied and complex axle configurations exist in the NAFTA Market. It has been proposed that these complex axle configurations be grouped into the model designation for a standard 6X4 Tractor. [EPA-HQ-OAR-2014-0827-1933-A1 p.3]

While this grouping to the classification would help OEMs utilize the GEM, it underscores the RMA position that the vocational classification is widely varied in scope, and should be defined to match the actual market diversity. The driving need to manufacture axle configurations such as an 8X4, or 10X4 single unit truck, is governed by the specific needs of loading and road type. It is clear that these configurations would be considered non-standard, but still subject to the GHG regulation. To group configurations with non-standard needs into the 6X4 classification could place OEM at disadvantage for loading specific, or environmental specific designs. [EPA-HQ-OAR-2014-0827-1933-A1 p.3]

In contrast, the long distance fuel-efficient market segment can be characterized by a homogenous application with fairly consistent axle configurations. The only reasonable method to address the vocational applications is to define subsets that take into account the varied needs of the vocational marketplace. [EPA-HQ-OAR-2014-0827-1933-A1 p.3]

### **III. Other GEM Input Issues**

In its October 1, 2015 comments, RMA highlighted several issues associated with the GEM. RMA continues to believe that these issues should be addressed in the final GEM. It is unclear whether the updated version has been adjusted to address these concerns. RMA encourages the agencies to assure that these issues are addressed when the rules are promulgated. [EPA-HQ-OAR-2014-0827-1933-A1 p.4]

First, RMA commented that the agencies should clarify what is intended when the term “loaded radius” is used. It is unclear whether the agencies are intending static loaded radius or dynamic loaded radius. When referring to the ISO 28580 test method for measuring tire rolling resistance, the proper term is dynamic loaded radius. However, throughout the NPRM, the agencies refer to the static loaded radius measurement from the ISO 28580 tire rolling resistance test method, i.e. “rL” and in the NPRM, the terms “static loaded radius” and “loaded radius” are both used. After reviewing where the terms are used, it seems that the agencies refer to these terms for three purposes: when referring to the ISO 28580 test method for measuring tire rolling resistance, for use in measuring roof height and as an input into the GEM. The agencies may be intending to refer to terms with the same meaning for all three purposes, or not. The agencies should clarify the term intended for each of these purposes and provide unambiguous definitions for each terms used. [EPA-HQ-OAR-2014-0827-1933-A1 p.4]

Second, the agencies should use tire revolutions per distance or dynamic tire loaded radius to calculate the drive axle rotational speed from vehicle speed. In the NPRM, the agencies propose for the vehicle manufacturers to “enter into GEM the tire manufacturer’s specified tire loaded radius for the vehicle’s drive tires,” but the agencies also ask for comments on “whether the proposed test procedure should be modified to measure the tire’s revolutions per distance directly, as opposed to using the loaded radius to calculate the drive axle rotational speed from vehicle speed.”<sup>3</sup> RMA views both tire revolutions per distance, recognizing that this may require a separate test, and dynamic tire loaded radius, per ISO 28580, as candidates for this purpose. [EPA-HQ-OAR-2014-0827-1933-A1 p.4-5]

Third, the agencies should include a range of yaw angles, e.g. 0° – 6°, for an averaged aerodynamic drag delta CDA GEM input, for a realistic and complete assessment of the overall trailer aerodynamic performance. The NPRM states that tractor aerodynamic drag is determined by testing conducted over a range of 0° – 6° yaw and averaged for the GEM P2 v1.0 input. The NPRM requires only a trailer aerodynamic drag delta CDA for trailer aerodynamics using the zero-yaw, e.g. 0° (or head-on wind) values. For a realistic and complete assessment of the overall trailer aerodynamic performance, a range of yaw angles, e.g. 0° – 6°, needs to be included for an averaged aerodynamic drag delta CDA GEM input, i.e. effects of real world cross winds on such tractor-trailer combinations. [EPA-HQ-OAR-2014-0827-1933-A1 p.5]

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3 80 Fed. Reg. at 40187.

35 ISO 28580:2009 Passenger car, truck and bus tires -- Methods of measuring rolling resistance -- Single point test and correlation of measurement results at 7.

**Response:**

With regard to loaded radius, GEM now uses tire revolutions per mile instead of loaded radius. See 40 CFR 1037.520 (g), which refers to SAE J1025 for the prescribed test procedure for determining tire revolutions per mile. If a vehicle is certified to the custom-chassis standards of 40 CFR 1037.105 (h) tire revs per mile is not an input for GEM.

The agencies agree with the comments from Rubber Manufacture Association regarding TPMS and have added the ability to recognize the effectiveness of TPMS in GEM.

The agencies evaluated the aerodynamic test data for our trailer program and concluded (consistent with this comment) that wind-averaging is able to better capture aerodynamic improvements from many devices, including several small-scale devices. We are adopting a wind-averaged approach for aerodynamic testing in the trailer program. Consistent with the tractor program, the trailer program is basing its wind-averaged values on the average of results from +4.5 and -4.5 degrees yaw.

**On Diversity of Configurations and Applications**

The agencies disagree that grouping configurations with non-standard axles into the 6X4 classification could place OEMs at a disadvantage for loading specific, or environmental specific designs. Because GEM uses a default vehicle tare weight and payload, we do not believe that certifying vehicles that are designed to haul heavier loads in GEM using the default settings will create a meaningful disadvantage for such vehicles. One clear disadvantage of simulating the additional axles of say a 10x6 as a 10x6 instead of a 6x4, is that these vehicles would have higher CO<sub>2</sub> compared to a vehicle with a 6x4 axle



which would put these vehicles at a disadvantage. Doing so could take away these options or at a minimum make them cost more from a certification perspective. Potentially one disadvantage could be if the configuration uses an overpowered engine for the default vehicle weight and payload, but adding additional vehicle categories comes with many other complexities. We conclude the advantages of regulatory simplicity outweigh the potential disadvantages to a small sales volume of specialty configurations. For further discussion of comments related to heavy-haul vocational vehicles, see the Preamble Section V.

**Organization:** SABIC Innovative Plastics US LLC

#### Credits for Lightweight Components Acknowledge their Contribution

SABIC strongly supports the agencies' inclusion of lightweight thermoplastic materials in the GEM model lightweighting credit menu, summarized below in Table 1. The competitive fuel conservation and emission reduction benefits offered by thermoplastics can and should be on equal footing with those achievable by aluminum and high-strength steel. The credit menu for the proposed Phase 2 rule includes thermoplastic hoods and front fenders, Day and Sleeper Cab roof fairings and aerodynamic side extenders, as shown in Table 1 below. These components have been commercialized or validated by customers, or in the case of the Sleeper Cab fairing, are in the process being validated. This supports their marketplace potential, while also allowing the agencies to gauge their lightweighting benefits. These components typify the 'emerging technologies not yet in widespread use' whose adoption is promoted by the credit menu. [EPA-HQ-OAR-2014-0827-1207-A1 p.2]

[Table 1, NPRM Proposed Weight Reduction Credits, can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1207-A1]

Lightweighting and aerodynamic improvements will provide cost-effective pathways to greater fuel efficiency and reduced emissions, while preserving vehicle performance and utility. SABIC appreciates the opportunity to comment and looks forward to working with the agencies and the industry to achieve that goal. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

In summary: SABIC supports the addition of thermoplastic parts to the lightweighting credit menu, including Day cab roof fairings, Sleeper Cab roof fairings, hood and front fenders and aerodynamic side extenders. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

#### **Response:**

We appreciate SABIC's support on the thermoplastic lightweighting components included in the regulations (see 40 CFR 1037.520).

**Organization:** Securing America's Future Energy

#### Greenhouse Gas Emissions Model (GEM)

We agree with the agencies' efforts to modify the GEM in the Phase 2 Proposal. However, we recommend addressing two important issues: [EPA-HQ-OAR-2014-0827-1462-A1 p.10]

- The Proposal does not include weight penalties for other weight-increasing technologies in the GEM. [EPA-HQ-OAR-2014-0827-1462-A1 p.10]

- The proposed weight increases that are assigned to natural gas vehicles do not take into account the weight differences among the wide variety of natural gas fuel systems. [EPA-HQ-OAR-2014-0827-1462-A1 p.10]

For parity, we suggest the agencies assign weight increases to hybrid and Rankine cycle engines and non-engine technologies that add weight. There are numerous technologies used by both conventional and alternative fuel vehicles that increase the weight of the vehicle but do not receive weight penalties in the GEM. (We acknowledge that all-electric and fuel cell vehicles generate zero GHG tailpipe emissions and therefore do not include these technologies in our request). [EPA-HQ-OAR-2014-0827-1462-A1 p.10]

Additionally, we recommend the agencies consider reducing the proposed weight increases that apply to natural gas-fueled vocational vehicles. The proposed use of a fixed weight increase for both tractors and vocational vehicles fueled by natural gas does not appear to take into consideration the weight differences between the fuel tanks in these vehicles, and therefore may unfairly penalize vocational vehicles. The amount of fuel storage required varies considerably with the class and type of the vehicle. As a result, natural gas fuel storage systems installed on vocational vehicles typically are smaller and weigh less than those installed on Class 7 and 8 tractors. [EPA-HQ-OAR-2014-0827-1462-A1 p.10]

**Response:**

The final rule will only provide opportunities for weight reduction and the agencies have removed all weight penalty items.

**Organization:** Truck & Engine Manufacturers Association (EMA)

Automatic Engine Shutdown (AES) Systems

GEM currently does not account for the provisions in proposed section 1037.660 that allow for the 5 percent credit to be prorated as an input to GEM based on the number of miles that tamper-resistant AES features will be in place. This feature, albeit a 5.0 g/ton-mile reduction, was included in the Phase 1 GEM tool, but not carried-over in the proposed Phase 2 GEM. The proposed Phase 2 GEM only includes a “Y” or “N” input for this feature, which would indicate that the prorated distance is no longer applicable and that credit-generating AES technology must be tamper-resistant for the full 1,259,000 miles. GEM should be corrected so that properly calculated, prorated inputs can be utilized. Additionally, the examples for calculating the input to GEM for the expiration mileage option should be updated to reflect the 5 percent reduction in addition to the 5.0 g/ton-mile reduction. [EPA-HQ-OAR-2014-0827-1269-A1 p.57]

Vehicle Speed Limiters Similar to AES, speed limiters can be programmed to be tamper-resistant for a reduced expiration time frame (or mileage) and the vehicle should receive corresponding partial credit. In that regard, proposed section 1037.640(c)(2) states that the input to GEM must be calculated and rounded to the nearest 0.1 mph. However, GEM does not recognize decimal places on the GEM input and is effectively rounding the input to the nearest whole number. Consequently, the results from GEM are the same for every tenth of a decimal depending on how the inputs round (up or down). Without correcting this error, the benefit of incremental changes to speed, expiration times, or “soft top” limits will not be accurately recognized in the vehicle scoring model. [EPA-HQ-OAR-2014-0827-1269-A1 p.57]

GEM Runtime Errors and Crashes Using the stand-alone executable version of GEM, there are instances where GEM will not process the inputs and will crash, providing the user with nothing other than an error message. An example of an error message repeatedly received is: [EPA-HQ-OAR-2014-0827-1269-A1 p.57-58]

Attempted to access result.phase\_NV\_ratio(2); index out of bounds because numel (result.phase\_NV\_ratio)=1. Error in => GEM\_main.m at line 251 [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

The agencies will need to work on resolving these significant functionality issues. [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

#### Torque Response

GEM has no torque lag and so assumes instant torque response to the throttle command. In reality, however, every engine requires some time to build up torque, particularly highly turbocharged heavy-duty diesel engines. This issue is not significant for vehicle simulation, but becomes significant when GEM output is used to create engine test cycles as proposed by the alternative engine certification (“cycle-average”) method. Although each engine has a unique torque response, inclusion of an average response characteristic would be much better than the current simulation. [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

#### Gear Shifting

GEM shifting does not match either a typical driver using a manual transmission or an automated manual transmission. This results in engine operation that does not match the real world. For example, GEM does not skip-shift either on acceleration or deceleration. Drivers and automated transmission will skip-shift when accelerating whenever conditions permit and will certainly skip-shift under deceleration. Again, this may not create a significant problem when GEM is used to simulate vehicle fuel consumption as originally intended, but can create significant anomalies when GEM is used to create engine test cycles. [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

#### N/V Output

GEM has an N/V output function that was set up for powertrain testing – i.e., the N/V is the transmission output speed over the vehicle speed. If the agencies intend to continue development of the alternative engine certification method, GEM must be set up to output engine speed over vehicle speed as well. [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

#### Additional GEM Features Needed

Transmission gear efficiency should be an input to GEM based on a defined test protocol. As noted, since the European Union is undertaking considerable work in defining a transmission test, and since similar transmissions are used in the US and EU, a common test protocol based on the EU test method should be considered. Currently, the only provision in the NPRM to account for gear efficiencies requires running the powertrain test. However, as also noted earlier, there are significant costs and facility constraints to running a powertrain test. Adding a transmission test and input to GEM would capture the benefits of more efficient gear meshes without the need to run the powertrain test. [EPA-HQ-OAR-2014-0827-1269-A1 p.58]

## Tire Rolling Resistance

When using the tables in the NRPM, the calculation of the model year 2024 tire Crr GEM input that is determined (by multiplying the penetration rate times the Crr value for each of the levels and then summing them together) does not match the GEM input value that EPA has shown for model year 2024 stringency determination. For example, for tractors, the baseline Crr of 7.8 multiplied by the 5% penetration rate, *plus* Level 1 Crr of 6.6 multiplied by the 50% penetration rate, *plus* Level 2 Crr of 5.7 multiplied by the 30% penetration rate, *plus* the Level 3 Crr of 4.3 multiplied by the 15% penetration rate, *equals* a Crr value of 6.045. However, EPA is using a Crr of 5.9 for the GEM-based stringency determination, which yields a more stringent standard than the technology performance and rates would dictate. [EPA-HQ-OAR-2014-0827-1269-A1 p.58-59]

Provisions also should be added to GEM to allow for the specification of different tire rolling resistance for vehicles equipped with tandem axles. That input is particularly important for 6x2 axle configurations where only one axle is driving and the tires are transmitting higher torque values than in a 6x4 configuration, which requires higher traction and more durable construction. At the same time, the tag axle has no torque transfer requirement, and so may be fitted with a low Crr tire that is typically used in trailers. In such cases, the tractor should not be penalized with the incorrect assumption that both axles use higher Crr tires. [EPA-HQ-OAR-2014-0827-1269-A1 p.59]

In addition to implementing the foregoing updates to GEM (as it continues to evolve), and to facilitate the implementation of Phase 2, especially in light of the increased complexity and stringency of the Proposed Phase 2 Standards, EPA should make available to engine and vehicle manufacturers a ".dll" executable version of GEM (along with a source code that matches the executable code) that can be integrated into manufacturers' production systems to allow for real-time processing and scoring of vehicles. That "final" version of GEM should be fully capable of being used for certification and compliance purposes. EMA's members are willing to work with EPA to define the input and output files for a ".dll" version and a suitable source code version of GEM. [EPA-HQ-OAR-2014-0827-1269-A1 p.59]

### **Response:**

We appreciate EMA's constructive comments. Consequently, we have made many changes to address to GEM.

With regard to automatic engine shutdown, the agencies have modified Phase 2 GEM for the final rule to accommodate a percent input value to represent the emissions reduction due to various idle reduction technologies, as specified in 40 CFR 1037.520. The agencies are recognizing both tamper-proof and adjustable AESS in Phase 2, therefore, we are not applying the Phase 1 expiring mileage option to Phase 2. The Phase 2 AESS will either be tamper-proof for 1,259,000 miles or else it is deemed adjustable.

We also made the change on VSL, allowing the user to input a value rounded to the nearest 0.1 MPH.

We recognized a few issues related to GEM runtime errors and crashes for the early released version of GEM, and all of these issues have been resolved.

The agencies agree with the comment regarding engine torque lag and have updated GEM to have a realistic torque response. The torque response in GEM was validated using data from a 2012 Cummins ISX.

With regards to comments on transmission shifting GEM does skip shift has the algorithm has been validated with powertrain, chassis and on-road vehicle data.<sup>31, 32</sup> We also have made significant improvement on gear shifting based on many testing data, which should address the gearing issues mentioned by EMA.

The agencies agree with the comment regarding GEM outputting engine N/V for the cycle average procedure and have added average vehicle speed to the GEM output file containing the engine cycle. The average engine speed comes for the engine test to get N/V.

Significant changes to transmission efficiency modeling in GEM have been made since the NPRM. We now allow the OEM to input the power loss for each transmission gear to replace the default power loss tables as indicated in Chapter 4.2.2.3.3 of the RIA. The test procedure that defines how to measure the transmission power losses is in 40 CFR 1036.565.

The agencies have modified the Crr levels and adoption rates for tractors in the final rule (see Preamble Section III.D.1.b). During that process, we have addressed the error highlighted by the commenter.

We also made changes to GEM that allow the manufacturer to input a different Crr value for each axle of the tandem to address the mismatched issue raised by the commenter. Since we implement a mechanism to account for the power loss of different axles, such as 6x4 and 6x2, the power loss for each type of axle can be input from the user. The user can also select default axle power loss specified by the agencies.

We will implement a “.dll” solution in the future. Since this “.dll” only acts like an interface between GEM output and OEM’s information system, it would not change the GEM results, and therefore, this can be done after the final rule is signed.

**Organization:** Truck & Engine Manufacturers Association (EMA)

## **2. Updated Version of GEM**

While the updated version of GEM that the NODA describes and makes available is improved, it still contains a number of significant problems. Those problems include: [EPA-HQ-OAR-2014-0827-1891-A1 p.3]

- GEM incorporates a new road grade model (Road Grade Profile “D”) that is unrealistic and overly aggressive, including grades that are too steep over the modeled road cycle (which is only 12 miles). That results in forcing unrepresentative transmission behavior and engine performance. EMA is working on an alternative revised road grade profile, and encourages the agencies to adopt the necessary revisions to the road grade profile. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]

**Response:**

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<sup>31</sup> SwRI July 2016, “Validation Testing for Phase 2 Greenhouse Gas Test Procedure and Greenhouse Gas Emissions Model (GEM) for Medium- and Heavy-Duty Engines and Powetrains.”

<sup>32</sup> Oakridge National Laboratory July 2016, “Powertrain Test Procedure Development for EPA GHG Certification of Medium- and Heavy-Duty Engines and Vehicles.”

Since releasing Road Grade Profile D, we have received many constructive comments from various stakeholders. We discussed many potential solutions through many EMA meeting held at the EPA site as well as many industry group conference calls. Some of the stakeholders also shared their CBI data with us, helping the agencies to develop a more reasonable grade profile. Consequently, we have made many changes to continue improve the road grade profile to better represent the real-life driving conditions. Those changes include addition flat road and  $\pm 0.5$  % road grade at the beginning and end of cycle, and reducing the peak road grades.

**Organization:** Volvo Group

Because some vocational vehicles are gear-bound at speeds below 65 MPH, the engines in these vehicles will necessarily run on the high speed governor when the GEM duty cycle drives the engine above the rated speed. To properly account for how these vehicles run at high road speed, the GEM torque curve input should be extended to the high idle speed. Fuel rate should be interpolated from the highest speed point measured in the proposed fuel map down to zero at the high idle point. [EPA-HQ-OAR-2014-0827-1290-A1 p.37-38]

It must also be noted that since the entire range of the engine fuel map is to be regulated and subject to compliance testing, the OEM will be subject to review and approval of even minor and inconsequential changes to the engine calibration. Furthermore the EPA will be obliged to provide such a review and approval. Such requirements will greatly increase the workload of both the OEM and the EPA with little benefit. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

Since the Agencies have chosen to regulate both the engine and the vehicle (including the engine), Volvo Group believes that the composite emissions from the regulated engine cycles (FTP, RMC) should be sufficient to ensure engine efficiency and fuel map compliance as has traditionally been the case. This also has the benefit of eliminating the non-value added work created by reporting and approving inconsequential changes to engine calibrations. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

Lastly, it should be noted that the advent of technologies being deployed to learn and adapt calibrations to customer duty cycles could be stifled by such restrictive requirements. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

Currently no credit is provided for vehicle speed limiters set at 65 MPH or above, despite the fact that a significant number of vehicles and miles are run above this speed. Duty cycles should account for the actual speeds run by heavy duty vehicles and speed limiter credit should be determined in GEM based on the actual speed reduction. This should apply to vocational vehicles and tractors. [EPA-HQ-OAR-2014-0827-1290-A1 p.50]

Transmission gear efficiency should be an input to GEM based on a defined test protocol. Since the European Union has done considerable work to define a transmission test and since similar transmissions are used in both the US and EU, a common test protocol based on the EU test should be established. Currently, the only provision in the NPRM to account for gear efficiencies requires running the powertrain test. As noted earlier, there are significant costs and facility barriers to running a powertrain test. Adding a transmission test and input to GEM would capture the benefits of more efficient gear meshes without the need to run the powertrain test. [EPA-HQ-OAR-2014-0827-1290-A1 p.50-51]

The NPRM does provide an axle efficiency test protocol but GEM currently has no means to input axle efficiency. We strongly support use of the axle test and request that GEM be upgraded to incorporate the results. [EPA-HQ-OAR-2014-0827-1290-A1 p.51]

#### GEM Executable Format

The EMA has requested that a ".dll" or other source code version of GEM be compiled to allow for easier system integration. As did other manufacturers, Volvo Group invested significant time, effort, and money in development of IT infrastructure and programming to allow for automated batch processing of production data to meet the Phase 1 reporting and storage requirements. Due to the Linux based production systems that Volvo Group utilizes and the Windows based Phase 1 GEM executable, the architecture that Volvo Group developed required complex system integration across multiple platforms. This integration would still be necessary with a ".dll" compiled Phase 2 version of GEM 2.0, as the .dll format is a Microsoft format used for storing code and procedures for Windows based programs. As such, Volvo Group also requests that the agencies provide a GEM 2.0 version that is compiled and validated in Linux based architecture. Another solution would be to provide the GEM 2.0 source code to the regulated entities and allow them to compile the code into any platform necessary and then validate the results against the agencies' GEM 2.0 file. In this way each manufacturer could simplify the integration of the GEM model as necessary for their specific platforms. [EPA-HQ-OAR-2014-0827-1290-A1 p.51]

#### Torque Response

GEM assumes zero torque lag, and therefore assumes instant torque response to the throttle command. In reality, every engine requires some time to build up torque, particularly highly turbocharged heavy-duty diesels. This issue is not significant for vehicle simulation but becomes significant when GEM output is used to create engine test cycles as proposed by the alternative engine certification (cycle average) method. Although each engine has a unique torque response, inclusion of an average response characteristic would be much better than the current simulation, allowing actual engines to more closely follow the GEM engine cycles. [EPA-HQ-OAR-2014-0827-1290-A1 p.51]

#### Gear Shifting

GEM shifting does not match either a typical driver using a manual transmission or an automated manual transmission. This results in engine operation that does not match real world. For example, GEM does not skip shift either on acceleration or deceleration. Drivers and automated transmission will skip shift when accelerating whenever conditions permit and will certainly skip shift under deceleration. Again, this may not create a significant problem when GEM is used to simulate vehicle fuel consumption as originally intended, but can create significant anomalies when GEM is used to create engine test cycles. [EPA-HQ-OAR-2014-0827-1290-A1 p.51]

#### N/V Output

GEM has an N/V output function that was set up for powertrain testing, i.e. the N/V is the transmission output speed over the vehicle speed. If the agencies intend to continue development of the alternative engine certification method, GEM must be set up to output engine speed over vehicle speed as well. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

#### Tire Rev/Mile

For accuracy in GEM calculations and in the proposed Vocational Duty Cycle segmentation calculations, the agencies should utilize tire revolutions per mile (rev/mile) as the GEM input and in the segmentation calculation as opposed to tire static loaded radius (SLR). Tire manufacturers should be given a standard procedure, such as SAE Recommended Practice J1025, to provide calculated tire rev/mile data, correlated to the standard procedure. [EPA-HQ-OAR-2014-0827-1290-A1 p.55]

The agencies have proposed utilizing tire static loaded radius in both GEM and Vocational segmentation. Based on discussions with tire manufacturers, SLR, when used alone, is not an accurate determinant of a tire's rotational speed at a given vehicle ground speed due to the tire's deflection under load. As a result unnecessary error is introduced and a higher GEM output is produced since GEM calculates axle RPM and, subsequently, engine speed based on the tire static loaded radius. [EPA-HQ-OAR-2014-0827-1290-A1 p.55]

As seen in the Michelin Truck Tire Service Manual pg. 131 inserted below, Michelin uses SAE Recommended Practice J1025 to measure tire rev/mile and has developed a correlated calculation to determine rev/mile based on the tire's outside diameter, SLR, and deflection under load that matches the measured value in the inserted example within 0.1% for a new tire. In contrast to the described method, using only SLR to calculate tire rev/mile provides a value of 536.4 rev/mile, which differs from the measured value of 513 rev/mile by 23.4 rev/mile, or 4.6%. [EPA-HQ-OAR-2014-0827-1290-A1 p.55]

GEM currently uses the vehicle speed, SLR, and total drivetrain gear ratio to determine engine speed, resulting in an engine speed over 50 RPM higher in GEM for a typical vehicle with a targeted cruise speed of 1,250 RPM. For this reason Volvo Group believes Tire Revolutions per Mile, provided by tire manufacturers, should be used instead of Static Loaded Radius. [EPA-HQ-OAR-2014-0827-1290-A1 p.55]

Volvo has been evaluating the latest GEM release (P2V2.1) and providing feedback on issues affecting GEM performance as they arise. We will continue to work with the Agency to bring these issues to light. In addition we have noted some assumption and calculation issues that impact GEM's ability to accurately reflect vehicle operation and improvements. [EPA-HQ-OAR-2014-0827-1928-A1 p.18]

### **NREL Road Grade Profile**

Volvo cannot support a duty cycle which results in engine operational characteristics that are not supported by real world data and could cause vehicle specifications driven by regulatory compliance, but that do not meet the end-user's application requirements and need for real-world fuel economy improvements. [EPA-HQ-OAR-2014-0827-1928-A1 p.11]

Volvo analysis of ~8,000 tractors equipped with Volvo's proprietary XE powertrain package (which was previously submitted to the agencies as CBI) shows the proposed NREL Road Grade Profile D results in engine operation on the 55 MPH and 65 MPH cruise cycles that is not representative of real-world engine operation in that the engine experiences significantly more time at 100% torque when simulated on the proposed profile. A result of this increased torque demand is a higher average power demand, along with an increased shift schedule. Volvo has worked with the EPA to understand significant contributing factors that may bias the analysis of Volvo's data, such as average vehicle mass compared to the default GEM value; however, the cumulative bias is insignificant when compared to the overall differences in results. [EPA-HQ-OAR-2014-0827-1928-A1 p.11]

As a result of this intense analysis, Volvo believes that NREL's method of looking only at road grade distribution is incorrect, as it does not provide for GEM simulations that appropriately reflect the actual



operation of vehicle systems in real-world operating modes. Volvo does agree that grade distribution should be considered, but not as the only variable to be matched. Though Volvo's data shows road grade distributions that match fairly well with the NREL analysis, at least on a macro scale, we find the way the distribution was stitched together inappropriately biases simulation results. Because of this we believe that NREL should consider additional parameters in their development of a realistic road grade profile, to include speed, torque, and power distributions, percent time in transmission top gear, number of shifts, and percent time coasting. Without considering these additional parameters to validate the road grade profile there is significant chance the regulation will drive vehicles configured for the demands of the regulatory model and not provide the in-use benefits projected in terms of reduced fuel consumption and greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1928-A1 p.11]

The Agency has proposed a modified Profile D and analysis is ongoing, but the mandated timeline is driving decision timing, rather than decision timing being driven by a validated solution; thus, Volvo recommends the agencies take the appropriate time to develop a new road grade profile with the above considerations included in the analysis. [EPA-HQ-OAR-2014-0827-1928-A1 p.11-12]

**Response:**

With regard to the engine torque curve and fuel map covering the entire operating range of the engine, the fuel mapping procedure in 40 CFR 1036.535 has been modified to map the engine from idle speed to  $n_{hi}$ .  $n_{hi}$  is defined in 40 CFR part 1065 as the highest speed where engine power equal to 70 percent of maximum engine power. Since 40 CFR part 1065 already requires the engine torque curve to be measured up to  $n_{mi}$ , both procedures now cover the full engine operating range.

The agencies do not agree that the FTP and SET are sufficient for determining compliance of the procedures defined in 40 CFR 1036.535, because the FTP and SET are different duty cycles from the cruise cycles where the fuel map is used to determine the vehicle CO<sub>2</sub> emissions.

The 65 mph cycle was created to be representative of the heavy-duty vehicle VMT-weighted speed limits, as detailed in RIA Chapter 3.4.2. The agencies did not receive any new data to support increasing the speed of this cycle. In addition, DOT is considering heavy-duty vehicle speed limiters in a separate rulemaking.

Significant changes on transmission modeling has been made since the NPRM GEM. We now allow the OEM to input the power loss for each gear to replace the default power loss tables by following the test procedure 40 CFR 1036.565 We have made many improvements on transmission gear shifting. The shifting logic in GEM now includes gear skip and we continued to improve the shifting in GEM based on new data including both CBI from our stakeholders and the agencies-sponsored programs at both SwRI and ORNL. The final GEM allows the user to input their own axle power loss by following the test procedure 40 CFR 1036.560.

We will implement a ".dll" solution. Since this ".dll" only acts like an interface between GEM output and OEM's information system, it would not change the GEM results, and therefore, this can be done after the final rule is signed.

We also modified GEM to better model torque response during transient operation in response to the comments by Volvo as well as others.

We also made N/V changes, allowing it to work with the cycle average approach.

With regard to loaded radius, GEM now uses tire revolutions per mile instead of loaded radius. See 40 CFR 1037.520 (g), which refers to SAE J1025 for the prescribed test procedure for determining tire revolutions per mile. If a vehicle is certified to the custom-chassis standards of 40 CFR 1037.105 (h) tire revs per mile is not an input for GEM.

We appreciate the comments made on “NREL Road Grade Profile.” In the final rule, we did not fully adopt the proposal made by Volvo, the proposal by NREL, but we did combine the NREL analysis with the other in-use data received from Volvo and other manufacturers. One of the reason why we did not fully adopt Volvo’s suggestions is that we recognize that their data only represented one engine power rating and a lower average vehicle mass than the average vehicle mass of our defined regulatory categories, so it does not represent the higher power ratings and higher vehicle weights. After taking all comments obtained from all stakeholders into consideration, we have made many changes on the road grade called Profile D after we released the NODA version of GEM to maintain the national representativeness of the profile and to better match engine operation of on road tractors. Some of the ways we did this was by adding additional miles at zero grade and  $\pm 0.5$  percent road grade road at the beginning and end of cycle, and reducing the peak grades, and to match the rate of change in grade of actual roads. See Chapter 3.4.2.1 of the RIA for the detailed description of the process the agencies took to create the final road grade profile.

**Organization:** Walsh, Michael and Charlton, Stephen

### 3.2.2 Vehicle Drive Cycles

Many vehicle drive cycles have been created, all with the objective of representing a given duty-cycle for a given vehicle class for the purpose of measuring emissions, fuel economy or performance under controlled and standardized conditions. Here the focus is on HD tractor engine drive cycles and especially their equivalence with engine test cycles. In a later section, engine BTE and fuel consumption data will be compared across several different sources, using a range of metrics. Therefore, the goal of this analysis is to compare and contrast the various cycles and to understand how they align one with another. [NHTSA-2014-0132-0102-A1 p.12]

Considering the key references reviewed in the report, the most important drive cycles to consider are: [NHTSA-2014-0132-0102-A1 p.13]

1. NESCAUM / NESCCAF long haul cycle with gradient
2. GEM 55mph cruise with gradient
3. GEM 65mph cruise with gradient
4. World Harmonized Vehicle Cycle (WHVC)
5. SuperTruck drive cycles [NHTSA-2014-0132-0102-A1 p.13]

The NESCAUM/NESCCAF long haul cycle [47] is a 117 minute road test simulation with approximately 27 minutes of urban driving and 90 minutes of interstate driving. The interstate portion is at vehicle speeds between 65mph and 70 mph. The cycle includes gradient changes which will require operation on the engine torque curve and gear shifts to access higher engine speeds. Figure 5 shows the region of the engine speed / load map where the NESCAUM long haul cycle will operate the majority of the time, assuming the truck is geared for 65mph between the A and B speeds. The region indicated is where the engine will spend most time on the cycle, it also the region of highest fuel burn – which largely determines CO<sub>2</sub> emissions on the cycle. The WHVC and NESCAUM/NESCCAF cycles are shown in Appendix C [see p.38 of docket number NHTSA-2014-0132-0102-A1], Figure 18 for reference. [NHTSA-2014-0132-0102-A1 p.13]

The GEM 65mph cycle with gradient [51] is very similar to the NESCAUM cycle, spending significant time at the cruise speed with gradient changes requiring access to the torque curve and gear shifts to access higher engine speeds. The GEM 65mph region is narrower than the NESCAUM/NESCCAF region since the NESCAUM/NESCCAF cycle is essentially 65mph to 70mph cruise, see Figure 5. [NHTSA-2014-0132-0102-A1 p.13]

The WHVC cycle [49] consists of urban, rural and motorway segments. For simulation of HD tractor-trailers the recommended weighting factors are 90% motorway, 10% urban. The average vehicle speed on the motorway segment is only 55mph (88kph). Therefore this cycle is very close in character to the GEM 55mph cruise with gradient drive cycle [51]. There is a danger at 55mph that a tractor-trailer engine could be operated at the edge or outside of the NTE zone, if the engine were integrated with a DCT or AMT transmission, allowing operation in top gear at low engine speeds. [NHTSA-2014-0132-0102-A1 p.13]

While there are a variety of engine test cycles and vehicle drive cycles, this analysis shows that the 55mph drive cycles (GEM 55mph and WHVC) are outliers and unlikely to be comparable with the other cycles from a CO<sub>2</sub> perspective. These cycles are valuable in illustrating the risk that engines could be operated outside of the NTE zone, with resulting risk to NO<sub>x</sub> and PM emissions. [NHTSA-2014-0132-0102-A1 p.13]

The remaining test cell and vehicle drive cycles overlap considerably as would be expected since they are all attempting to achieve the same goal. Data from various sources with the exception of GEM 55mph and WHVC will be directly comparable within a small margin of error, estimated at 1-2% of CO<sub>2</sub> or fuel consumption. Figure 6 from SWRI [42] confirms this finding where results are compared for the GEM 65mph cycle, modeled by SWRI as a single engine operating point, and NESCAUM long haul cycle, and show little to no difference in fuel savings with different technologies. [NHTSA-2014-0132-0102-A1 p.13]

This is important because it allows direct comparison of data from the various sources referenced in this study, even though they were gathered in slightly different ways. [NHTSA-2014-0132-0102-A1 p.13]

### *5.3 SWRI Report #1 Commissioned by NHTSA, June 2015 [42]*

The SWRI research project, contained in two reports by Reinhart [42, 43], was designed to inform NHTSA and EPA's development of Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (Class 2b – 8). [NHTSA-2014-0132-0102-A1 p.16]

The study included a literature review to identify potential fuel saving technologies and to assess the state of the art. A large number of engine and vehicle technologies were selected for analysis, and their fuel saving performance was simulated to assess the fuel savings potential of each technology over a wide range of duty cycles. The study used a combination of computer simulation and experimental data to assess the potential for improvements in engine and vehicle fuel efficiency. [NHTSA-2014-0132-0102-A1 p.17]

The engine study assessed a range of incremental improvements and new technologies in two stages. Report #1 [42] assessed the fuel efficiency impact of technologies individually. Report #2 [43] assessed the fuel efficiency impact of technologies in combination. The assessments were made over a range of drive cycles, including: [NHTSA-2014-0132-0102-A1 p.17]

- GEM 55mph cruise and GEM 65mph cruise - without gradient changes [51], single operating point
- WHVC [49]
- NESCAUM/NESCCAF Long Haul Cycle with gradient changes [47]

Each of the above cycles was studied at 0%, 50% and 100% payload. The engine used in the study was the MY 2011 14.8L DD15 produced by Daimler for application in Freightliner and Western Star trucks in the U.S. The vehicle road load was represented by a Kenworth T700 tractor unit with empty weight of 33,960 lb., payload capacity of 46,040 lb., and a GVWR of 80,000 lb. [NHTSA-2014-0132-0102-A1 p.17]

The analysis consisted of running GT-Power simulations at multiple steady-state engine operating points to allow estimates of drive-cycle fuel economy to be made. Appendix E [see p.40], Figure 21 describes the analysis plan for the assessment of engine technologies and Appendix F [see p.41] describes the analysis plan for the assessment of vehicle technologies. [NHTSA-2014-0132-0102-A1 p.17]

It should be noted that the SWRI analysis was carried out at a single operating point for the GEM 55mph and 65 mph drive cycles, which is also the approach taken by the SuperTruck projects in demonstrating engine BTE performance. Unlike the SuperTruck over-the-road drive cycle demonstrations, the SWRI analysis did not include transient performance. [NHTSA-2014-0132-0102-A1 p.17]

The literature review covered air handling, combustion, aftertreatment, friction and parasitic losses, and waste heat recovery. However, with few exceptions, only a modest attempt was made to quantify the potential fuel consumption gains of these areas of advanced technology – either for the near term or for the time frame of the proposed Phase 2 rule. Where estimates of fuel savings are made, there is little evidence those estimates were used in the analysis, preferring instead to perform ‘parametric sweeps’ over a range of values which seem to have been chosen semi-arbitrarily. [NHTSA-2014-0132-0102-A1 p.17]

This is a weakness of SWRI report #1 [42], which is carried over into SWRI report #2 [43], where combinations of advanced technologies are assessed to ensure interactions are accounted for. The GT-Power simulation study which forms the basis of SWRI report #1, is a parametric study which in significant areas is a simple sensitivity study with ranges applied to key parameters, for example: [NHTSA-2014-0132-0102-A1 p.17]

- 10% reduction in engine friction (FMEP) at high loads, 35% at lower loads
- 10% reduction in turbocharger efficiency
- 25% reduction in tractor aerodynamic drag (Cd)
- 30% reduction in tire rolling resistance [NHTSA-2014-0132-0102-A1 p.17]

Results from this parametric ‘sweep’ study are shown in Figure 6 for engine, and Figure 7 for vehicle technologies. Below is an example of a ‘technology package’ with semi-arbitrary values given to key parameters taken from the second study where technologies are studied in combination [43]. [NHTSA-2014-0132-0102-A1 p.17]

[Figure 6 and 7 can be found on p.18 of docket number NHTSA-2014-0132-0102-A1]

*“T700 Package 2 has a 25% Cd reduction, a 30% Crr reduction, and a 6.5% empty weight reduction, with the 2019 baseline DD15 engine. This package provides 19 to 24% fuel savings on the three high speed cycles, with the smaller values coming on the more realistic NESCCAF cycle, which includes grades and a small stop and go segment. Fuel savings are over 7% even on the low speed CARB cycle [43][NHTSA-2014-0132-0102-A1 p.17].”*

When viewing these results it important to bear in mind the nature of the study. The study is simply exploring the parametric design space, and makes little attempt to assess or extrapolate the state of the art between 2015 and 2027. [NHTSA-2014-0132-0102-A1 p.17]

Downspeeding results are shown in Figure 6, which presents results from a GT-Power cycle simulation of a HD tractor engine – in this case a Daimler DD15 engine rated at 455 HP. Through gearing and drive axle selection the highway cruise speed of the engine was reduced from 1368 rpm to 1209 rpm at 65 mph (Downspeed A) and reduced further to 1051 rpm (Downspeed B). Figure 6 shows that downspeeding can reduce fuel consumption by between 2% and 4% with engine speeds as low as 1051 r/min at 65 mph. [NHTSA-2014-0132-0102-A1 p.18]

Turbocompound results are also shown in Figure 6 in two different formats – with electric drive, and downsized power turbine (‘optimized turbocompound’). The results show fuel savings of less than 1% on all drive cycles, compared with WHR, which shows 2.5%-5.0% fuel savings with these assumptions. [NHTSA-2014-0132-0102-A1 p.18]

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42 Reinhart, T. E., “Commercial medium- and heavy-duty truck fuel efficiency technology study - Report #1. (Report No. DOT HS 812 146). Washington, DC: National Highway Traffic Safety Administration. June 2015.

47 Marin, A.N., “Reducing Heavy-Duty Long Haul Combination Truck GHG Emissions and Fuel Consumption,” Mobile Source Technical Review Subcommittee, NESCAUM/NESCCAF, October 6, 2009

49 “Development of WHVC Weighting Factors,” Working Paper No. HDH-15-07e, 15th HDH meeting, Institute of Internal Combustion Engines and Thermodynamics, October 2013

51 “Greenhouse Gas Emissions Model (GEM) User Manual - Vehicle Simulation Tool for Compliance with the Proposed Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium and Heavy –Duty Engines and Vehicles: Phase 2,” Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, June 2015.

**Response:**

We appreciate the commenter’s comments on vehicle drive cycles, and some of points on NTE for WHVC and 55mph cycles are very well taken. We are aware that there is a possibility that under some vehicle configurations, such as very low axle ratio, the vehicle operating points could be in or even slightly out of the boundary of NTE zone. We also notice that for those potential vehicle configurations with very low axle ratio may run into the issue with higher frequent gearing shifting due to lack of torque margin at such low engine speeds, which could result in poorer fuel economy. Therefore, it would not be vehicle manufacturers’ interests to design a vehicle to continue running the engine into this operational region. Even though this could happen, 55mph cycle is still a small portion of the tractor CO<sub>2</sub> emissions and fuel consumption. Regarding the SwRI report, we believe that SwRI has done a

good job in analyzing the potential impact of future technologies. These were done by varying a range of vehicle and engine key parameters to address the impact of the future technologies on fuel economy. While it seems that the range of variations sounds to simply explore the sensitivity studies, more careful review on the range of parameter variation shows that the range is consistent with our finding based on different sources. For example, 25% of Cd reduction translates the CdA drops from 6.481 to 4.86, which is just in the range of Bin V of our evaluation for 2027 vehicle (Table III-10 of Section III.D of the Preamble), while our data collection is completely independent of SwRI report. Furthermore, with the limited data source, we are not sure how they could do better to define the range of the parameters to predict the long-term technology impacts.

**Organization:** ZF TRW Commercial Steering

## **Introduction**

ZF TRW has been a supplier to the automotive and commercial vehicle market for over 100 years. ZF TRW Commercial Steering Division is based in Lafayette, Indiana, and specializes in Steering Systems for the Class 5 -8 market with a very strong presence in North America. Part of the steering system is the power steering pump, which is traditionally driven by the engine. This is a parasitic loss in a similar manner as the alternator, air compressor, and water pump. Any efficiency improvements to these subsystems also improve the overall efficiency of the vehicle. [EPA-HQ-OAR-2014-0827-1882-A1 p.1]

On March 2, a revised version of GEM was included as part of the Phase 2 Notice of Data Availability. As explained in our comments to follow, ZF TRW requests that a power steering pump using secondary chamber deactivation be credited and accounted for in the Phase 2 Standards' Greenhouse Gas Emissions Model (GEM). [EPA-HQ-OAR-2014-0827-1882-A1 p.1]

## **Power Steering Background and Power Consumption**

The power steering system is sized to match the vehicle needs and the driver's expectations. This includes the ability to have full power assist during a docking or parking maneuver when the engine is at idle speed, and the vehicle is not moving. The driver expects to be able to turn the steering wheel approximately 1.5 turns per second. This performance expectation is part of what determines the size of the power steering pump. As the vehicle is driven at speed and the engine rpm increases, the extra flow generated by the pump must be controlled and re-circulated. This extra flow is wasted energy and is a parasitic loss to the engine above what is necessary for proper function of the steering. Per SAE J1343, a typical line haul truck requires an average of 0.4 – 1.1 kW for hydraulic steering. [EPA-HQ-OAR-2014-0827-1882-A1 p.1]

## **Current Technology Considerations**

EPS (Electric Power Steering) - This technology holds great promise, but is power limited and the adoption rate and business case limit the potential environmental impact in the near future. The ability to steer Class 7- 8 vehicles will require electrical upgrades and is likely 10 years away. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]

EHPS (ElectroHydraulic Power Steering) – This technology (or the above) allows for engine off power steering, but the efficiency of an EHP S system is highly dependent upon the duty cycle of the vehicle. Line haul vehicles benefit more from a direct drive power steering pump, without the electric conversion efficiency losses. Again, adoption rates and return on investment will limit the impact to the environment on a large scale. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]]

## **ZF TRW Consideration**

ZF TRW has been working on fuel efficient options for several years. Based on vehicle duty studies, line haul commercial vehicles spend most of their time either at engine idle, or at cruising speed. While efforts to reduce idle time are being addressed by OEMs, ZF TRW has developed a new power steering pump that addresses the wasted energy of excess flow at cruising speed. This pump is called ActivMode (trademark pending), and it effectively behaves as two pumps in one. At engine idle, both sides of the pump combine to provide the required flow and pressure for the system needs. At highway speeds, the pump flow control system shifts to generate flow only from one side, thereby deactivating the secondary chamber. The effect of this deactivation is to reduce the pump drive torque by approximately 30-40%. In addition, since it is not generating extra flow, it also reduces the system temperature of the power steering fluid. As such, power steering coolers can be avoided or eliminated for further cost and weight savings. This technology is undergoing vehicle fleet testing and will be available for full production in 2017. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]

This pump is a direct bolt on replacement, requiring only minor changes (if any) to the hose connections, but without any performance sacrifice for the driver. The cost impact is a minimal up charge from current production, approximately \$25-50 more than a standard hydraulic pump. The anticipated payback on fuel savings alone is less than 6 months for a normal line haul application. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]

As such, this type of product has the potential for a rapid, high adoption rate at the OEMs, with additional benefits of improved fuel economy and reduced power steering temperatures for the end user. The cumulative effect for the environment can be very positive. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]

We request that this technology is accounted for and added to the Phase 2 regulations for greenhouse gas credit. [EPA-HQ-OAR-2014-0827-1882-A1 p.2]

### **Response:**

We introduced a mechanism to recognize some accessories, including electric power steering pumps. More information can be seen in 40 CFR 1037.520 (j). Manufacturers have the option to apply for off-cycle credits for the other types and designs of high efficiency accessories, such as dual displacement power steering pumps.

## **2.3 Validation of GEM**

**Organization:** Daimler Trucks North America LLC

**Flaws of EPA's GEM validation testing** - The EPA purports to have validated GEM but, in doing so, some of the validation used different powertrain inputs than are available in GEM. Specifically, in testing 28 vehicles with SwRI and putting their corresponding inputs into GEM, the EPA did not use GEM as the agency would require manufacturers to do; the EPA used the vehicles' actual transmission characteristics in simulating the vehicles. By contrast, the regulatory GEM uses default transmission information like gear efficiencies. The agencies should recognize that manufacturers will need accurate GEM results, like the agencies did, and therefore should be similarly willing to let vehicle manufacturers input actual transmission information into GEM. Manufacturers should get the same benefits as the agency. 80 FR 40522. [EPA-HQ-OAR-2014-0827-1164-A1 p.54]

**Response:**

Please see the agencies' general response to GEM validation in RTC Section 2.1 above. In the final GEM, the transmission efficiency and power loss are part of the user input.

**Organization:** Truck & Engine Manufacturers Association (EMA)

**Open Issues With the Revised GEM**

The agencies purport to have validated GEM. While the agencies have undertaken validation testing – for example, testing 28 vehicles at SwRI and incorporating the corresponding inputs into GEM – that testing did not demonstrate GEM's validity as EPA claims. In particular, EPA used different powertrain inputs in GEM than are available in the regulatory program. EPA also used the vehicles' actual transmission characteristics in simulating the vehicles. By contrast, the regulatory GEM process uses a default shift schedule and gear efficiencies. Therefore, it is not correct to assert that the alignment of test and simulation results validates GEM. EPA did not actually simulate GEM results as manufacturers must. [EPA-HQ-OAR-2014-0827-1269-A1 p.56]

Moreover, as noted above, there are still many issues that need to be finalized and accounted for in the revised GEM. For example, there currently is no means to account for rear axle efficiency in GEM. That needs to be corrected. Similarly, there are inadequate means to account for auto-shut down features and, more importantly, programmable idle-shutdown, which is widely deployed in the heavy-duty and medium-duty vehicle fleet, in part due to state and local regulations that mandate idle-shutdown after a prescribed number of minutes. GEM needs to give clearly defined credit for those factors, and others impacting vehicle fuel efficiency, including, but not limited to, "Eco-Roll" and "E-Coast" technologies, programmable automatic engine-shutdown systems, and tire-pressure monitoring systems. Further, transmission modeling is inadequate in GEM, forcing the engine to run at unrealistic speeds and loads in some cases. That could be especially problematic if GEM were used to create test profiles, as proposed under the alternative certification ("cycle-average") method. [EPA-HQ-OAR-2014-0827-1269-A1 p.57]

Among the many specific revisions and updates that still need to be incorporated into GEM are the following: [EPA-HQ-OAR-2014-0827-1269-A1 p.57]

**Response:**

Please see the agencies' general response to GEM validation in RTC Section 2.1 above. Validation against the transmission shifting tables provided by manufacturers are the first, and most important step to demonstrate the model fidelity, ensuring all components to work properly. We made improvements on transmission gear shifting prior to the final rule to more realistically represent the real world driving condition. Since NPRM, significant model validations have been conducted against powertrain tests with the agencies' default shifting strategy. In addition, GEM validation with default transmission shifting logic was also conducted against a real-world driving routes with two very well defined trucks. The detailed comparisons and discussions can be seen in Chapter 4 of the RIA. More detailed explanation and derivation on the gasoline engine map can be seen by SwRI final report entitled "Validation Testing for Phase 2 Greenhouse Gas Test Procedures and The Greenhouse Gas Emissions Model (GEM) for Medium- and Heavy Duty Engines and Powertrains" [EPA-HQ-OAR-2014-0827]. In the final GEM, the transmission efficiency and power loss are part of the user input. The axle efficiency is also part of the user input by allowing the user to input their own power loss table. We have made many improvements and changes in those technology inputs to GEM related to idle, tire pressure



monitoring systems, intelligent control such as predictive cruise and neutral coast to address these concerns, which are specified in CFR 40 1037.520 (j).

## 2.4 Supplements to GEM Simulation

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Powertrain testing

ACEEE strongly supports the inclusion of an option to test tractors and vocational vehicles using a powertrain test (p.40179). Given the very substantial benefits to be gained from the integration of engine and transmission, it is important that the efficiency benefits of such integration be not only recognized but factored into the stringency of the standards, especially for vocational vehicles. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

Needless to say, this option will not help to incentivize engine-transmission integration unless powertrain testing can demonstrate the efficiency benefit of the integration. If the integrated powertrain does not achieve better results on the powertrain test than it – or a less efficient powertrain – achieves in GEM testing, the powertrain option will serve no purpose. Transmission loss in present GEM is conservative and efficiency gain from transmission is generous than powertrain testing. It is important that the agencies keep this issue in mind as they determine how the GEM executable handles the various transmissions types. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

Recommendation: Powertrain testing [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

-Calibrate GEM treatment of transmission efficiency to yield result that can be compared to results of powertrain testing. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

**Response:**

We appreciate the ACEEE's support on powertrain testing.

**Organization:** Daimler Trucks North America LLC

**Advantages of Complete Vehicle Simulation** – In the NPRM the agencies discuss how they intended to provide regulatory incentives to use more fuel efficient technologies and expanded GEM to recognize engine and other powertrain component improvements. But the agencies state one disadvantage of the increased complexity of including engine details in GEM: vehicle manufacturers would be required to conduct additional engine tests, and track additional GEM inputs for compliance purposes. 80 FR 40181. The agencies seek comment on the changes. DTNA strongly agrees that expanding GEM to recognize more engine and other powertrain components provides flexibility and reduces the risk of a divergence between test-cycle and real-world fuel efficiency improvements. We think that the benefits of a more accurate GEM outweigh the drawback that we will need to do more testing. Rather, we think the solution to the problem of additional testing is that the EPA and NHTSA try to align their test procedures as much as possible with those being used in Europe, so that there is commonality of testing. For example, there is no reason to test rear axles differently in the US than in Europe. [EPA-HQ-OAR-2014-0827-1164-A1 p.13]

Moreover, the agencies request comment on the advantages and disadvantages of the proposed structure that would require vehicle manufacturers to provide additional inputs into GEM to represent the engine. 80 FR 40250. DTNA thinks it is unlikely that recognizing engine improvements in GEM could force a vehicle manufacturer to do engine testing as the engine manufacturer must provide certified engine data to the OEM for use in GEM. A vehicle OEM would not rely on its own engine test data in order to certify a vehicle in GEM, nor (as we understand) would the regulations require a vehicle manufacturer to do so. Rather, a vehicle OEM would rely on engine manufacturer data in Phase 2 just the same as it relies on tire manufacturer data in Phase 1. In summary, we strongly support adding inputs to GEM, as this makes for a more accurate simulation process that can better regulate what is important—the fuel consumption of the full vehicle. [EPA-HQ-OAR-2014-0827-1164-A1 p.13]

**DTNA Agrees that GEM Should Be Updated and Expanded** - The agencies request comments on the proposed GEM structure that would require vehicle manufacturers to provide additional inputs into GEM to represent the engine, transmission, drive axle(s), loaded tire radius, etc. We strongly agree with the agencies' approach of regulating through an updated version of GEM that incorporates many more vehicle and engine parameters and with realistic drive cycles. This better represents the actual vehicle in real-world operation than does the Phase 1 GEM. 80 FR 40181. [EPA-HQ-OAR-2014-0827-1164-A1 p.42]

**Transmission Mapping Improvement to GEM** - The agencies requested comment on aspects of the GEM tool relating to how it models transmissions and shifting strategies. 80 FR 40297. Separately the agencies proposed a powertrain test in order to incorporate to the GHG Phase 2 program the 'deep integration' of the transmission with the engine. As we discuss in our comments, below, we believe that what the agencies mischaracterize as deep integration is in significant part just the benefit of using actual transmission gear efficiencies in GEM calculations. That is, if the agencies would allow vehicle manufacturers to input into GEM the measured transmission efficiency map, as is proposed for rear axles, then GEM would properly capture integration effects. For example, in tractor applications, there is little gear shifting in GEM for tractor applications so that, no matter the gear shifting strategy, there is so little shifting that there is no room for improvement (as we have shown the EPA and would be willing to show again in a confidential setting). Similarly, for vocational vehicles, although there is more gear shifting, much of the deep integration benefit comes from efficient gearing and only a part from optimized shifting, such that the agencies penalize manufacturers by using the default gears or forcing manufacturers into expensive and resource intensive powertrain testing. In short, we recommend allowing transmission efficiency maps as inputs to GEM, and we propose that the agencies adopt the European transmission mapping procedure to do so. [EPA-HQ-OAR-2014-0827-1164-A1 p.54-55]

**Hybrid Test Procedures** – The agencies propose to keep hybrid features out of GEM and to only credit hybridization if a manufacturer does actual powertrain or vehicle testing. We agree with this approach. GEM would become too complicated if it had to account for all types of hybrids. In their comments and the new regulatory text about the hybrid powertrain testing, the agencies seem to propose that manufacturers would perform powertrain testing using only powertrain and hybrid components, omitting all “non-powertrain features” like variations in aerodynamics or tires. 80 FR 40298 and § 1037.550. We agree that this is the correct approach to minimize test burden yet get sufficiently accurate results. [EPA-HQ-OAR-2014-0827-1164-A1 p.64]

**Response:**

We appreciate DTNA's support adding more inputs to GEM and the support to keep hybrid out of GEM. We also made significant changes and improvement on GEM, which can be summarized as follows, which address the comments related to GEM.

- Added optional input table for transmission power loss data
- Modified road grade profile for 55- and 65-mph cruise cycles
- Revised idle cycles into overall vocational vehicles with new vocational cycle weightings
- Made significant changes on the input file structures. Examples includes additions of columns for axle configuration (“6x2”, “6x4”, “6x4D”, “4x2”), and additions of a few more technology improvement inputs, such as “Neutral Idle and Start/Stop.”
- Made significant changes on output file structures. Examples includes an option to allow the user to output detailed results on average speed, average work before and after transmissions, and the numbers of shift for each phase (55 and 65mph cycles and ARB cycle).
- Added input file for axle power losses (function of axle output speed and torque) and replaced single axle efficiency in model with lookup table of torque loss
- Added simulation of engine torque response with fast response region defined by engine displacement, and slower torque increase in boosted region with fast falloff on available torque
- Added regression models for all certification cycles to allow the user to simulate vehicle with cycle average approach
- Added different fuel properties according to 1036.530.
- Significantly improved shift strategy based on testing data
- Adjusted transmission loss & inertia scale factors per regulatory subcategory
- Added minimum torque converter lock-up gear input for AT
- Retuned the default transmission mechanical efficiency based on the testing data
- Added neutral idle and start/stop features during simulation
- Adjusted shift and torque converter lockup strategy

**Organization:** Natural Resources Defense Council (NRDC)

In our comments to the Phase 1 rule, NRDC urged the agencies to ensure that the medium- and heavy-duty standards and compliance mechanisms recognize the potential for fuel efficiency technologies applied across the vehicle. Therefore, NRDC greatly appreciates the agencies’ proposed expanded full vehicle simulation Greenhouse Gas Emissions Model (GEM). By expanding GEM to include the engine, transmission, axle and tires in actual vehicle configurations (instead of the constant default values), manufacturers have an enhanced incentive to integrate the various components to improve efficiency. NRDC agrees with the agencies’ assessment that the GEM improvements also enhance manufacturer flexibility to mix and match technologies as they wish to meet the performance-based targets of the standards. [EPA-HQ-OAR-2014-0827-1220-A1 p.6]

**Response:**

We appreciate NRDC’s comments on GEM.

#### **2.4.1 Technology Test Procedures**

**Organization:** Afton Chemical

As a leading producer of fuel and lubricant additives, Afton Chemical Corporation has long been recognized as an expert in developing and testing products that lead to an increase in fuel efficiency while reducing emissions. It is with this expertise in mind that we would like to comment on EPA and

NHTSA's proposed rule on Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2. [EPA-HQ-OAR-2014-0827-1129-A2 p.1]

Our comments will be focused on the Heavy Duty Axle Efficiency procedure and how lubricant oils will be tested in this process. We agree with EPA that fuel efficient gear lubricants can make a worthwhile and measureable contribution to fuel efficiency. Thus Afton's comments are directed at comparing fuel efficient commercial gear lubricants in a way that can precisely detect efficiency differences in these lubricants. Afton has significant experience in running gear fuel efficient tests. We believe the procedure as proposed by EPA has areas that will lead to high variability of results. As proposed, there is the potential for poor performing oils to be determined good and good oils to be rejected. We do not believe that it is EPA's intent to develop a procedure that will inaccurately demonstrate the effectiveness or lack thereof of lubricant oils. Such a result will not help EPA or the country reach the stated goals of the proposed rule. [EPA-HQ-OAR-2014-0827-1129-A2 p.1]

We have separately attached our comments that look at modifying the procedure and how the lubricant is evaluated. We would be pleased to work and discuss with EPA how these changes and refinements can improve the procedure. We believe these refinements to the procedure can be run by a number of laboratories, provide precise results at meaningful speed and torque combinations, produce an incentive for lubricant suppliers to innovate for better lubricant efficiency and be accomplished in a cost effective fashion. In this way, we believe this will help carry out EPA's mandate. [EPA-HQ-OAR-2014-0827-1129-A2 p.1]

Areas of comments related to the EPA test procedure given in 40 CFR 1037.560 of the Phase 2 [EPA-HQ-OAR-2014-0827-1129-A2 p.2]

- The Emgard<sup>®</sup> FE 75W-90 lubricant has been assigned a 0.5% efficacy advantage over normal lubricants in axle efficiency. We agree that this is realistic and propose the Emgard<sup>®</sup> FE 75W-90 lubricant be considered a reference oil by which other lubricants can be measured in an axle efficiency test. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
- We know lubricants can exceed the FE improvement offered by the Emgard<sup>®</sup> FE 75W-90 lubricant. The EPA proposal does not indicate additional credit can be gained by these lubricants. This could stifle innovation. We believe if an oil run in the FE test shows statistically significant better FE than Emgard<sup>®</sup> FE 75W-90 it should be awarded additional efficiency credit beyond the 0.5% afforded by Emgard<sup>®</sup> FE 75W-90 if employed as initial fill by the truck manufacturer. If it shows statistically equivalent to Emgard<sup>®</sup> FE 75W-90 it should be awarded the same 0.5% improvement. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
- All tested lubricants must hold SAE J2360 performance credentials to demonstrate fluid performance for major commercial vehicle axles. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
- As acknowledged by your comments in the proposal, axle efficiency varies by speed and torque with highest efficiency being given at high torque, high speeds. Hence at high efficiency conditions, there is little room for improvement. However, most commercial vehicles run only a small portion of time at these high torque values and in general run at a fraction of rated speed and torque. It is at these lower speeds and loads that one can see significant differences in lubricant efficiency. Thus, we propose that lubricants be evaluated at a maximum of 4 speeds and loads with greater weight being given to those areas of speed and load that correspond to actual vehicle service. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
- Different axles can give different efficiencies; however, a FE lube will generally be efficient regardless of the axle. To verify the efficiency, we believe a matrix of no more than 2 axles, one each from the two major axle manufacturers supplying the U.S. commercial vehicle market. These axles could be specified by these same manufacturers. If a lube shows an average

efficiency statistically the same or better than Emgard, it should be awarded FE credit. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]

- The test was originally defined to measure axle hardware capabilities. It was not defined for lubricant efficiency measurements. However, areas within the test procedure that could be improved: [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
  - Break-in time of 3 increments of 77 minutes may not be enough. In our experience, the axle requires at least a full day of break-in and often more before stable results are obtained. We believe the break-in should be run until a measure of adequate repeatability is obtained to show stable results. This could be something akin to repeat runs of efficiency which show an effective repeatability of no more than 0.2%. If as noted above no more than 2 'mainline' axle assemblies are used to measure lubricant efficiency, then these 2 axles once broken in can be repeatedly used for different lubricants. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
  - Order of running for FE measurement should be Emgard® FE 75W-90 at different speeds and loads run multiple times with repeatability of the runs falling within an appropriate band followed by the lube to be measured at same conditions and repeatability followed by Emgard to verify there has been no change in the repeatability measurements or the test stand or axle. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
  - Test rig capability needs to be defined, but ultimately it needs to achieve the precision necessary for measuring the FE differences in lubes. Thus, a precision statement or rig precision requirements will be very important. [EPA-HQ-OAR-2014-0827-1129-A2 p.2]
  - In our experience, a test point of 0 Nm can create control problems for the dynos. This could lead to dangerous instability and thus we never run or try to control a large dyno rig at that point. 0 Nm is more suited to what is measured by a 'spin loss' rig. [EPA-HQ-OAR-2014-0827-1129-A2 p.3]
  - Testing order, sets of test, calculation of efficiency data, data quality and acceptance limits, and statistical methods to be used all need to be defined to assure adequate precision and quality testing. [EPA-HQ-OAR-2014-0827-1129-A2 p.3]
- The time for release of the proposal is first part of 2016. This does not leave much time to develop a comprehensive and well thought out procedure. However, Afton stands ready to work with EPA and other parties to help develop and refine a procedure. [EPA-HQ-OAR-2014-0827-1129-A2 p.3]

**Response:**

We appreciate many constructive comments by Afton Chemical. We recognize the importance of lubricant additives used in axle. As a matter of fact, we modified the final GEM to allow the user to input their own axle power loss, where the measurement on the power loss will include any benefits due to lubricant and its additives. See 40 CFR 1037.560.

**Organization:** Allison Transmission, Inc.

**The Version of GEM Available For Public Comment Contains Several Deficiencies and Inaccuracies; EPA and NHTSA Must Revise GEM and Allow for Further Review and Comment**

On the whole, Allison believes that EPA and NHTSA have made substantial progress in revising GEM for the Phase 2 rule to make this model a more accurate predictor of real world GHG emissions and FE. In the Phase 2 GEM, the engine is better defined and the agencies have incorporated or improved

several vehicle elements that can have significant impact on the emissions profile and fuel use of MD/HD vehicles. GEM inputs concerning transmission ratios, axle ratios and tire size all represent improvements compared with the inputs utilized in the Phase 1 GEM. And, as we stated at the beginning of these comments, Allison supports the use of GEM as the primary certification tool. [EPA-HQ-OAR-2014-0827-1284-A1 p.18]

Despite improvements to GEM, however, the agencies must recognize that this model is still somewhat a work in progress. Allison addressed this issue in its comments at the public hearing held in Chicago, Illinois on August 6th along with specific recommendations as to how the agencies should proceed with further GEM development after the close of this comment period, including with regard to seeking additional public review and comment of significant alterations to GEM.<sup>32</sup> In the comments, below we submit additional technical issues with GEM P2v1.0 along with proposed solutions.

### **EPA and NHTSA Must Make Several Changes In Order to Properly Credit Neutral-Idle Technology Within GEM**

In the Proposed Rule, EPA and NHTSA explicitly state that GEM is intended to address Neutral-Idle technology that is utilized during the transient cycle. We agree with the agencies that many vocational vehicle applications operate on patterns implicating workday idle cycles and that GEM should account for these cycles and the control of emissions which results through the use of Neutral-Idle technology. Including such technology within GEM would both increase the accuracy of projected emissions/fuel consumption of the vehicles being modeled as well as more accurately represent what is already occurring within the marketplace. [EPA-HQ-OAR-2014-0827-1284-A1 p.19]

Given the overall purpose and intent to account for such systems in GEM, however, it is inconsistent for EPA and NHTSA to not simulate Neutral-Idle within GEM during the ARB transient cycle – or to not credit this technology within the ARB transient cycle through post processing for an AT. Specifically, it can be seen that since 16% of the ARB transient cycle consists of idle, the impact of ARB transient idle time can be nearly as much in the weighted CO2 emissions calculation (i.e., 74%) as the idle cycle itself (depending on vocational chassis subcategory). EPA and NHTSA cannot ignore such significant periods of vehicle operation and must accordingly make changes to GEM to account for Neutral-Idle in the ARB transient cycle. The GEM simulation does credit the AMT and the MT with Neutral-Idle fuel rate during the ARB transient cycle simulation and does not use Neutral-Idle fuel rate for the AT even when Neutral-Idle is selected as an option. The agencies must correct this disparity. [EPA-HQ-OAR-2014-0827-1284-A1 p.19]

This disparity is even more important to address when one considers that GEM correctly rewards Neutral-Idle technology in the idle cycle. Recognizing Neutral-Idle technology in the idle cycle, but not within the transient cycle, would lead to inconsistent results in projecting real world emissions and would be arbitrary and capricious. Retaining this differential treatment in the final rule would effectively give partial credit for this important and effective emission reduction technology and unduly and incorrectly penalize ATs that incorporate the technology. [EPA-HQ-OAR-2014-0827-1284-A1 p.19]

The agencies should also be aware that Eaton has announced AMT product changes affecting low speed operations.<sup>34</sup> Allison does not know precisely how this functionality is achieved; its existence, however, it raises serious questions as to whether the AMT will always operate at a true Neutral-Idle state as modeled in GEM. Therefore, given the possibility that AMTs operation may change in the direction of higher fuel consumption during the lifespan of the Phase 2 rule, Allison recommends that GEM drop-downs for Neutral-idle also be used for AMTs. Since new features may consume more fuel at idle, the

likelihood of higher fuel rates being reflected via an optional powertrain test is unlikely and further reinforces the need to account for this fuel usage in GEM. [EPA-HQ-OAR-2014-0827-1284-A1 p.19]

In addition, EPA and NHTSA must also address engine Start-Stop technology within the ARB transient cycle. GEM already provides such credit in the idle cycle, creating the same issues as described above with respect to Neutral-Idle technology. Again, EPA and NHTSA must correct this differential treatment in the final rule. The Proposed Rule does not allow Neutral-Idle technology and engine Start-Stop to both be utilized in the same simulation even though both features are offered together with an AT transmission. If engine Start-Stop credit remains in the idle cycle only, then Neutral-Idle technology option should be available to be utilized in the GEM simulation of the ARB transient cycle for the AT transmission. AMT and MT simulation will assume Neutral-Idle fuel rates during the ARB transient cycle and the AT should be treated similarly as well if the Neutral-Idle option is selected. [EPA-HQ-OAR-2014-0827-1284-A1 p.20]

Finally, EPA and NHTSA must recognize Neutral-Idle technologies within the ARB transient cycle not only with respect to vocational vehicles, but also with regard to tractors. Even if an idle cycle is not added to the tractor weighted emission calculations, there is still no rational reason to exclude Neutral-Idle technology in tractors during ARB transient idle time. The chart below summarizes our recommendations as to the periods of time when both Neutral-Idle and Stop-Start technologies should be credited within the ARB transient cycle for all vehicles subject to such testing/simulation: [EPA-HQ-OAR-2014-0827-1284-A1 p.20]

[Chart, 'Recommendations for when neutral-idle and stop-start technologies should be credited within the ARB transient cycle', can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

### **EPA and NHTSA Should Not Include Dual-Clutch Transmissions Within GEM**

In the Proposed Rule, manufacturers can select from one of three types of transmissions in GEM: MTs, AMTs and ATs. With regard to heavy-duty DCTs, the agencies explain that “because production of heavy-duty dual clutch transmissions has only begun in the past few months, we do not yet have any experimental data to validate our GEM simulation of this transmission type.” Despite lacking data with regard to DCTs, however, EPA and NHTSA have indicated that they “may finalize GEM for Phase 2 with a fourth transmission type for dual clutch transmissions.” The agencies also indicate that they may address DCTs through post-simulation adjustment. Table 4-12 of the RIA lists a 2% adjustment for DCTs for certain Class 7 and 8 vehicles, the same adjustment as provided for ATs and AMTs. Table 4-13 of the RIA provides a 2.3% adjustment for Vocational Vehicle HHD AMTs or DCTs, but no similar adjustment for ATs.<sup>37</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.20-21]

EPA and NHTSA do not have a sufficient basis in the record to either include DCTs within GEM or to allow for a post-simulation adjustment such as that indicated in the RIA. First, as EPA and NHTSA admit, there is no data to validate GEM simulation of DCTs. Without such data, any value that would be included within GEM for DCTs would be without foundation and, by definition, arbitrary and capricious. Second, even if there were some data available, the agencies need to account for the fact that there are a number of DCT variants and a number of control strategies that could potentially affect related emissions and fuel efficiency. Due to all of this variation, it would not be possible to render a singular GEM value for this technology. Finally, EPA and NHTSA must take into account the fact that DCTs are often larger and heavier than current MTs, AMTs and ATs. This additional weight would negatively affect the emissions and fuel efficiency associated with DCTs. Yet Allison has not uncovered anything in the rulemaking record to indicate that the agencies are aware of this negative effect and have

taken it into account in calculation of technology improvement values. [EPA-HQ-OAR-2014-0827-1284-A1 p.21]

In general, DCTs share some characteristics of AMTs and some characteristics of powershifting ATs. For many of the same reasons that DCTs cannot be included in GEM, however, a post simulation adjustment also cannot accurately characterize DCT performance when compared to a MT, AMT or AT. Specifically, the agencies lack any basis in this rulemaking to assign the same value of 2% for DCTs in certain Class 7 and 8 applications as AMTs and ATs and there is no record support for a 2.3% value for DCTs and AMTs in the Vocational Vehicle category when denying such an adjustment for ATs. Again, since EPA and NHTSA cannot reasonably predict the effect of utilizing DCTs in vocational vehicles or tractor applications, the percentage values for DCTs are inherently unsupported in the record. As a data point, Allison recently completed competitive assessment testing of the Eaton Procision DCT. During that assessment, the Procision DCT fuel usage at idle in drive was significantly higher than the fuel usage for the Allison 2000 Series<sup>TM</sup> used in the assessment. This seems to be a result of the Eaton hardware/software implementation that some clutches stay applied during stop in drive scenarios (see table below). [EPA-HQ-OAR-2014-0827-1284-A1 p.21]

Instead, EPA and NHTSA must only include DCTs in GEM when there is a verified model available. Since that currently does not exist, the agencies must develop or obtain such data and make it available for public review prior to assigning a regulatory value to utilization of DCTs. Such data must be done with a 2010 engine in order to have the same baseline as other transmission technologies; utilizing a newer engine would create unacceptable bias in the results. Altogether, without a factual basis in the Proposed Rule, including DCTs in GEM or allowing for post-simulation adjustment cannot be considered a logical outgrowth of the general discussion of this technology provided in the Preamble and supporting documents.<sup>38</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.21-22]

Moreover, if additional information is provided regarding DCTs, EPA and NHTSA must conduct additional notice and comment rulemaking before including DCTs in GEM or otherwise allowing for crediting of this technology. This is especially true since testing conducted by Allison has indicated that DCTs have more GHG emissions and less fuel economy in transient operation when compared to vehicles incorporating ATs. [EPA-HQ-OAR-2014-0827-1284-A1 p.22]

In recent testing, two trucks were setup to be identical except for the transmission for each vehicle. Full throttle shift speeds were changed on the Allison 2000 Series<sup>TM</sup> to match the Eaton Procision DCT and Neutral at Stop was enabled for the AT. Subsequently, ARB Transient, 55 mph, 65 mph and idle tests were conducted following SAE1526 testing guidelines. The 55 mph and 65 mph tests were conducted on a circle track with a maximum positive grade of 0.78% and maximum negative grade of -0.78%.<sup>39</sup> The results of this testing are contained on the chart below: [EPA-HQ-OAR-2014-0827-1284-A1 p.22]

[Table, 'Results of fuel usage tests for DCTs versus ATs', can be found on p.22 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

### **EPA and NHTSA Must Revise Assumptions on Full Pressure Pump Loss**

For Idle Stop simulation of ATs, GEM assumes full pressure pump loss. In current production, AT transmissions reduce pressure when not needed for clutch capacity or other purposes. By 2021, this on-demand pressure reduction will operate at even lower pressures at idle in all AT transmissions. This pressure reduction directly reduces the pump loss and thus emissions. GEM must therefore be adjusted to take this capability into account. [EPA-HQ-OAR-2014-0827-1284-A1 p.26]



The example below is a combination of test results and analytical post-processing (to convert measured pressures to torque). The figure demonstrates a real world reduction in pump loss during an Idle Stop, versus a Drive Stop. The pump loss reduction is approximately 66%, with very little influence from idle speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.26]

[Chart, 'Pump Loss Reduction at Idle Stop', can be found on p.26 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

### **EPA and NHTSA Should Reweight Drive Cycles Used in GEM**

The agencies have requested comment on whether there is a need to “include segments of lower or variable speed operation in the nominally 55 mph and 65 mph drive cycles used in GEM and how this may or may not impact strategies manufacturers would develop.” Data that Allison has developed indicate that average cruising speeds and stops are much greater than reflected in the proposed duty cycle weightings. [EPA-HQ-OAR-2014-0827-1284-A1 p.27]

Allison has assembled data from 16 different tractor fleets using the TC10 transmission. TC10 customer evaluation fleets average 1.5 stops/mile, with a range of 0.2 to 8.9 stops/mile. Duty cycle information for the TC10 therefore indicates that more stops/mile and idle time should be incorporated into the day cab cycle. In general, Allison supports weighting the ARB transient cycle more heavily, reducing the 65 mph cycle percentage and adding 5% idle cycle to the tractor day cabs. Our specific recommended values as weighting and average speeds are contained below: [EPA-HQ-OAR-2014-0827-1284-A1 p.27]

[Tables, 'recommended values for weighing and average speeds', can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

### **Allison Agrees With EPA and NHTSA General Approach on Shift Strategies, But Improvements Are Necessary To Generic Shift Algorithm To Address Lockup**

EPA and NHTSA have recognized that there are a number of technical and policy barriers to incorporating proprietary shift strategies within GEM, including the disclosure of proprietary information and the total number of such strategies and the use of dynamic switching as between strategies. Including such strategies within GEM could also be counterproductive and lead to sub-optimal vehicle configurations. Allison concurs with the agencies in this assessment. It would be exceedingly complex to simulate all the various shift strategies which exist in a single Transmission Control Module (TCM). Utilization of a generic shift algorithm presents a reasonable approach and strikes a reasonable balance between the testing burden imposed and the need for accuracy in testing and certification. [EPA-HQ-OAR-2014-0827-1284-A1 p.29]

Allison does have several concerns regarding the general shift algorithms; however, Allison is concerned about the timing of torque converter lockup (LU) engagement. Allison's TC10, 2000 xFETM and 3000 xFE TM transmission models operate with LU in 1st range. Early LU operation increases efficiency significantly and improves fuel economy by up to 3%. Due to the larger ratio step required for some transmissions, Allison does not believe that all transmissions will have LU in 1st. Allison recommends that GEM be modified to require input of the range in which LU is applied in order to better represent the real world fuel efficiency. [EPA-HQ-OAR-2014-0827-1284-A1 p.29]

In addition, within GEM, the MLHD<sup>48</sup> AT and HHD AT lock/unlock schedules appear to match Allison maximum performance shift schedules. These samples are outliers and do not accurately represent

typical shift schedules in today's fuel economy-driven industry. Further, these lock/unlock schedules must not be used for slower engines because lockup may be unattainable and GEM emissions results would be unrealistically high. [EPA-HQ-OAR-2014-0827-1284-A1 p.29]

Therefore, Allison requests to replace the current MLHD AT lock/unlock schedule (similar to Allison 2600 performance schedule) with the Allison 1800 performance schedule. The Allison 1800 performance schedule still has a performance-oriented shift strategy, but the lower speeds would make it universally compatible with engines in this category. Likewise, we request to replace the current HHD AT lock/unlock schedule (similar to Allison 2100 performance schedule) with the Allison 1600 performance schedule. The Allison 1600 performance schedule still has a performance-oriented shift strategy, but the lower speeds would make it universally compatible with engines in this category. [EPA-HQ-OAR-2014-0827-1284-A1 p.29-30]

Lastly, Allison requests to utilize the 1st Range lock and unlock schedules from these respective shift schedules in those cases where 1st lockup is selected by the user and enabled by GEM. [EPA-HQ-OAR-2014-0827-1284-A1 p.30]

[Chart, 'Percent throttle plotted against turbine speed for MLHD AT and HHD AT', can be found on p.30 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

### **EPA and NHTSA Must Give Equal Credit to ATs for 1:1 Gear Ratio**

GEM assumes certain transmission gear efficiencies for all ranges. Furthermore, GEM credits a 2% gear efficiency improvement for any range with a 1:1 gear ratio. Allison agrees this is a reasonable assumption, since 1:1 ranges do not exercise any dynamic gear meshes, thus gear meshing losses are reduced. However, this 2% gear efficiency credit for 1:1 ranges is applied to AMT and MT only. Allison requests the same credit for AT, since the same physical phenomenon is observed in AT planetary and countershaft systems alike. Since EPA and NHTSA lack a reasoned basis to distinguish between ATs, AMTs and MTs with regard to 1:1 gear ratios, it would be arbitrary and capricious to selectively grant credits to some, but not all, transmission architectures where this gear ratio is included in the certified vehicle. [EPA-HQ-OAR-2014-0827-1284-A1 p.30]

### **EPA and NHTSA Must Fix GEM “Bugs”**

In GEM simulations with automatic transmissions, Allison has commonly observed the lockup clutch cycling during vehicle launches. When this cycling occurs, it is generally followed by 3rd Range torque converter operation. This behavior is unrealistic and does not reflect the lockup schedules embedded within GEM. If followed correctly, those GEM TCC schedules would result in vehicle launches which lockup in 2nd Range and stay locked until vehicle slows to the 2nd Range unlock shift point. [EPA-HQ-OAR-2014-0827-1284-A1 p.30]

The GEM transmission controller also consults the lockup schedules using the current range, rather than the selected range. Thus, during a 2-3 upshift, turbine speed is commonly pulled below the 2nd Range unlock threshold, thereby triggering GEM to unlock incorrectly. EPA and NHTSA should allow the GEM transmission controller to consult the lockup schedules using the selected range. This would result in the 3rd Range unlock threshold being much lower and correct the unintended unlock and lockup cycling defect. Other solutions do exist, but for any solution, Allison requests that the GEM lockup controller be corrected to reflect real world behavior of the torque converter lockup operation. In 2nd Range lockup transmissions, this means that the torque converter locks in 2nd Range and stays locked.

Likewise, in 1st Range lockup enabled transmissions, the torque converter should lock in 1st Range and stay locked. [EPA-HQ-OAR-2014-0827-1284-A1 p.30-31]

### **GEM Should Include Starting Range Input for ATs**

Allison manufactures a 7 speed transmission. The 7 speed transmission is a 6 speed gear box with an adaptor housing for a low range or “granny” gear. This low range is only accessible via a manual range selection made by the operator and is only used in off-road conditions. Normal on-highway driving utilizes 2nd thru 7th ranges. The current GEM model operates the ARB Transient cycle using 1st through 7th ranges which does not reflect real world operation. Therefore Allison recommends GEM add a starting range input and the criteria for selecting the starting range would be the starting range used most often (similar to the two speed axle requirement). [EPA-HQ-OAR-2014-0827-1284-A1 p.31]

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32 Attachment 3.

34 See Attachment 4.

37 RIA at 4-36.

38 An agency “must itself provide notice of a regulatory proposal.” Fertilizer Inst. V. EPA, 935 F.2d. 1303,1312 (D.C. Cir 1990). See also Ass’n of Private Sector Colleges and Universities v. Duncan, 681 F. 3d (D.C. Cir.2012).

39 It should be noted here that the grades to do not match the GEM simulation grades.

48 “MLHD” is the term utilized in GEM for the combination of LHD and MHD vehicle classes.

### **I. EPA and NHTSA Must Correct Stop Start Delay Time**

From Allison’s review of the NODA and associated documents, it appears that when using engine stop/start in GEM, the simulation puts the transmission into neutral at stops, waits for 5 seconds, and then stops the engine. Specifically, during analyses that we performed using GEM 2v2.1, the following transmission/engine behavior was observed for the simulated engine stop/start feature during the transient cycle: (1) vehicle decelerates to a stop; (2) transmission shifts to neutral (if automatic transmission neutral idle is enabled); (3) a 5 second period ensues; and (4) after this 5 second period, the engine shuts down. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]

This element of GEM, however, is inaccurate when compared to the operation of an engine stop-start system that is under development. Based on the current Allison stop-start development level with the 1000/2000 Series<sup>TM</sup>, the transmission generated delay time is less than 1.5 seconds. Overall, the time from vehicle stop, to engine stop, is typically less than 2 seconds. EPA should therefore correct the model’s time variable to substantially revise downward the current level of 5 seconds, to something approximating Allison’s experienced delay of between 1.5 and 2.0 seconds. [EPA-HQ-OAR-2014-0827-1892-A1 p.2]

Although less of a concern for non-transient duty cycles that are largely composed of 55 miles per hour (“MPH”) and 65 MPH operation, the excessive time that the model places a vehicle in neutral disadvantages an automatic transmission (“AT”) more severely than an automated manual (“AMT”) or manual transmission (“MT”) since ATs are more efficient in transient drive cycles than AMTs. A longer period of time before engine-shut down occurs directionally hurts the more efficient operation of ATs in

transient cycles and creates an unjustified disparity in measuring the emissions performance of AT versus AMT or MT transmissions. [EPA-HQ-OAR-2014-0827-1892-A1 p.2-3]

#### **IV. GEM's Estimation of Transmission Losses is Flawed and Results in Unjustified Benefits to AMTs**

After reviewing the most recent updates to GEM, it is clear that EPA has adopted a conservative approach towards modeling losses in a transmission. That is, GEM results in an overestimation of transmission losses in order to provide an incentive for a transmission manufacturer to either provide actual loss data or conduct powertrain testing. This result first conflicts with what should be the goal of GEM modeling: to provide the best estimation of real world performance. But additionally, this result unduly and unjustifiably favors AMTs over ATs. [EPA-HQ-OAR-2014-0827-1892-A1 p.8]

For an AMT, there are two areas of losses: gear efficiency and spin loss. For an AT, there are four areas of losses: gear efficiency, spin loss, pump loss and torque converter loss. Therefore, in GEM, an AT may have a larger total number of losses than an AMT/MT transmission. But it appears that EPA may have applied a "conservative factor" to each such loss in the form of a percentage. This has the effect of multiplying losses for transmissions with higher number of losses. In other words, if the conservative factor is 1.2 (20% higher losses) when applied to a transmission with a 20 Nm loss – this results in 4 Nm of extra loss. But if a transmission has higher losses, for example 100 Nm, then applying the same 1.2 factor results in 20 Nm of additional loss which is highly overstated on an absolute basis. Allison does not believe that application of such a factor – presuming we are right in how the calculation was made -- is either technically supported or justified. [EPA-HQ-OAR-2014-0827-1892-A1 p.8]

As an example of this effect, the GEM model was executed on two 10-speeds, an Eaton MT and an Allison TC10® AT on both tractor day cab and sleeper cab weighted cycles. Then, actual loss numbers were substituted into GEM. The results are contained in the chart below: [EPA-HQ-OAR-2014-0827-1892-A1 p.8]

[Chart, 'CO2 Impact of Power Loss', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1892-A1]

The above chart shows when going from GEM default losses to actual losses for the MT, CO2 was reduced 1.5% and 1.4%. But when GEM default losses to actual losses are compared for the AT, actual loss data resulted in CO2 reductions of 3.2% and 2.6%. This means that the GEM modeling of ATs would be severely disadvantaged relative to AMTs no matter what specific method was used to calculate the differentials. The important, real world effect of this calculation, however, is to create significant incentives to not use GEM defaults for ATs; an undue test burden is placed on manufacturers who produce AT-equipped vehicles and/or ATs creating an associated market disadvantage. [EPA-HQ-OAR-2014-0827-1892-A1 p.9]

Instead, Allison recommends that EPA apply a fixed amount of extra loss (i.e., a single Nm amount) to all transmission types. Such an approach would level the playing field as between all transmission types and not unduly favor a transmission with lower actual losses in GEM. A manufacturer would always be free to provide actual loss data or conduct powertrain testing in order to replace the default values, but would not be "forced" to do so based on transmission type. [EPA-HQ-OAR-2014-0827-1892-A1 p.9]

#### **Response:**

We have made significant changes and improvements based on Allison comments as well as address the issues Allison raised regarding GEM.

- Modified road grade profile for 55- and 65-mph cruise cycles
- Revised idle cycles into overall vocational vehicles with new vocational cycle weightings
- Made significant changes on the input file structures. Examples includes additions of columns for axle configuration ("6x2", "6x4", "6x4D", "4x2"), and additions of a few more technology improvement inputs, such as "Neutral Idle and Start/Stop."

- Made significant changes on output file structures. Examples includes an option to allow the user to output detailed results on average speed, average work before and after transmissions, and the numbers of shift for each phase (55 and 65mph cycles and ARB cycle).
- Added input file for axle power losses (function of axle output speed and torque) and replaced single axle efficiency in model with lookup table of torque loss
- Added simulation of engine torque response with fast response region defined by engine displacement, and slower torque increase in boosted region with fast falloff on available torque
- Added regression models for all certification cycles to allow the user to simulate vehicle with cycle average approach
- Added different fuel properties according to 1036.530.
- Significantly improved shift strategy based on testing data
- Adjusted transmission loss & inertia scale factors per regulatory subcategory
- Added optional input table for transmission power loss data
- Added minimum torque converter lock-up gear input for AT
- Retuned the default transmission mechanical efficiency based on the testing data
- Added neutral idle and start/stop features during simulation
- Adjusted shift and torque converter lockup strategy

The agencies made changes to GEM with respect to neutral idle as well as start-stop. More can be seen in Chapter 4.4.1.7 of the RIA .

We agree that DCT should not be included in the final GEM. As a matter of fact, DCT is modeled as AMT. More can be seen in Chapter 4.4.1.1 of the RIA.

We also made a number of improvements on pressure pump loss of the transmission as the default input tables. We also allow the OEM to input their own power loss tables if they believe our default power loss is too conservative. In addition, we also provide OEM an option to conduct powertrain test if its own power loss table would not be able to address the benefits related the integration of engine and transmission.

The agencies considered these comments along with the information that was used to derive the drive cycle weightings in Phase 1. The agencies are adopting provisions in Phase 2, and have existing provisions in Phase 1 (EPA's 40 CFR 1037.630 and NHTSA's regulation at 49 CFR 523.2), that allow low-roof tractors intended for intra-city pickup and delivery, such as those that deliver bottled beverages to retail stores, to be treated as vocational vehicles. The vocational vehicle standards are predicated on drive cycles with distance-based weighting factors of 20, 54, or 90 percent transient cycle depending on the type of vocational operation (see 40 CFR 1037.510). The agencies cannot determine based on the information provided whether some of these tractors may actually be treated as vocational vehicles in the regulations, but it is possible. The agencies believe this new data from a small subset of the tractor fleets falls within the range of drive cycle weightings for day cabs and the final vocational drive cycle weightings. Therefore, we are adopting the drive cycle weightings for tractors that we adopted for Phase 1 and proposed for Phase 2.

We did change the 1:1 gear ratio efficiency based on the data we obtained for both AT and AMT.

We did not make the stop-start delay time shorter as Allison recommended. We have to consider all related technologies on the market, making sure that we would not reward those technologies that cannot shut down in 5 seconds.

We have made many changes on AT transmission loss.

We did add features into GEM, allowing idle stop, neutral stop, and Start/Stop technologies to be accounted for.

The agencies evaluated an AT and AMT during powertrain testing. Please see RIA Chapter 2.8.2.6. The AT we tested included some features that are unique to AT, such as TC 1<sup>st</sup> gear lockup, and neutral idle, and start/stop features. Once AT can utilize those features, difference between AT and AMT would be small. As a matter of fact, AT can perform better than AMT for certain conditions. However, we have a concern using the Allison TC10 as the default automatic transmission. This is because this TC10 is unique and it appears more efficient than many other transmissions, and using it as the baseline would award those transmissions that do not have the same performance as the TC10.

With regard to the default transmission losses, the agencies used data provided by manufacturers to set the losses for each transmission type and weight class so that GEM represented a conservative 2018 MY baseline. This was done to fairly represent each transmission architecture without overly benefiting transmissions that have lower efficiency than the high volume transmissions. With regard to increasing the losses of all transmission, we did not do this because we did not want manufactures to get credit for just performing the test without improving the efficiency of the transmission.

With regard to manually engaged granny gears, 40 CFR 1037.520 (g) states to input into GEM all the “available” gears. This language was written to address transmissions that have gears that are not available to the operator, but could be expanded to automatic transmission that have manually engaged granny gears. The agencies welcome input on how this language could be modified to more clearly apply to these transmissions.

**Organization:** Aluminum Association

#### Freight Efficiency Benefits

As regards item 2 above, the Association is concerned that the existing EPA GEM methodologies do not adequately account for the benefit inherent in the lightweighting of medium and heavy duty vehicles. The GEM calculates the benefit of lightweighting a heavy duty tractor and/or trailer by assigning 33% of the decrease from lightweighting to a payload increase and 67% of the decrease from lightweighting to a vehicle mass decrease. For vocational trucks, the GEM assigns 50% of the decrease from lightweighting each to a payload increase and to a vehicle mass decrease. This makes sense when applied to the fuel efficiency calculation for an individual heavy duty tractor, trailer, or vocational truck and EPA’s GEM ratios in this area account for the fact that the trucking industry values lightweighting benefits differently according to whether or not the truck/trailer is ‘weighted out’ or ‘cubed out’. [EPA-HQ-OAR-2014-0827-1260-A1 p.4]

What they significantly fail to capture, however, is the benefit that lightweighting provides to dramatically increase overall freight efficiency in addition to individual truck fuel efficiency. This is a key distinction and the difference between the two is best captured by the Lightweighting Confidence Study report issued on August 25, 2015 by the National Council on Freight Efficiency (NACFE) which notes – [EPA-HQ-OAR-2014-0827-1260-A1 p.4]

*“Freight efficiency is the measure of the quantity of goods moved per unit of energy needed (measured in ton-miles per gallon of fuel if the load is heavy and cube-miles per gallon for lighter weight loads), while fuel efficiency is simply the miles per gallon achieved by the truck at its maximum weight, but*

*does not take into account the amount of work being performed (work being the movement of cargo).”*  
[EPA-HQ-OAR-2014-0827-1260-A1 p.4]

Measured through the GEM lens of fuel efficiency, the per truck fuel economy benefit of lightweighting is in the range of 0.5% to 0.6% improvement in fuel efficiency per 1,000 lbs of weight reduction and EPA in fact notes that weight reduction is a “technology with a high cost that offers small benefit to the transportation sector” (80 FR 40223). However, this misses the real and fundamentally significant benefit of lightweighting to improve the overall freight efficiency of transportation operations. In this regard, lightweighting is the only technology being considered for Phase 2 inclusion in the GEM that confers this benefit. [EPA-HQ-OAR-2014-0827-1260-A1 p.4-5]

And what a benefit it is - For heavy duty trucks and trailers, the GEM methodology reflects that 340 pounds of every 1,000 lbs of weight reduction is translated to increased payload. Using the GEM’s 19 ton default payload for heavy duty trucks and trailers, an aluminum intensive combination tractor/trailer as modeled by the Ricardo Study noted above with 3300 lbs of aluminum lightweighting transports 3% more freight overall  $(3300 \times .34)/(19 \times 2000)$ , equivalent to a 3% overall increase in freight efficiency and eliminating the need for one trip out of every 33 previously taken. [EPA-HQ-OAR-2014-0827-1260-A1 p.5]

For vocational trucks, the savings are similar as the GEM reflects that a 1000 lb weight reduction (assuming a smaller weight reduction as vocational trucks are smaller and lighter to begin with) would result in a 500 lb payload increase. This corresponds to a freight efficiency increase of 3.3 %  $(1000 \times 0.50)/(7.5 \times 2000)$  and eliminating the need for one trip out of every 30 taken. [EPA-HQ-OAR-2014-0827-1260-A1 p.5]

Because the GEM as currently configured only looks at vehicle specific fuel efficiency and not at overall freight efficiency, the portion of lightweighting of an individual truck allocated to a payload increase is considered detrimental in the GEM methodology. This masks the true value of lightweighting’s benefit in terms of fuel efficiency and GHG emissions reduction at the freight efficiency level as it is not captured in the current GEM calculations and subsequent output. This must be corrected in the final rule and its accompanying GEM. The best way to do this would be to include the full credit for weight reduction in the GEM to account for the freight efficiency component of that weight reduction which results in the elimination of vehicle trips and the commensurate reduction in GHG emissions. [EPA-HQ-OAR-2014-0827-1260-A1 p.5]

**Response:**

We agree with Aluminum Association on the benefits of light weight material. We have enhanced the number of lightweighting components recognized in the regulations. The detailed list can be seen in 40 CFR 1037.520.

The agencies did not assess the impact of individual technologies in terms of freight efficiency of the entire sector. The metrics we use to evaluate a single vehicle is a freight efficiency metric – grams of CO<sub>2</sub> per ton-mile and gallons of fuel per 1000 ton-miles. Our split treatment of the weight reduction items recognizes that for a portion of the trips when the vehicle is at weight limit, that vehicle will be able to carry more payload.

**Organization:** American Automotive Policy Council

**Adding Technologies to GEM**

While the introduction of dual clutch heavy transmission may be a few years away from entry in the U.S. market, EPA needs to establish a procedure to add new fuel saving technologies to GEM. The process to add technologies must be clearly written and concise. The procedure should be vetted throughout the agencies, including EPA certification staff, and issued via guidance. Investing in new technologies can require hundreds of millions of dollars in up front funding. Furthermore, GEM, as proposed, provides no clear path towards incorporation of new, fuel saving technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.33]

While the feasibility of a heavy-duty dual clutch transmission may be debatable, the possibility of new technologies emerging that could and should be included in GEM is real. Hence the agencies needs to layout out a clear, concise, step by step process that OEM's can follow to add technologies to the GEM pick list and the EPA certification staff can follow to approval or deny technology. Furthermore this process needs to be open and transparent to all parties. [EPA-HQ-OAR-2014-0827-1238-A1 p.33]

Simply discussing a process to add technologies to GEM in the draft RIA and assuming it can be used to make GEM technology changes post rulemaking is insufficient. The agencies need to add clear step-by-step guidelines with multiple examples using aero, driveline, axle, transmission, engine, aftertreatment, and climate control (heating and cooling technologies) that both industry and EPA can follow. [EPA-HQ-OAR-2014-0827-1238-A1 p.33]

Given the "newness of GEM" and the extreme difference in terms of speed and load demanded by the various urban, 55 mph, and 65 mph drive cycles vs the heavy-duty FTP additional flexibilities are needed to reflect in-use accessory load reduction. In addition to FEAD components discussed in the NPRM, other technologies that may not be fully reflected in the engine mapping process or underrepresented because of improper or unknown GEM assumptions need to be included. These include clutched, electric, variable speed, variable pressure coolant, fuel, engine oil, transmission oil, air conditioning and/or DEF pumps. Additionally, the agencies should consider adding generic powertrain and vehicle scaling features to GEM (aerodynamics, loads, etc.). [EPA-HQ-OAR-2014-0827-1238-A1 p.33]

AAPC believes that GEM credits for idle reduction technologies. such as neutral idle, idle shut down and stop-start, fall short of actual on-road CO2 benefits. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]

**Response:**

We have considerably expand the technology improvement inputs to recognize many new technologies including various idle technologies. We also expand the test procedures that can detail the procedure of how these new technologies can be recognized. For example, all new technologies related to the engines will be recognized during the engine fuel map generation, including variable speed pumps on oil, fuel and water, as long as those components are part of the engines that are being tested. For transmission related new technology, it can be recognized by individual gear transmission efficiency tests or powertrain tests. As pointed out in Chapter 4.4.1.1 of the RIA, we do not model DCT directly. Rather, we model DCT as AMT.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

*Updates to modeled technologies*

Changes to the representation of transmission, engine, and axle allow for more precise modeling of vehicle behavior in the GEM model. Additional vehicle technologies and greater acceptance of numeric



parameters (instead of Y/N) for technology inputs allows manufacturers greater representation of the vehicles they are actually putting on the road. [EPA-HQ-OAR-2014-0827-1896-A1 p.4]

**Impact on the proposal**

Modeling powertrain technology more accurately will help align GEM results with real world reductions. It will also allow for greater capture of incremental improvements. The proposal assumed fixed technology improvements—however, as is evident from sources like the Southwest Research Institute report,<sup>10</sup> there will be continuous development of many of these technologies throughout the course of this rule. Because GEM can now better capture these more subtle technology improvements related to transmission efficiencies, etc., it is critical that the agencies tighten their 2024 and 2027 targets accordingly to ensure that the targets represent the “maximum feasible” and “technology forcing” standards. Similarly, the inclusion of technologies that the agencies did not originally model within the GEM model (e.g., tractor neutral idling) means that those targets should be tightened to recognize that these technologies can reduce fuel use from heavy-duty trucks. [EPA-HQ-OAR-2014-0827-1896-A1 p.4]

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10 EPA-HQ-OAR-2014-0827-1623/NHTSA-2014-0132-0185.

**Response:**

We have changed many technology improvement inputs from Y/N to %, allowing the user to input specific values for those technologies defined by 40 CFR 1037.520. These technologies are very well defined as part of the stringency development. Please see Preamble Sections III.D, IV.D, and V.C for discussions regarding the stringency of the tractor, trailer, and vocational vehicle standards.

**Organization:** BYD Motors

*Further Refine Duty Cycles to More Fully Capture Technology Benefits*

Despite significant improvement to the duty cycle, particularly for urban and multipurpose vehicles that spend much of the day parked or in transient operation, further improvements can be made to ensure that the broad spectrum of vocational vehicles is adequately represented and that the regulation drives the full spectrum of fuel consumption reduction technologies applicable to such a diverse fleet. [EPA-HQ-OAR-2014-0827-1182-A1 p.3]

Work trucks frequently experience idle time exceeding those of even the urban vehicle category. Furthermore, by setting stringency exclusively with the GEM model, the agencies have excluded fuel used for power take-off (PTO) operation at work sites and, in turn, technologies that would reduce this fuel use. The agencies have in Phase 2, as in Phase 1, a certification pathway that allows manufacturers to claim credit for hybrid and electric PTO; however, they did not include any uptake of this technology in the baseline assumptions, further undermining the stringency levels that should be assumed in vocational vehicles. [EPA-HQ-OAR-2014-0827-1182-A1 p.3]

**Response:**

We have made numerous changes to account for the benefits related to idle and PTO as part of input parameters for GEM, specifically targeting vocational sectors.

**Organization:** Daimler Trucks North America LLC

**Use of rear axle efficiency test results to override GEM defaults** – The agencies request comment on an optional axle efficiency test procedure to override the agencies simulated axle in GEM. 80 FR 40176. DTNA welcomes the option to override the GEM default value for axle efficiency based on the result of an axle efficiency test. This will be beneficial both to manufacturers and the agencies by providing better information about actual axle efficiencies than the default, literature value of 95.5%. While we appreciate the agencies' efforts to define a new procedure to measure axle efficiency, we recommend instead aligning with the ACEA's test protocol for axle efficiency measurement. Refer to Appendix D for ACEA's Axle Test Method. [EPA-HQ-OAR-2014-0827-1164-A1 p.54]

**Axles** – The agencies request comment on the best way to recognize improved axle technology for vocational vehicles, either through a GEM calculation or a fixed assigned value. 80 FR 40299. Axle efficiency improvements whether it is lubrication or axle disconnect (6x2) should be rewarded with a GEM calculation or a fixed value. In the interest to keep a uniform approach across all vehicle subcategories we recommend adopting the proposed method for tractors, i.e. applying a fixed improvement value in the post-processing of GEM. [EPA-HQ-OAR-2014-0827-1164-A1 p.54]

**Simulating Human Driver Behavior and Transmissions for Vehicle Certification** - The EPA describes the complexity of its driver model on 80 FR 40184 and requests information on ideas like using transmission-specific shift logic and improved driver models. We at DTNA have modeled vehicles with different shift logic, from a simplified version to a complex one that required software in the loop. We found that for the EPA's linehaul cycles, there was very little difference in the results for the different versions--the reason being that there is very little gear shifting involved in the EPA's linehaul cycles. See the section on GEM, above. On vocational cycles, there could be significant differences, because the higher frequency of gear shifts. But the complexity of modeling all of the different drivers and the ways that their quirks impact shifting make it impossible to get one common driver model that both covers all of the quirks yet is generic enough to work in a regulatory setting. Therefore, we think that the agencies' approach with the generic shift strategy and driver model is the correct approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.63]

**DCT Should Get No More Credit Than AMT** – The agencies propose to assign a 2% benefit for dual-clutch transmissions. § 1037.520(f)(3). Despite having studied such transmissions, we do not see so large a FE benefit beyond the benefit that comes from the automated nature of the transmission. Therefore, we agree with the agencies' proposal—as we understand it—that gives DCTs the same 2% benefit that AMTs get. If however we misunderstand and the DCT gets 2% plus the 2% for being automated, then we think the agencies' approach is incorrect. [EPA-HQ-OAR-2014-0827-1164-A1 p.63]

**Off-Cycle Technology Credits** - The agencies propose to continue the process of innovative technology credits, now called off-cycle technology credits. We agree that this is an appropriate method of incentivizing development of FE technologies, even those that do not show FCRs on the GEM cycle or on a chassis dynamometer, given that a lot of the real world cannot be accurately represented on a chassis dynamometer. We also agree that the agencies should take the list of known off-cycle technologies, including predictive cruise control and tire inflation systems, and give manufacturers credit without forcing the manufacturers to go through the cumbersome off-cycle certification procedure. However, if a manufacturer makes a significant breakthrough, for example taking predictive technologies and developing one that can achieve significantly more than the 2% that the agencies currently propose to credit, then the manufacturer should be able to use the off-cycle credit procedure to demonstrate that delta and to get credit for it. [EPA-HQ-OAR-2014-0827-1164-A1 p.76]

**Innovative and Off-Cycle Technology Credits** - The agencies request comment on whether off-cycle technologies in the Phase 2 program should be limited by infrequent common use, in what model years, and what should be penetration rate to be considered not in common use. 80 FR 40158. First, as a preface, DTNA tried very hard for two years to get certification for off-cycle technologies (then called innovative technologies) that were not in common use at the start of Phase 1; we never achieved certification. For some technologies, the agencies objected that the technology was common enough at the beginning of Phase 1 that it could not be considered innovative. Leaving this to regulators' discretion after rulemaking seemed to open the door to the arbitrary decision that some technologies, which were not in common use at the start of the program, were in sufficiently common use to be denied innotech credits. As a solution to this, we propose that any technology be eligible for off-cycle credits if it is not included in GEM. Obviously, if a FE technology was invented only after start of Phase 2, it will be too new to be in GEM and should automatically be eligible for off-cycle credits. Similarly if there is a technology not invented at the time of the rulemaking but invented prior to the start of Phase 2, then it should automatically be eligible too. But even if the technology was invented and in use during the rulemaking or before, the fact that the agencies did not consider it for a pull-down menu-type credit should not prevent its eligibility. Any fuel savings are valid fuel savings. In short, with the agencies trying to capture as many technologies as possible with the pull-down menu credits, any that are omitted or that are not captured by GEM should be eligible for off-cycle credits. [EPA-HQ-OAR-2014-0827-1164-A1 p.76-77]

**Innovative and Off-Cycle Technology Credits** - On an appropriate penetration rate for a technology not to be considered in common use. 80 FR 40330. DTNA believes that any technology that provides measurable fuel savings and is not reflected in GEM should be eligible to be an accredited off-cycle technology. Especially in light of the ambitious CO2 reduction targets proposed by the EPA the ability to generate CO2 credits is very important and should further incentivize OEMs improve fuel efficiency. [EPA-HQ-OAR-2014-0827-1164-A1 p.77]

**Innovative Technology and Off-Cycle Credits** - Not granting any off-cycle credits for crash avoidance technologies, and also the possibility of adopting aspects of the light-duty off-cycle program. 80 FR 40158. DTNA believes that crash avoidance technologies have a tangible effect on FCR. Any reduction in crashes and the road congestion often associated with them will result in wasted fuel. NHTSA should grant off-cycle credits for crash avoidance technologies. DTNA agrees with the requirement for documentation for off-cycle requests so long as the requirement is straightforward and not unnecessarily complex. [EPA-HQ-OAR-2014-0827-1164-A1 p.77]

**Off-cycle (innotech) burden in Phase 1 is too high; this is a better approach:** DTNA favors to see as many technologies as possible to be recognized via separate fixed inputs into GEM. Beyond that DTNA fully supports the agencies' intention to provide a regulatory path for off-cycle technology credits as a complement to GEM. 80 FR 40330. However, following our experience with the inno-tech process in Phase 1, we urge the agencies to clearly define a clear path towards certification of a given technology. [redacted] For Phase 2 it is important to avoid scenarios like this. It should be feasible for OEMs to claim credits with a reasonable amount of effort, even at the expense of slight over crediting. Of course, good engineering judgement always has to be employed. It is important to remember that the agencies intend to credit similar technologies (with variable benefits) via predefined improvement factors in GEM. AMTs always allow the possibility to be operated manually and predictive cruise control technologies may never be active in a metropolitan area with dense infrastructure and high traffic density. [EPA-HQ-OAR-2014-0827-1164-A1 p.77-78]

**Off-cycle (innotech) DF:** in 1037.610(d)(7), the EPA proposes to require a demonstration of the in-use durability of the off-cycle technology. This is likely unnecessary or impracticable for many off-cycle

technologies. For example, if there is some technology like the future version of eCoast or Predictive Cruise Control, a programming-based technology, the technology does not degrade, so no demonstration is necessary. And for other technologies that are more hardware based (as opposed to software based), the demonstration may be impracticable or impossible, especially given the limited resources available to run test trucks for long mileages simply to look for deterioration. That is, trucks are designed for approximately a million miles of operation, with hardware components designed for similar operation (albeit perhaps with maintenance involved, as is allowed under the EPA's DF procedures for engines). There is no reason to believe that off-cycle technology would be any less robust than the rest of a vehicle. Then, to slow production and agency recognition of such technologies by mandating several hundred thousand miles of operation to validate a manufacturer's claim of durability is unnecessary. We recommend that the EPA apply a 'good engineering judgment' standard here, allowing a manufacturer to claim no deterioration (albeit, again, perhaps with maintenance required at prescribed intervals). If after introduction into commerce of such a technology, the agency has reason to believe the technology is not as durable as the manufacturer claimed, the agency could revoke certification of the technology or demand it be recalled and upgraded. 1037.610(d)(7) [EPA-HQ-OAR-2014-0827-1164-A1 p.78]

**Describing post-processing technologies in 1037.205(b):** it is not clear to us what level of detail would be required in describing the technologies listed in 1037.205(b), such as predictive cruise control. Additionally it is not clear whether a vehicle manufacturer could provide such information when the technology, again such as PCC, is supplied by an independent engine manufacturer. These are details that should be ironed out during the rulemaking process, as (in our experience) leaving this until after the rulemaking when manufacturers are trying to certify off-cycle technologies leads to months or years of back-and-forth on what information is required for certification. 1037.205(b) [EPA-HQ-OAR-2014-0827-1164-A1 p.78]

**Predictive Cruise Control (PCC) is counted as a pull-down menu technology but eCoast, which provided huge fuel savings on Super Truck, is not.** The agencies should correct this omission. At the least, the agencies should use a [redacted] value, which is representative of an average vehicle with eCoast. It is worth noting that the more aerodynamic a vehicle and/or the lower its rolling resistance, the more its eCoast will save fuel (as demonstrated by the DTNA Super Truck). If the agencies have the time, they should provide increased eCoast FCR benefits in GEM for the more aerodynamic vehicles (e.g., [redacted]% for eCoast on a Bin VII vehicle and [redacted].5% on a Bin VI, etc.). 1037.520(f) [EPA-HQ-OAR-2014-0827-1164-A1 p.80]

**Response:**

We appreciate many constructive comments from DTNA. Accordingly, we made many changes.

We do allow the rear axle efficiency tests result to override GEM defaults, which specifically address the benefits from 6x2 and lubricant, many advanced technologies related to axle.

We appreciate DTNA's support for us to use generic shift strategy.

GEM will model DCTs as AMTs as DTNA suggested.

Although off-cycle credits will remain an option under Phase 2, the agencies have included many more technologies within GEM (so these are not off-cycle anymore, but rather already credited). These include predictive cruise control and tire inflation systems through % instead of N/Y option. Both predictive cruise control and neutral coast (eCoast) are defined as Intelligent Controls in the GEM input

file, which means that they can be all recognized as technology improvement inputs to get credit. How all those technology improvement inputs for off-cycle credit are used in GEM is defined in 40 CFR 1037.520(j).

**Organization:** Dana Holding Corporation

These comments specifically address the newly docketed Greenhouse Gas Emissions Model (GEM) P2v2.1 (EPA Docket No. EPA-HQ-OAR-2014-0827-1626), on which the agencies requested public comment. [EPA-HQ-OAR-2014-0827-1917-A1 p.1]

### **Axle Efficiency Testing**

Dana fully supports the joint initiative by the National Highway Traffic Safety Administration and the Environmental Protection Agency to further reduce greenhouse gas (“GHG”) emissions and improve the fuel economy of medium- and heavy-duty vehicles as described in Alternative 3 of the proposed rule published in 80 FR 40137. On September 24, 2015, Dana submitted comments identifying our position related to the proposed rule and made several suggestions for consideration by the agencies during the process of promulgating a final rule. Dana remains committed to the views contained in our September 24, 2015, comments. Dana believes that various material changes have been made to the GEM since those comments were submitted that require the filing of these additional comments. [EPA-HQ-OAR-2014-0827-1917-A1 p.2]

Specifically, Dana notes that the agencies have adopted a “two-option” approach to determining axle efficiency within GEM P2v2.1. This new two-option approach will provide axle manufacturers with the choice to use either a very conservative default fixed axle efficiency that can be interpolated by ratio through a linear equation or, as a second option, to provide a full rear axle power-loss map obtained through standardized dynamometer testing. Given that the default efficiencies are very conservative and understate leading axle efficiency ratings, axle manufacturers like Dana are most likely to rely on the full dynamometer test to determine credits for the efficiencies designed into their proprietary axles. [EPA-HQ-OAR-2014-0827-1917-A1 p.2]

It is important to note that, given this new two-option approach, Dana supports the use of conservative default efficiency values to ensure that higher efficiency ratings are not awarded to axles that do not merit them. Our review of the GEM P2v2.1 shows that all default efficiency values are in fact conservative. As a result, Dana supports these efficiency values and related equations. [EPA-HQ-OAR-2014-0827-1917-A1 p.2]

Dana’s primary concerns are with the full dynamometer testing for rear axles. Our position remains the same as noted in our first set of comments on the proposed rule. It is Dana’s opinion that the standardized dynamometer testing would result in excessive complexity and documentation for fractions of a percent improvement in efficiency. It is also our opinion that various easily and visually identifiable features can serve as a less complicated checklist of efficiency credits with prescribed efficiency improvement values. A checklist approach with prescribed efficiency values for various features would be less complicated and allow axle manufacturers to focus on the development of innovative products rather than testing axles for the pure benefit of certification. [EPA-HQ-OAR-2014-0827-1917-A1 p.2]

As an axle manufacturer that is not vertically integrated within a vehicle manufacturer, Dana provides axles that are designed to meet the needs of a full range of customers. This results in extensive complexity within our product portfolio and requires us to provide customers with a number of axle offerings. For example, axle manufacturers (not vertically integrated within vehicle manufacturing

OEMs) serve the heavy-duty, on-highway line haul market with an array of axle families with multiple ratios for each axle family. Under the new GEM P2v2.1, leading axle manufacturers like Dana would need to conduct full dynamometer testing for their axles to ensure that they do not understate the efficiency values for their products by using the proposed conservative default values. Providing axle dynamometer testing for all axle families and each ratio will be extremely demanding on our human and capital resources with little resulting gain in achieving the proposed rule's goals to reduce emissions and fuel consumption. Even minor changes to the axles would require recertification to ensure that efficiency values are stated correctly. Given the number of axle families produced by Dana, the various ratios offered within those axle families, and the numerous changes that occur on axles over their product life, the cost of testing for certification and recertification could be prohibitive. In addition to the cost of dyno-testing, there would be the opportunity cost of not utilizing those same human and capital resources for research, development, and advanced engineering programs that lead to innovative products that drive efficiency gains in our products and help improve the fuel efficiency of our customers' vehicles. [EPA-HQ-OAR-2014-0827-1917-A1 p.2-3]

For the reasons noted above, we are suggesting a more simplistic approach to the full dynamometer bench testing. Rather than testing each ratio or variant of the axle within a product family, Dana suggests a combination of testing two book-end ratios for the product family and the development of an industry-acceptable mathematical formula to interpolate the remaining ratios. This will minimize the extent of the testing and balance the need to provide accurate axle efficiency values while not imposing costs that could limit our ability to develop innovative products to make the vehicles affected by the proposed rule more efficient. [EPA-HQ-OAR-2014-0827-1917-A1 p.3]

### **Full-time 6x2s, Part-time 6x2s, and Two-Speed Disconnecting Tandems**

Class 8 on-highway line haul vehicles with 6x2 and part-time 6x2 configurations will clearly offer an option to help achieve the proposed rule's GHG emissions and fuel-efficiency standards. At Dana, we are positioning our products to support both full-time and part-time 6x2s to accommodate the future market. Given the important role these configurations could play in meeting the proposed standards, we can agree with the agencies' position not to offer a fixed 2.5% efficiency credit post GEM for 6x2 vehicles. [EPA-HQ-OAR-2014-0827-1917-A1 p.3]

The new two-option approach of using conservative default efficiency values or full power-loss efficiency maps within the GEM supports a more accurate approach. We can attest that the default values are in fact conservative. We also find that the mathematical equation used to interpolate ratio efficiency for 6x2 configurations is reasonable and uses a conservative 37 Nm loss for tag axles. [EPA-HQ-OAR-2014-0827-1917-A1 p.3]

Our review of the GEM P2v2.1 also concludes that it does not accommodate two-speed axles. As noted in our previous comments, Dana has developed a dual-range (two-speed), "disconnectable" tandem axle. This new axle innovation will operate as a traditional axle in 6x4 configuration with a higher numerical rear axle ratio to support the low-speed vehicle performance and safety. While approaching cruise speeds the tandem axle will automatically (without driver intervention) "disconnect" and no longer turn the inter-axle driveshaft, rear-rear pinion and ring-gear, therefore, operating fully on the forward of the rear axle. During this disconnected configuration, the axle operates at the equivalent efficiency of a 6x2 arrangement. Since the GEM does not allow for two-speed axles, we suggest that the GEM use the ratio that is expected to be engaged over the greatest driving distance to be used to determine axle efficiency and power-loss values. [EPA-HQ-OAR-2014-0827-1917-A1 p.3-4]

### **Automatic Tire Inflation Systems**

In addition to driveline systems (steer axles, driveshafts and drive axles), Dana offers automatic tire inflation systems that can be used on the full range of vehicles affected by the proposed rule (class 2b – 8). The Spicer® Tire Optimization Management System is designed for use with steer and drive axles, ensuring that tires in all tractor positions are at their target inflation without depending on driver/human intervention. Dana’s automatic tire inflation (ATI) solution is one of a number of available systems in the commercial vehicle space that automatically keep tires at the appropriate inflation to reduce rolling resistance, and provide significant fuel economy benefits. [EPA-HQ-OAR-2014-0827-1917-A1 p.4]

Dana’s independent studies support the findings in Section II.C.1.(f) (80 FR 40187) of the proposed Phase 2 rule, highlighting that tire pressure monitoring systems cannot sufficiently guarantee the proper inflation of tires. These studies are supported by substantial fleet testimonials suggesting that monitor-only systems are too dependent on driver intervention to be effective, and even when used in combination with telematics, fleet managers typically only direct a truck in for unscheduled service if tires are at dangerously low pressures and at risk of blowout. Until tires reach this point, the benefits of reduced rolling resistance are typically not realized. Dana therefore agreed that the proposed rule did not assign an efficiency credit for tire pressure monitoring systems. We have learned that the agencies may now offer a 0.25% efficiency credit for tire pressure monitoring systems. For the reasons stated above, Dana does not support offering a 0.25% efficiency credit for tire pressure monitoring systems that require human intervention to pressurize the tire when signaling a low-pressure warning. [EPA-HQ-OAR-2014-0827-1917-A1 p.4]]

While Dana supports the agencies’ findings related to providing post-simulation adjustments for class 7 and 8 tractors, the fuel economy benefits of reduced rolling resistance can be realized for all vehicles spending time on highway. As a result, Dana proposes that credit for automatic tire inflation systems be granted for all vehicle classes (2b-8) included in the rule, including credit for vocational vehicles as these vehicles tend to be on-highway between 40-60% of their life. [EPA-HQ-OAR-2014-0827-1917-A1 p.4]

Further, the proposed rule grants a 1% “reduction value” as a post-simulation adjustment for the use of ATI systems on drive axles in tractors (40 CFR 1037.520(f)(7) (80 FR 40631 of the proposed rule). Maintaining proper tire inflation of the front tires on the steer axles can also contribute to reduced rolling resistance, and improved fuel economy. Dana proposes an additional 0.25% credit be granted for tractors with ATI systems equipped on both steer and drive axles, for a total credit of 1.25%. [EPA-HQ-OAR-2014-0827-1917-A1 p.4]

#### **Automatic Tire Inflation & Deflation System Credit**

In addition to automatic tire inflation, the Spicer® Tire Optimization Management System will include an active deflate feature for an incremental fuel economy and safety benefit. In a recent OEM study, it was determined that tractors equipped with active inflate and deflate technology saw a 2% improvement in fuel economy as a result of making active modifications due to terrain, vehicle load, and duty-cycle. This level of sophistication is currently provided by Dana and is used in military and vocational vehicles. Dana is committed to bringing this technology to fruition in support of all on-highway tractors, and suggests that the agencies account for this enhanced solution in the final version of GEM by providing a 2% reduction value for active inflate and deflate systems. [EPA-HQ-OAR-2014-0827-1917-A1 p.4-5]

#### **Early Banking of Automatic Tire Inflation & Deflation System Credits**

As automatic tire inflation systems are currently available, Dana suggests that the agencies allow vehicle OEMs that adopt automatic tire inflation systems before the start of phase 2 to be able to bank the 1% - 2% (depending on whether the system includes active inflate and deflate features) credit for such systems during the phase 1 timeframe. Those credits could be banked for use within the MY2021 – MY2027 timeframe. [EPA-HQ-OAR-2014-0827-1917-A1 p.5]

Overall, Dana supports the changes made to GEM that are reflected in the new release (GEM P2v2.1). The changes support a more accurate approach and provide additional efficiency credits that reflect the important role axles and automatic tire inflation systems can play in meeting the proposed Phase 2 standards. Dana's suggestions above aim to better balance the amount of axle testing with the anticipated value achieved by that testing. We believe that the suggestions provided above strike that balance. Dana's commitment is to continue to provide innovative solutions that enable our customers to transport freight and people safely, efficiently and effectively. [EPA-HQ-OAR-2014-0827-1917-A1 p.5]

**Response:**

We appreciate Dana's support on our axle two-option approach. In principle, we agree with Dana that rather than testing each ratio or variant of the axle within a product family, we could develop a combination of testing two book-end ratios for the product family and the development of an industry-acceptable mathematical formula to interpolate the remaining ratios. This methodology is adopted in the final rule in 40 CFR 1037.560.

GEM does allow two speed disconnecting tandems named as 6x4D, where the vehicle is simulated on the 55 and 65mph cycle as a 6x2 and as a 6x4 on the transient cycle. However, the axle ratio would be still the same for this two speed axle option, prompting OEM to select most commonly used axle ratio for GEM based on their driving condition. The main reason for this decision is that we believe that two speed axle is primarily used in tractor applications, where cruise speeds are pre-dominated. The cycle weighing on transient cycle is small compared to ones on two cruise speed cycles. As such, the lower axle ratio should be selected. This is not a perfect solution, but can greatly simplify GEM.

Taking into many other comments on tire pressure system, we recognize both TPMS and ATIS in Phase 2 GEM, though the effectiveness of TPMS is lower than ATIS to recognize the need for operator intervention. Please see Preamble Section III.D. 1.b for further discussion. Consistent with Dana's recommendation, the agencies are providing early credits for ATIS (see 40 CFR 1037.150(y)).

**Organization:** Eaton Vehicle Group

**Introduce the ability to overwrite GEM defaults with measured data:** We recommend the certification procedure allow the GEM default transmission efficiencies to be overwritten with values measured on transmission efficiency test stands. This approach pulls through hardware improvements such as advanced lubrication and reduced friction similar to the measured axle efficiencies described in the NPRM. While the magnitude of these improvements is modest compared to those provided by controls, they are intrinsic to the transmission hardware and independent of its controls. Thus, the benefits can be exercised for all vehicles with the same transmission and without concerns over in-use tampering or family definitions. [EPA-HQ-OAR-2014-0827-1194-A1 p.3-4]

**Overwriting GEM defaults with measured data**

The NPRM defines two paths for certification: the use of "slightly conservative" transmission models and the powertrain test option. The latter makes sense to be used only for those transmissions that



implement advanced technologies not modeled in GEM, and where the benefits of transmission shift strategies and engine/transmission deep integration is significant. [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

### **Rationale**

For axle technologies, the NPRM has two different options: GEM “slightly conservative” models (power-loss or efficiency models, to be precise), and the potential to overwrite these models with a loss model that is linear in input shaft speed (so-called spin losses that have to do mostly with lubrication) and torque (losses that have to do mostly with gear contacts and friction of sliding surfaces). [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

We recommend the agency allow a similar procedure for transmissions. The GEM default transmission efficiencies would be overwritten with values measured on transmission efficiency test stands for selected gears, and GEM defaults would be used for all other gears. A variant of this test is used in the draft European Commission VECTO simulation. [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

### **Technical approach**

The basis of this approach is to recognize that the transmission power loss in a given gear  $k$  is of the form: [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

$$\text{Transmission torque loss} = a_k W_{\text{input}} + B_k T_{\text{input}}$$

The coefficient  $a_k$  is determined on a spin test by measuring the power loss of a transmission spun at a few different engine speeds  $w_{\text{input}}$  at the input shaft, but with no load on the output shaft. The coefficient  $B_k$  is calculated using the transmission in gear  $k$  between two dynamometers that load both the input shaft with torque and the output shaft with the corresponding torque to balance the system. In the second case, torque is measured at both inputs and outputs and the difference determines the torque loss, hence  $B_k$ . It is important to run the test at two representative oil temperatures and the losses of the test stand itself need to be isolated from the losses of the transmission. [EPA-HQ-OAR-2014-0827-1194-A1 p.11]

[Figure 1 can be found p.12 of docket number EPA-HQ-OAR-2014-0827-1194-A1]

Note that the European VECTO approach is measuring data at many torque and RPM points, in some estimates at more than 1,300 test points per transmission. Such burden and precision are excessive, especially given that GEM and VECTO are run with generic controllers that introduce more significant errors than the actual power loss versus the bi-linear model above. [EPA-HQ-OAR-2014-0827-1194-A1 p.12]

We run such tests for development purposes to determine transmission efficiency. Based on that approach, we estimate that the unburdened costs of such tests are less than \$40,000 per test. We have provided cost estimates based on actual expenses to the EPA [CBI data provided]. [EPA-HQ-OAR-2014-0827-1194-A1 p.12]

### **Limitation and compliance value**

This approach pulls through hardware improvements such as advanced lubrication and reduced friction. While the magnitude of these improvements is modest compared to those provided by controls (5-10%

of the compliance gap for line haul tractors and 10-20% of the compliance gap for Vocational vehicles), they are intrinsic to the transmission hardware and independent of its controls. Thus, the benefits can be exercised for all vehicles with the same transmission and without any in-use tampering concerns or powertrain family issues. For example, for an Eaton LAS 10-speed transmission approximately 2% fuel reduction over GEM predictions can be captured with such an approach. However, for an MXP 18-speed transmission the benefit is minimal because the most used gears are roughly 96% efficient and 98% efficient in direct applications (close to the GEM defaults). We have provided the EPA with relevant data from several transmissions that show that  $f_3 = 0.02$  in direct gear (98% efficiency) and  $f_3=0.04$  (96% efficiency) in other gears is a “slightly conservative” GEM setting [Jackson 2015 and CBI data provided]<sup>1</sup>, but for other transmissions the typical values range between 0.007 and 0.011 in direct and 0.015 in the other relevant gears. For such transmissions, the benefit of overwriting GEM default values results in 1-3% fuel consumption improvement. [EPA-HQ-OAR-2014-0827-1194-A1 p.12]

**Recommendation:** The EPA should introduce a transmission efficiency overwrite of GEM defaults based on measured gearbox efficiency in select gears. [EPA-HQ-OAR-2014-0827-1194-A1 p.12]

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1 Jackson, G.A. and Palazzolo, J.J. (2015) ‘Fuel economy and performance improvement enabled by medium-duty dual clutch transmissions’, Int. J. Powertrains, Vol. 4, No. 3, pp.243–262

We believe that the following characteristics are critical to the success of GEM as a tool and to realizing the improvements envisioned by the rule in an efficient way for the industry: [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

- GEM results need to reproduce the technology trends in transmission technologies, so that GEM does not create a bias in vehicle design. [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

**Response:**

We have made many changes to address Eaton’s constructive comments. We do allow GEM default loss for transmission to be overwritten by the OEM’s data.

**Organization:** Gentherm, Inc.

All of our comments are directly addressing observed shortcomings and we are suggesting mechanisms which would incentivize engine manufacturers to replace inefficient, mechanically driven accessories with highly efficient and better controlled electrified accessories. Supertruck Program<sup>1</sup> has shown that such replacement is one of the basic approaches in further improving engine and overall vehicle fuel efficiency. [EPA-HQ-OAR-2014-0827-1133-A1 p.1]

**Comment #3. Provide a clear mechanism for off-cycle credits for waste heat recovery and other alternative means to produce on-board electricity.** [EPA-HQ-OAR-2014-0827-1133-A1 p.4]

**Background from Draft**

“In particular, we project a more limited use of waste exhaust heat recovery systems in 2027, projecting that about 10 percent of tractor engines will have turbocompounding systems, and an additional 15 percent of tractor engines would employ Rankine-cycle waste heat recovery. We do not project that

turbocompounding or Rankine-cycle waste heat recovery technology will be utilized in vocational engines. Although we see great potential for waste heat recovery systems to achieve significant fuel savings and CO<sub>2</sub> emission reductions, we are not projecting that the technology could be available for more wide-spread use in this time frame.” [EPA-HQ-OAR-2014-0827-1133-A1 p.4]

Agencies are recognizing limited penetration of waste heat recovery and other energy harvesting technologies. It is justified to assume that implementation of Rankine-cycle waste heat recovery in vocational vehicles will remain to be limited due to complexity of the ORC equipment. This comment addresses the issue of off-cycle accounting for electricity production using innovative waste energy recovery and energy harvesting technologies which are producing electricity. [EPA-HQ-OAR-2014-0827-1133-A1 p.4]

**Proposed change:** Gentherm proposes a simplified mechanism to provide the off-cycle credits for fuel savings and emissions reduction by allowing the bench testing at component- or subsystem-level, and then using the results of the testing to calculate emission reduction and fuel saving coefficient in the GEM simulation. In general, we view implementation of an energy source which is not using additional fuel to generate electricity as a clean energy source which is reducing fuel consumption. Waste heat recovery is an example of such an energy source. We propose using similar approach in evaluating this benefit as in case of evaluating effect of electrification of accessories. Waste heat recovery or energy harvesting electrical source is substituting mechanically driven alternator. We propose a four-step calculation: [EPA-HQ-OAR-2014-0827-1133-A1 p.4]

Step 1: Benchtop evaluation of efficiency of efficiency of alternator ( $\eta_{\text{alternator}}$ ). [EPA-HQ-OAR-2014-0827-1133-A1 p.4]

Step 2: Measurement of electrical power generated by a waste heat recovery device in the range of conditions matching the engine operating range PWHR. Calculate instantaneous energy saving ( $P_{\text{saving}}$ ) as a result of implementation of waste heat energy source as: [EPA-HQ-OAR-2014-0827-1133-A1 p.5]

$$P_{\text{saving}} = \text{BHP}_{\text{engine}} - P_{\text{WHR}}/\eta_{\text{alternator}}$$

Using alternator efficiency in the denominator of term on the right side ensures appropriate accounting for downsizing of alternator as a result of additional electrical power generated by waste heat recovery device. [EPA-HQ-OAR-2014-0827-1133-A1 p.5]

Step 3: Use calculated net energy saving to calculate engine load reduction coefficient as: [EPA-HQ-OAR-2014-0827-1133-A1 p.5]

$$K_{\text{WHR}} = (\text{average engine power in the regulatory cycle}) - \text{Average } P_{\text{saving}} \text{ in regulatory cycle}/(\text{average engine power in the regulatory cycle})$$

Step 4: Apply calculated coefficient ( $K_{\text{WHR}}$ ) in GEM simulation as an engine emission and fuel efficiency correction coefficient. [EPA-HQ-OAR-2014-0827-1133-A1 p.5]

The proposed process does not take in account duty cycle that would be observed while using waste heat recovery device. However, it stimulates engine manufacturers to design engines and exhaust systems in such a way that waste heat recovery devices can be optimally integrated. Waste heat recovery systems are the only type of devices that produce electricity without consuming any additional fuel. Making more electricity available without addition of larger, inefficient alternator encourages other energy beneficial choices such as downsizing of electrified accessories and developing new electrified

accessories. These devices are otherwise not taken in consideration during engine or powertrain test and are normally used in vehicles. [EPA-HQ-OAR-2014-0827-1133-A1 p.5]

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<sup>1</sup> The U.S. Supertruck program, expediting the development of advanced heavy duty vehicle efficiency technologies, O. Delgado and N. Lutsev, ICCT, 2014

### **Response**

We appreciate the comments and suggestions on a new potential and simplified test procedure to recognize benefits from an accessory device. It should be clear that waste heat recovery technologies, such as Rankine cycle and turbo-compound, mentioned in our regulation is not an off-cycle credit. Its benefits are fully measurable by the dynamometer test procedure, and, in addition, it is part of the basis for the tractor standard and so would not be an off-cycle credit for that reason alone. In addition, any benefits due to technologies or components that can be measured through engine dynamometer tests as part of the engine fuel map procedure will be recognized by GEM. Technologies that cannot be measured through engine or powertrain test or are not part of technology improvement inputs used in GEM could be recognized by the innovative off-cycle credit, following the procedure defined as 40 CFR 1037.610.

**Organization:** Lubrizol Corporation

### **Axle and Transmission Lubricants**

Higher-performing axle and transmission lubricants should also play an important role in helping the OEMs comply with the Phase 2 Rule. Providing the most effective incentives for the use of higher-efficiency axle and transmission lubricants will provide benefits throughout the recommended service interval of all trucks that use these fluids. In addition, because service intervals vary considerably across the range of applications covered by the Phase 2 Rule, additional consideration should be given to ensuring that this efficiency improvement remains after the initial required service interval and throughout the useful life of the vehicle or equipment. [EPA-HQ-OAR-2014-0827-1325-A1 p.5]

As currently drafted in the Phase 2 Proposal, OEMs will be incentivized to use higher-performing axle lubricants via a Greenhouse Gas Emissions Model (GEM) credit that will go to OEMS that use higher-performing axle lubricants in certifying their vehicles.<sup>9</sup> More specifically, the Proposal provides a 0.5 percent CO<sub>2</sub> emissions reduction value to OEMs that certify their vehicles with a qualifying axle lubricant.<sup>10</sup> This will likely ensure widespread adoption of 75W90 axle lubricants, which will be a significant improvement over the status quo. [EPA-HQ-OAR-2014-0827-1325-A1 p.5]

While Lubrizol supports the adoption of a rear-axle efficiency test, eliminating ambiguities in the test procedure and providing a mechanism for additional GEM credits for axle lubricants that provide greater-than-0.5 percent efficiency improvements will make a very useful provision even more effective over the long run. We also recommend the adoption of incentives for higher-efficiency transmissions fluids (i.e., provisions to encourage higher-efficiency manual transmission fluids) and the inclusion of axle and transmission lubricants in the categories that can qualify for future Off-Cycle Technology Credits. [EPA-HQ-OAR-2014-0827-1325-A1 p.5]

We appreciate that the current Proposal will help ensure a significant improvement over the status quo. We have provided recommendations below that we believe will further strengthen the Proposal by clarifying language in the test procedure and further incentivizing or encouraging higher-efficiency axle and transmission lubricants. [EPA-HQ-OAR-2014-0827-1325-A1 p.5]

### **Higher-Efficiency Axle and Transmission Lubricants**

While the Phase 2 Proposal does not regulate axle or transmission lubricants, it does include a number of provisions related to these lubricants. These include: [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

- Low-friction axle lubricants: The Phase 2 Proposal maintains the current 0.5 percent default value for the CO<sub>2</sub> and fuel consumption reductions provided for low-friction axle lubricants in the Greenhouse Gas Emission Model (GEM);[EPA-HQ-OAR-2014-0827-1325-A1 p.12]
- Rear-axle Efficiency Test (§1037.560(draft)): The Proposal seeks comment on a new test procedure to compare new lubricants to BASF Emgard FE 2986 and to identify superior performance at specified speed and torque values; and [EPA-HQ-OAR-2014-0827-1325-A1 p.13]
- Off-Cycle Technology Credits: If adopted, these could be used to provide additional credits to new axle lubricants and other advanced technologies that are not widely used and are not reflected in the GEM simulation tool even after the rule is finalized. [EPA-HQ-OAR-2014-0827-1325-A1 p.13]

### **Lubrizol Supports the Proposed 0.5 Percent Default Value for Low-Friction Axle Lubricants, But Encourages EPA to Remove the Ambiguity in the Current Proposal**

Based on significant experience with speed-load testing in commercial vehicles, Lubrizol strongly supports including the 0.5 percent default value for low-friction axle lubricants in the Proposal. The current Proposal will likely ensure widespread adoption of 75W90 axle lubricants, which will be a significant improvement over the status quo. [EPA-HQ-OAR-2014-0827-1325-A1 p.13]

Under the current Proposal, a lubricant qualifies if it meets the specifications for BASF Emgard FE 2986 as described in “Emgard®FE 75W-90 Fuel Efficient Synthetic Gear Lubricant.” BASF Emgard FE 2986 is a good choice of baseline, but some consideration should be given to ensure it remains constant over the life of this rule. In addition, it is possible that a variety of 75W-90 fluids could meet the performance described, but not deliver the same efficiency improvement as BASF Emgard FE 2986. We recommend that EPA adopts a baseline that is based on a static formulation and include a defined procedure for equivalent, or improved, efficiency demonstration. Doing so will eliminate the risk that OEMs will be able to claim the 0.5% credit without actually delivering the efficiency benefit. [EPA-HQ-OAR-2014-0827-1325-A1 p.13]

We note that it is more accurate to call these lubricants “higher efficiency” than to call them “low-friction.” While lowering friction may be a necessary attribute of the higher-efficiency axle lubricants that will be in the market during the Phase 2 period, it is not a sufficient definition to ensure safe, efficient operation over the life of the vehicle, given the need to address churning losses and traction in all modes of operation. Thus, we suggest that the final Phase 2 Rule adopt a “High Efficiency” terminology, rather than continue the use of the “low-friction” phrase. [EPA-HQ-OAR-2014-0827-1325-A1 p.13]

### **Lubrizol Supports the Adoption of a Rear-Axle Efficiency Test, but the Final Rule Should Eliminate the Ambiguity in the Proposal**

We strongly support the adoption of a new rear-axle efficiency test to evaluate new lubricants, and agree that the BASF Emgard FE 2986 is a good choice as the baseline lubricant for such a rear-axle efficiency test. We believe that this will help incentivize the use of axle lubricants that exceed the 0.5% default value and add value to the overall Phase 2 program. However, we are concerned that the proposed test is not defined in an unambiguous way. The final Phase 2 Rule should include three clarifications or changes to remove these ambiguities and improve the overall program. [EPA-HQ-OAR-2014-0827-1325-A1 p.13]

First, the baseline fluid should be unambiguously defined and should be used in all rear-axle efficiency testing. Given that developing new fluids requires a significant investment in time and resources, it is critical that the baseline fluid remains static so it can be relied upon as a reference constant throughout the Phase 2 Rule's time frame. [EPA-HQ-OAR-2014-0827-1325-A1 p.14]

Second, we note that, within any given viscosity grade, there can be significant variations in efficiency and CO2 emissions. Therefore, we recommend that EPA provide a more consistent technical baseline than exists in the current draft. API specification, viscosity, and the exact fluid to be used are examples of details that should be clearly defined in any comparative test. [EPA-HQ-OAR-2014-0827-1325-A1 p.14]

Third, we also note that the proposed test design requires that the lubricant is equivalent or better than the Emgard baseline fluid at each and every of the many points in the test cycle. We are concerned that this approach applies a "one-strike baseball" test that will disqualify lubricants that provide better performance than the baseline fluid in most real-world conditions. [EPA-HQ-OAR-2014-0827-1325-A1 p.14]

Given that no axle or transmission spends equal time at each of the proposed conditions, we recommend an approach that weights the various results in each stage of the test and then converts them into an overall axle efficiency score. The overall axle efficiency score could then be used to provide additional GEM credits to axle lubricants that exceed the performance of the Emgard baseline fluid, i.e., beyond the 0.5 percent default value in the Proposal. Given that there is evidence that higher efficiencies are possible,<sup>24</sup> doing so would create incentives for higher-efficiency axle lubricants to enter the market in years to come. [EPA-HQ-OAR-2014-0827-1325-A1 p.14]

### **Lubrizol Supports Additional Credit for Higher-Efficiency Rear-Axle and Transmission Lubricants Through the Off-Cycle Technology Credit**

We encourage EPA to provide additional credit for rear-axle lubricants that exceed the 0.5 percent default value provided in the GEM. In addition to establishing a mechanism within the Rear-Axle Efficiency Test to provide such GEM credit, as discussed above, this can be done via the adoption of the proposed Off-Cycle Technology Credit. If the final Phase 2 Rule includes the Off-Cycle Technology Credit, we encourage EPA to unambiguously define the conditions and thresholds for demonstrating an efficiency gain that is greater than 0.5 percent, as well as the data or other proof that would be necessary to secure the additional credit. [EPA-HQ-OAR-2014-0827-1325-A1 p.14]

Because providing credits for the use of higher-efficiency axle and transmission lubricants will provide benefits throughout the useful life of all trucks that use these fluids, we also recommend that transmission lubricants be included in any future Off-Cycle Technology Credit. [EPA-HQ-OAR-2014-0827-1325-A1 p.15]

### **Higher-Efficiency Lubricants for Manual Transmissions Can Provide Additional Improvements**

As noted above, the Proposal does not regulate transmission lubricants. It also provides no incentives (through the use of GEM credits or otherwise) for the use of higher-performing transmission lubricants. However, including provisions to encourage higher-efficiency manual transmission fluids in the final Phase 2 Rule will be very worthwhile. [EPA-HQ-OAR-2014-0827-1325-A1 p.15]

Lubrizol testing has found that significant efficiency improvements can be obtained through the use of high-performing transmission lubricants. Lubricant-based efficiency gains in the transmission can be similar in magnitude to those in axles. Like the axle test results noted above, this data is proprietary, but is based on years of rig testing involving significant capital investments.<sup>25</sup> We are happy to discuss this data with you further upon request. [EPA-HQ-OAR-2014-0827-1325-A1 p.15]

We encourage the creation of GEM credits for lubricants that increase efficiency in manual transmissions. There are a number of ways to do this, including (i) creating a comparative test that provides credit for percentage improvements over a baseline fluid or (ii) providing some other mechanism that enables OEMs to validate equivalence to a designative test fluid. Lubrizol has test data and other information that it would be willing to share with EPA in order to assist in the creation of such GEM credits. [EPA-HQ-OAR-2014-0827-1325-A1 p.15]

### **Summary of Axle and Transmission Comments**

Providing the most effective incentives for the use of higher-efficiency axle and transmission lubricants will provide significant benefits that will enhance the overall Phase 2 Rule. The current proposal will likely ensure widespread adoption of 75W90 axle lubricants, which will be a significant improvement over the status quo. However, eliminating the ambiguity in baseline fluid and the test procedure and providing a mechanism for additional GEM credits for axle lubricants that provide greater-than-0.5 percent efficiency improvements will make a very useful provision even more effective over the long run. Similarly, including provisions to encourage higher-efficiency manual transmission fluids is worth doing. [EPA-HQ-OAR-2014-0827-1325-A1 p.15]

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24 See, e.g., Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles; National Research Council; Transportation Research Board (2010). “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles.” <http://www.nap.edu/catalog/12845/technologies-and-approaches-to-reducing-the-fuel-consumption-of-medium--and-heavy-duty-vehicles>, page 67 (justifying a 1.0% improvement); and Green, D.A., et al. “The Effect of Engine, Axle, and Transmission Lubricant, and Operating Conditions on Heavy Duty Diesel Fuel Economy. Part 1: Measurements.” SAE 2011-01-2129. SAE International Journal of Fuels and Lubricants. <http://papers.sae.org/2011-01-2129/>, January 2012 (summarizing European field tests that found improvements up to 1.8%).

25 Rig testing is a better way to isolate the efficiency improvements of one transmission fluid over another than in-use or chassis dynamometer testing.

### **Response:**

We appreciate Lubrizol’s comments on both axle and transmission lubricants. In order to fully recognize the benefits resulted from lubricants, we allow the axle or transmission manufacturers or other manufacturers to perform their own tests to overwrite the default power loss table in GEM. In all of

these tests, benefits due to lubricants will be measured, and therefore the benefits due to lubricants can be recognized by GEM.

**Organization:** Meritor, Inc

### **Upgrade the GEM Baseline Axle-Efficiency Model**

Meritor is concerned that a flat 95.5 percent axle efficiency as proposed in the rule is not representative of the “typical” 2017 axle upon which the baseline truck model is derived. In fact, when considering the breadth of the commercial truck segments that are being regulated, Meritor believes that 95.5 percent axle efficiency is artificially high, which would dis-incentivize the implementation of higher efficiency axles. For example a 95.5 percent efficient axle for a heavy haul application does not seem appropriate given the high numerical axle ratio. Chart 4.1 compares three common 40k GAWR tandem axles, each with a 3.55 ratio, for a typical North American linehaul application. [EPA-HQ-OAR-2014-0827-1254-A1 p.3]

[Chart 4.1, 'Ratio Axle Efficiency Comparison', can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Therefore, Meritor is requesting that the default axle efficiency in GEM be modified from the current flat 95.5 percent assumption in the current proposal to a ratio- sensitive axle-efficiency model which is more realistic, as illustrated in Chart 4.2, and appropriately supports the downspeeding trend. [EPA-HQ-OAR-2014-0827-1254-A1 p.4]

[Chart 4.2, 'Tandem Axle Efficiency Ratio Sensitivity', can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

The GEM model already includes an input for axle ratio so establishing a relationship between axle ratio and efficiency seems relatively straightforward to implement into the model. It should also be noted that the default axle efficiency in the EU regulatory compliance model (VECTO) is currently ratio sensitive. [EPA-HQ-OAR-2014-0827-1254-A1 p.4]

Although Meritor is advocating a single, ratio-sensitive default-axle efficiency, we acknowledge that there may be alternate ways to implement this methodology. The following is a list of alternative axle-efficiency methods in preferential order: [EPA-HQ-OAR-2014-0827-1254-A1 p.5]

Linear Formula – Our preferred method is to calculate default axle efficiency for the bulk of the axle market using a formula based on a sloped line. Based on the chart above, we suggest the following formula:  $\text{EffAxle} = 99.56 - (1.54 * \text{RatioAxle})$ , for ratios 2.15 to 4.11. For ratios outside of this range, the axle efficiency at the nearest limit can be assumed to be constant. For example, ratios less than 2.15 will assume the efficiency of the 2.15 ratio (96.2%) and ratios numerically higher than 4.11 will use the efficiency of 4.11 (93.2%). [EPA-HQ-OAR-2014-0827-1254-A1 p.5]

[Chart, 'Single Reduction Axle Default Efficiency', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Linear Bi-modal – This simpler method, if less accurate method establishes two default axle efficiencies, one for low ratios and one for high ratios. This method mirrors the bi-modal nature of axle ratios in the actual market. [EPA-HQ-OAR-2014-0827-1254-A1 p.5]



[Chart, '2015 Percent of N.A. Sales', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Meritor's bi-modal recommendation is: [EPA-HQ-OAR-2014-0827-1254-A1 p.5]

$Eff_{Axle} = 95.5\% @ Ratio_{Axle} = 3$   $Eff_{Axle} = 94.1\% @ Ratio_{Axle} \geq 3$  [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

If a single number is necessary, then a more appropriate value based on the distribution of the market would be 94.8% (the average of 95.5% and 94.1%). [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

It should be noted that all axle-efficiency recommendations detailed above include the use of BASF EmGuard® FE 2986 SAE 75W-90 or equivalent lube which is the current standard for the 0.5 percent high efficiency credit. [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

### **Include Axle-Efficiency Map Input in GEM and Modify the Associated Axle Test.**

Meritor is supportive of an optional axle efficiency test that can be used to override the default GEM axle efficiency values. We believe this test option encourages continued development of high efficiency axles as it provides an established avenue to validate technologies and receive the appropriate fuel-efficiency credit throughout the lifetime of the regulation. Meritor acknowledges that we made several recommendations that influenced the axle efficiency test in the current proposal; we are now recommending an alternative that better aligns with the direction of the test procedure and axle mapping method from the proposed EU greenhouse gas simulation model known as VECTO. As such, Meritor proposes that the EU VECTO mapping method be considered as a starting point, and that the U.S. method be as consistent as is practical with that method. [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

First, output torque is the preferred test specification method as opposed to input torque for a final drive (the proposed procedure specifies input torque). A vehicle drive cycle dictates a common output – or, wheel torque profile – for a given macro vehicle specification, independent of axle ratio. Therefore, output torque will normalize the map across the spectrum of axle ratios. Also, it is difficult to test at true zero input torque as the output will be in a negative (coast mode) torque condition. If input torque is desirable for GEM as a forward-looking simulation type, GEM could internally convert an output-torque-based map to an input-torque-based map by considering both the axle ratio and the torque loss. [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

The map torque specification should account for the number of drive axles. For example, 6x2 and 4x2 drive axles should be tested at two times the output torque as a single-drive axle of a 6x4 configuration as it sees two times the torque in operation. A composite 6x4 drive-axle map should consist of the average of the front- and rear-drive axle-efficiency maps. This will normalize the maps such that an "X"x2-axle map will have the same grid density as a combined 6x4-axle map across the vehicle operating envelope. [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

The maximum mandatory output torque for the map should be limited to a reasonable level for two primary reasons: [EPA-HQ-OAR-2014-0827-1254-A1 p.6]

Axle dynamometers used for efficiency testing require highly sensitive torque sensors to measure small torque losses through the final drive. This imposes practical limits on maximum torque as torque cells with adequate sensitivity have limited torque range. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

Most of the operating torques on the GEM drive cycle are well below the peak torque for the transient drive cycle. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

A recommended maximum mandatory output torque is equivalent to 1.0 - 1.5 percent steady state grade torque at cruising speed for a Class 8 vehicle which is approximately 4000 N-m (2950 lb-ft) total wheel torque, or 2000 N-m (1475 lb-ft) for each drive axle of a 6x4 configuration. This is high enough to capture most of the operating points for both Cruise cycles (see Annex A). Note this is less than the maximum torque of the EU VECTO map proposal of 10,000 N-m which we find excessive. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

Meritor offers two recommendations for handling torque beyond the maximum mandatory standard output: [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

Allow optional torque levels to be included in the map above the maximum mandatory torque, at standard increments. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

In the GEM simulation, extrapolate to torque levels above the map by assuming a linear relationship between torque loss and nominal torque at a given speed. This recommendation is based on the EU VECTO map proposal and on Meritor's observation that torque loss is very linear with nominal torque (see Annex B). Note that the linear relationship assumption means that the axle efficiency will approach a constant maximum value at high torque, with the value being a simple function of the slope of the fitted line. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

Provision should be made to exclude map points above a given power. A rectangular torque/speed-map grid will include points at the high-torque/high-speed "corner" that exceed the maximum power of the powertrain (for example, the largest default GEM engine is rated at 455 hp [339kW]). These points are immaterial as they will never be encountered in operation. Therefore, the map should allow no entry or "NaN" (Not a Number) type entries for "excessive power" grid points. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

Table 5.1 below illustrates the EU VECTO axle map grid. On the whole it is adequate for North American purposes but the torque and speed granularity is rather fine, resulting in many cells and a heavy testing burden. Also, the mandatory maximum torque is rather high. A proposed map grid is given in Table 5.2 in which the torque and speed increments are larger but consistent with the EU VECTO map, and the mandatory maximum torque is lower. [EPA-HQ-OAR-2014-0827-1254-A1 p.7]

[Table 5.1, 'Reference EU VECTO Axle Map Grid', and Table 5.2, 'Proposed Axle Map Grid for Single Axle Efficiency Test', can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

In addition to the items noted above, other characteristics of the test method associated with map generation and usage should be either common with or as consistent as practical with EU VECTO for the intent of making axle map data portable between the U.S. and the EU. These elements include oil temperature, type, level, condition, and filtering; ambient temperature; torque and speed tolerances; torque cell temperature correction; run-in procedure; test torque-speed sequence; data sampling time, rate, averaging, and filtering; and "lumping" parameters and tolerances for grouping of axle maps. [EPA-HQ-OAR-2014-0827-1254-A1 p.9]

### **Resolve 0.5 percent Advanced Lube Credit with Axle-Efficiency Test Baseline Lube**

With regard to the Advanced Lube Credit of 0.5 percent, Meritor is in favor of the concept, however, it is important to clarify a few matters prior to implementation of the rule as written. One concern is that BASF EmGuard FE 2986 SAE 75W-90 is designated as the baseline lubricant for the axle efficiency test but is also the baseline lubricant for the 0.5 percent “advanced lube” FE credit. As a result, if an axle supplier submits an axle map from an efficiency test, the results would include the advanced lube. When implemented in production, the OE would claim the axle efficiency as tested with the advanced lube and receive the 0.5 percent advanced lube credit, in effect double dipping. This cannot remain the case. One solution is to give the 0.5 percent advanced lube credit when using the default GEM axle efficiency, but eliminate the credit when using an axle-efficiency map. [EPA-HQ-OAR-2014-0827-1254-A1 p.9]

Also, there is no flexibility in the rule to get credit for an even more advanced lube except through off-cycle. We suggest allowing an axle test and the associated map using a more advanced lube than 2986 to provide a simple avenue for more advanced lubrication credits. [EPA-HQ-OAR-2014-0827-1254-A1 p.9]

It is important to note that if a 0.5 percent FE credit is to be given for the use of 2986, then our previous recommendations for baseline axle efficiency should be reduced by 0.45 percent accordingly (i.e. 99.56 is reduced to 99.11; 95.5% and 94.1% are reduced to 95.05% and 93.65% ,repectively; and 94.8% is reduced to 94.35%). [EPA-HQ-OAR-2014-0827-1254-A1 p.9]

### **Account for 2-Speed Axles**

Although there is no regulatory framework regarding 2-Speed Axles, they are mentioned in the Regulatory Impact Analysis’ Technology Section 2.4.5.2 Gear Ratio (2-37) as a technology “many axle manufacturers are developing” to enhance vehicle performance. If that statement is true then it follows that 2-Speed Axles should be included in the regulation to better account for future market penetration. [EPA-HQ-OAR-2014-0827-1254-A1 p.11]

The first area that needs to be addressed with regards to 2-Speed Axles is fuel efficiency. A 2-Speed Axle can improve tractive force at low speeds and allow greater downspeeding at high speeds thereby potentially netting greater vehicle fuel efficiency however, it requires several more gears and bearings which will actually reduce axle efficiency. Meritor recommends that default axle efficiency of a 2-Speed Axle be reduced by 1 percent to prevent an artificial market incentive to a potentially less efficient axle configuration. Secondly, there needs to be some instruction on how to model a 2-Speed Axle in GEM. As written, GEM allows a single-axle ratio input but a 2- speed axle has two distinct ratios. Although a 2-speed axle can be used in conjunction with a transmission to double the number of gear ratios; that is not how this technology is being applied in North America. Rather, the 2-speed axle is being used to enable engine downspeeding by providing a very low downspeed axle ratio as well as a high torque “starting” ratio. Therefore, we suggest that GEM allow for an axle ratio input for each drive cycle in which the lower numerical axle ratio would apply to the 55- and 65-mph drive cycles and the higher numerical ratio would be applied to the transient drive cycle. [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

### **Response:**

We appreciate Meritor’s constructive comments on axle efficiency with a flat and fixed efficiency of 95.5% used in NPRM. Specifically, we appreciate very much that Meritor provided many highly valuable information on the axle performance and power loss tables to the agencies. As a result, we adopted their recommendations of using the power loss tables as default, and those default tables can be

replaced by a manufacturer's measured values, and therefore, all technologies related to the axle, such as advanced lubricant, can be accounted for by this approach. GEM does allow two speed tandems named as 6x4D, which is only applied to 55 and 65mph cycle with 6x2 option, and then switch back to 6x4 once running the transient cycle. However, the axle ratio would be still the same for these two speed axle option, prompting OEM to select most commonly used axle ratio for GEM based on their driving condition. The main reason for this decision is that we believe that two speed axle is primarily used in tractor applications, where cruise speeds are pre-dominated. The cycle weighing on transient cycle is small compared to ones on two cruise speed cycles. As such, the lower axle ratio should be selected. This is not a perfect solution, but can greatly simplify GEM.

**Organization:** Odyne Systems LLC

*Modeling and Testing for the Full Workday*

Odyne understands the difficulty in modeling fuel efficiency improvements for hybrid technology within the GEM, as hybrid systems interact with the transmission, drivetrain, and engine, in addition to auxiliary activities beyond driving not currently modeled in the GEM. We appreciate EPA's efforts to improve the accuracy of the GEM to account for real work driving. However, Odyne strongly believes that it is important to model the full day vocational vehicle duty cycle, including driving, idling, and stationary operation of truck-mounted equipment through a Power Take-off (PTO). [EPA-HQ-OAR-2014-0827-1239-A1 p.18-19]

Modeling the entire duty cycle would be consistent with efforts by CARB to understand the total emissions produced by the vehicle throughout the entire day. Since the GEM does not have a specific module for hybrid systems it is difficult to evaluate their impact on driving and stationary aspects of the full workday. Also it does not seem to properly account for all the differences in idle conditions, which are a large part of the full workday. We believe improvements to the accounting of hybrid systems and modeling of the full workday are necessary to properly developing emission standards and verifying emission savings. This needs to be handled separately from the hybrid PTO / e-PTO module in the GEM to account for idle time. Our system is active during the driving and stationary operation of the vehicle and provides unique benefits in both and when they are properly combined result in the real world benefits of a full workday. [EPA-HQ-OAR-2014-0827-1239-A1 p.19]

**Response:**

The agencies agree with comments from Odyne with regard to recognizing technologies that reduce emission while the vehicle is moving and at idle and because of this have modified 40 CFR 1036.540, 40 CFR 1037.540 and 40 CFR 1037.550 to allow for testing of these systems. 40 CFR 1036.540 and 40 CFR 1037.550 can be used to test hybrids and PHEV that use the stored energy to propel the vehicle. We added many features to recognize the benefits with various idle technologies. This has been done by the two idle cycles (parked idle and drive idle) and the PTO test. For electrified and PHEV PTO systems 40 CFR 1037.540 can be used to recognize the benefits of these systems, through an input to GEM.

**Organization:** Oshkosh Corporation

**Simulating Axles for Vehicle Certification** – The agencies request comment on whether or not we should finalize this test procedure and either require its use or allow its use optionally to determine an axle efficiency data table as an input to GEM, which would override the fixed axle efficiency we are proposing at this time. 80 FR 40185. We recommend that the EPA and NHTSA use the European test

procedure, word for word and step by step. There should be the ability to input our own axle efficiency value if greater than the baseline value.[EPA-HQ-OAR-2014-0827-1164-A1 p.63]

**Response:**

Regarding the axle efficiency test, the agencies have reviewed the draft European test procedure but since it was not a final procedure that could be referenced, the agency have worked closely with major axle manufacturers and lubricant manufacturers to define a robust test procedure for measuring axle power losses. The agencies have worked to make the procedures overlap is as much as possible so that data from one procedure could be used for the other test procedure.

**Organization:** Truck & Engine Manufacturers Association (EMA)

Transmission Efficiencies

The currently available Phase 2 version of GEM uses default transmission efficiencies. However, those efficiencies for gear and pumping losses can be reduced by approximately 1% to 2% through design-specific actions to transmissions, and will vary from product-to-product. Accordingly, having a test method that can capture the product-specific performance and an optional transmission efficiency input for GEM would allow OEMs to determine and utilize the actual engineered GHG/FE benefits in Phase 2. The European agencies are working on a transmission efficiency test procedure that could be the starting point for the agencies in developing a Phase 2 option. EMA recommends that the same test procedure and data input formats that are being developed in Europe should be incorporated into Phase 2. [EPA-HQ-OAR-2014-0827-1269-A1 p.53]

**Response:**

In the final rule, we do allow the manufacturers the option to use their own tested power loss table to replace the agency's default power loss table by following the test procedure 40 CFR 1036.565.

**Organization:** Volvo Group

Axle Efficiency Test

Volvo Group supports the option to test axle efficiency and offers comment on ensuring the test is run appropriately and consistently. In general, we suggest the test protocol should be reviewed jointly by the agencies working with the EMA Vehicle Measurement and Test Committee. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

We first note that the new axle break-in period is inadequate. Although we expect a longer break-in is needed, we do not have a specific recommendation at this time. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

Test targets should be based on output torque rather than input torque. Use of input torque will result in extremely high output torque for high axle ratios. Manufacturer axle torque ratings are not specified in a consistent manner and should not be the basis for test set-up. Maximum output torque should be based on the wheel slip torque on dry pavement at the legal load for the axle. Testing could be done in increments of axle slip torque, i.e. 25%, 50%, 75%, 100%. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

The accuracy of the average torque set point control within 1 N-m is tighter than it needs to be and may not be feasible. We expect that 5 N-m's would not affect the efficiency result. The deviation of individual test points should also have a limited band, i.e. +/- 5% or 10%. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

Ambient temperature is irrelevant when oil temperature is controlled. In any case, maintaining ambient temperature between 20-30° C would require an unnecessary air conditioned facility. We recommend that the oil temperature measurement location be specified as the drain of the sump. Since the test result is an average of four runs at each torque and wheel speed, criteria should be established as to allowable variation between runs and to identify outlier data that should be discarded. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

The protocol requires testing 5 torque levels and 6 speeds, repeating each 4 times. This requires 120 test runs, and this is just for one axle ratio. Unless there is data showing significant variability within the 300 seconds run for each test point, it should not be necessary to repeat each test point four times. The 300 seconds of data could be parsed into 10 second test segments to establish efficiency variability. Alternatively, we could commission testing to determine variability at a given test point to see if the proposed protocol could be shortened. [EPA-HQ-OAR-2014-0827-1290-A1 p.52]

### **Default Axle Efficiency Map**

The NoDA GEM release incorporates axle efficiency maps in place of a single axle efficiency number. A vehicle manufacturer has the option to use the default map provided within GEM, or to derive by test the axle efficiency map for the actual axles installed in the vehicle. If the default map is selected GEM uses the GEM\_default\_axle.m file to determine the axle efficiency based on a vehicle's weight class, drive axle configuration, axle gear ratio. [EPA-HQ-OAR-2014-0827-1928-A1 p.18]

Where the default map is determined as a function of the vehicle's axle configuration (e.g. 6x4), the Agency assumes that a dual-drive 6x4 configuration has a base spin loss torque 2.1 times that of a single drive 4x2 or 6x2 configuration. In addition, a 6x4 disconnect configuration uses a factor of 1.06 when operating in a 6x2 drive configuration. However, in a typical 6x4 configuration the front drive axle of the tandem has an additional gear mesh compared to the rear drive axle of the combination in order to accommodate the front axle's output to the rear axle. In addition, the front drive axle incorporates an inter-axle differential or power divider. In the case of a single drive axle, the need for the additional gear mesh to accommodate the throughput to the second drive axle is eliminated, along with the inter-axle differential or power divider. Because of this, the front drive axle in a typical tandem will have a lower efficiency than the rear. [EPA-HQ-OAR-2014-0827-1928-A1 p.18-19]

As such, Volvo does not agree that the base spin loss torque of a tandem axle configuration, either disconnectable or full time, would be 2.1 times that of a single drive axle. Nor do we agree with the 1.06 factor applied to a 6x4 disconnect when operating in 6x2 mode, as a disconnectable 6x4 configuration would also have a front drive axle with a lower efficiency than the rear. For accuracy, Volvo suggests revision of the default axle map to accommodate these effects, as well as the ability within GEM to accommodate unique front and rear tandem drive axle efficiencies. [EPA-HQ-OAR-2014-0827-1928-A1 p.19]

### **Axle Family Definition**

The proposed axle mapping test procedure requires axles to be split into families for which a test of the "parent" could apply. Volvo proposes that axle families be defined by the following attributes: [EPA-HQ-OAR-2014-0827-1928-A1 p.19]

1. Carrier family (typically driven by torque capacity)
2. Number of gear meshes
3. Inclusion of interaxle differential or power divider
4. Number of reductions (single reduction vs. double reduction)

Volvo also proposes that axles within a family be defined by a parent ratio that would either represent the worst efficiency map in the family, or that a default ratio efficiency factor be applied across all families as the EPA has done for the default axle map (gear\_efficiency\_norm as defined in the above noted default axle efficiency file). In addition, where a manufacturer believes their ratio efficiency numbers are better than the Agency's default, they should be allowed to perform testing based on the proposed axle efficiency test procedure and use the resultant values. [EPA-HQ-OAR-2014-0827-1928-A1 p.19]

In order to eliminate unnecessary test burden, axle manufacturers should also be given the option to declare and test tandem axle families where the front and rear axles of a tandem are installed together in the vehicle. In this case tandem families would be defined by, at least: [EPA-HQ-OAR-2014-0827-1928-A1 p.19]

1. Carrier family (typically driven by torque capacity)
2. Number of reductions (single reduction vs. double reduction)

#### **Additional Axle Efficiency Item of Note**

It is not clear why the Agency has applied a factor of 1.65 to the base\_spin\_loss\_torque\_Nm parameter in GEM\_default\_axle.m. [EPA-HQ-OAR-2014-0827-1928-A1 p.19]

#### **Transmission Efficiency**

In the agencies' summary of GEM P2V2.1 updates provided with the GEM release, it is noted that the agencies have revised the Automated Manual Transmission (AMT) and Automatic Transmission (AT) default gear efficiencies. For an AMT the default efficiencies were changed to 99.5% for direct drive and 96.5% for non-direct drive. For ATs the defaults were changed to 99.5% and 98.5% for direct drive and non-direct drive respectively. It is Volvo's experience that mechanical efficiency of both a Manual Transmission and an AMT typically exceeds that of an AT. Therefore, Volvo requests the supporting data to understand these assumptions and the opportunity to work with the agencies to correct any erroneous values. In addition, Volvo does not agree with the assumption that all non-direct drive gears have the same efficiency and suggests a default file that accounts for each gear individually. [EPA-HQ-OAR-2014-0827-1928-A1 p.20]

The 2% difference between a manual and an AMT in our view is questionable. From a technology standpoint, a skilled driver should be able to obtain the same fuel efficiency as an AMT. So the difference is human (an unskilled or aggressive driver), not the technology. We have done simulations for highway cycles that supports they are equivalent or at most 0.5% worse, but clearly not 2%. [EPA-HQ-OAR-2014-0827-1928-A1 p.20]

#### **Response:**

Regarding the axle efficiency test, the agency has worked closely with major axle manufacturers and lubricant manufacturers to define a robust test procedure for measuring axle power losses. With respect to the break-in period the agencies believe leaving it up to good engineering judgement is a conservative position because axle losses typically decrease with additional break-in time. In addition to this the procedure has a specified repeatability requirement so if the axle has not been broke-in enough the repeatability specification will not be met, due to the axle losses changing with additional testing.

Based on comments the axle test procedure has be updated in the following ways:

- Test targets have been changed to output torque.
- Torque transducer accuracy requirements have been changed to  $\pm 0.2$  % of the maximum axle input torque or output torque tested for loaded test points, and  $\pm 1$  N·m of the maximum axle torque tested for unloaded test points.

- Stabilization and averaging period has been changed to a minimum of 10 seconds.
- Specify that the gear oil temperature must be measured at the drain of the sump.
- Axle family definition.

With the update to the stabilization and averaging time and the requirement of a minimum of 3 repeats the time to complete the testing has reduced significantly from the procedure that was published with the proposal to the rule.

The agencies have based the default axle losses on data from multiple axle manufacturers. Based on our analysis of this data the default axle losses are consistent with the manufacture data. In addition to this, the ability for an OEM to input the specific loss map for the axle being installed on the certifying vehicle, allows the actual losses of the axle to be used in GEM for vehicle certification.

On axle family comments, we ask the manufacturers to use good engineering judgment to divide your product line into axle or transmission families that are expected to have similar hardware, noting that efficiencies can differ across the members of a family.

Regarding transmission efficiency used in GEM, the mechanical efficiency we chose for both AT and AMT are based on the recommendations of transmission OEMs. In the final GEM, we further split the AMT gears into two groups for a total gear number larger than 10. When the gear number is smaller than 6, it will use 96% as the default efficiency, and when the gear number larger than 6, it will use 98% except 1:1 gear ratio. The reasons why MT has 2% worse than AMT in efficiency is based on the valuable inputs from one major transmission supplier. We believe that their recommendations reflect the reality.

## **2.4.2 Powertrain Testing**

**Organization:** Truck & Engine Manufacturers Association (EMA)

### Powertrain Test Requirements

The preliminary results obtained through the powertrain test are uncertain and unproven. It is unclear how child ratings are to be treated, how the powertrain test applies across different engine and vehicle configurations, and what specific test procedures apply. [EPA-HQ-OAR-2014-0827-1269-A1 p.39-40]

In addition, the proposed powertrain test is inadequately defined and fails to include a proper test protocol for managing a modern transmission. Specifically, testing in the lowest transmission gears is not feasible due to high torque and low RPMs. It also appears that the dynamometer inertial effects have not been accounted for. Other issues are likely to arise under the proposed powertrain test, but many manufacturers have not had the opportunity to run the test (which may not even be loadable into GEM as of yet) and so have not been able to complete a thorough evaluation. Such an in-depth evaluation should be undertaken before the agencies finalize the powertrain test procedures. [EPA-HQ-OAR-2014-0827-1269-A1 p.40]

**Organization:** Navistar, Inc.



We believe that the powertrain testing proposal and the subsequent stringency as related to the vocational vehicle segment are entirely unreasonable. The proposed powertrain testing method is a relatively new concept, and while it does show technical merit we believe that it should be included as an optional method for showing compliance. However, even if the powertrain alternative method were to be used as only an optional method there are significant issues and risks associated with this method that we wish to address. [EPA-HQ-OAR-2014-0827-1199-A1 p.34]

The first issue, and likely the most complicated to resolve, is the selection of the generic vehicles with which to test in a powertrain dynamometer. The variability in truck configurations sold in both the vocational and tractor market space will inevitably cause certain configurations to fall outside the bounds of the powertrain generic vehicle map. We foresee extrapolation outside the bounds of the test points as an unacceptable method of certification due to the large amounts of error that can arise from this method as already noted by EPA data. One might initially think that modification of the point selection technique could alleviate this problem; however, testing will be difficult as it will prove more difficult to derive the correct test points for certain powertrain families than others. If manufacturers are not able to ensure that the powertrain testing maps will ensure coverage of all vehicle configurations, this could limit both manufacture and customer choice in terms of vehicle configurations that are made available for sale. This limitation could lead to customers choosing vehicles that perform sub-optimally thereby leaving potential CO<sub>2</sub> reductions on the table. [EPA-HQ-OAR-2014-0827-1199-A1 p.34]

The current nine point selection method for the powertrain testing points also requires testing of vehicle configurations that are entirely unreasonable. The selection of a vehicle to run at the minimum NTE exclusion speed at 65mph will result in either cruising engine speeds that are entirely too low when compared to real-world trucks, or will result in gearing down to run the GEM cycles thus resulting in higher engine speeds than intended. If the method was to be made optional and a range of vehicles were tested using a specific powertrain that would exhibit the sought-after deep integration benefits, we would request that the points be chosen in such a way as to cover the range of vehicles sold. [EPA-HQ-OAR-2014-0827-1199-A1 p.34-35]

Secondly, the family structure is ambiguously defined. Different manufactures could take a widely different view on what constitutes a “common calibration attribute” thus lead to a certification process that is unnecessarily complex and burdensome. The RIA itself notes that “impact of transmissions including shifting strategies and numbers of gears, axle ratio to be minimal if the plots are designed in such a way that average engine speed (N) over average vehicle speed (V) defined as N/V is selected.” If this is the case, then it could be argued there is no need to separate the families in such a way. If this is the case it is potentially contradictory to the proposal’s sections on deep integration which makes the exact counter claim that significant fuel economy gains can be had through these types of changes. [EPA-HQ-OAR-2014-0827-1199-A1 p.35]

Because of these uncertainties, even if the powertrain testing procedure is used as an option, it should await the completion of the SAE technical procedure, currently under development. [EPA-HQ-OAR-2014-0827-1199-A1 p.35]

In order to address this issue we have undertaken a study of our own vehicle sales volumes and generated powertrain maps and fuel used values via an in-house simulation tool for all one year period of vehicles using a BSFC and a powertrain map. The trends we have seen from this study show that when applied to a whole vehicle population the powertrain testing issue shows inaccuracies that have not appeared in the limited testing performed. These issues are best described by having r-square values lower than .7 and .9 for the 55 and 65 GEM cycles respectively. [EPA-HQ-OAR-2014-0827-1199-A1 p.35]

It is also important to note that a powertrain test will be for a particular transmission calibration and engine calibration. The worst case calibration for the combination needs to be selected per the protocol requirements. Although it is uncertain whether a benefit can be demonstrated on a powertrain test that could meet the stringency requirement of 4-7%, it is even more unlikely that the worst case configuration will meet this aspect of the NPRM's estimate. If transmission families are divided even further, which will further increase the test burden, there is an adverse consequence that these calibrations will be unable to be adjusted in the field. Because of an inability to modify the calibration, customers may order the powertrain that is NOT tested so as to preserve their resale value even if the tested combination provides better fuel economy. This will drive the opposite behavior from that desired by the regulation. For this reason, if powertrain testing is included in the final rule, the rule should allow powertrain modifications to ensure the customer can optimize for their application while still improving their fuel economy. [EPA-HQ-OAR-2014-0827-1199-A1 p.36]

Along the same lines, one could potentially see how the difference between GEM results and powertrain testing done thus far could be the result of inadequacies in the GEM modeling process. The combination of transmission efficiencies, differences in accessory loads (GEM uses constant power sink) and the lack of an engine transient torque model can all lead to a reduction in CO<sub>2</sub> emissions that is not due to any inherent advantages in engineering development but is due instead unaccounted for pieces within the model. Although this requires additional test methodologies, we feel this is preferable to the test proliferation and mandatory inclusion of powertrain testing in the Proposed Rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.36]

Finally, the implementation in GEM of the powertrain method has several structural issues. The method of calculation of N/V in the proposed rule is based solely on the axle ratio and tire size, as opposed to a true N/V (engine rpm/vehicle speed). The workgroup associated with this method and most of the analysis upon which the method is based has not yet even completed this methodology. While the same trends and results may hold true for both methods, insufficient work and time have been expended to verify this possibility. This method of accounting for N/V would seem to have little to no impact on 55 and 65 mph cycles with the current grade, because most of the cycle will be driven in a single gear. The general trend for these types of cycles will be that decreasing the N/V ratio, as calculated in the proposal, will result in a better CO<sub>2</sub> number, e.g. down speeding. However, the ARB cycle, as well as other more urban type cycles can exhibit different characteristics and highly non-linear trends, depending on the cycle and powertrain under study. Accounting for N/V as done in the proposal will not represent these non-linearities. [EPA-HQ-OAR-2014-0827-1199-A1 p.36-37]

Further complicating these matters is that when certifying a combination via GEM with the powertrain option one is no longer certifying the actual vehicle configuration or powertrain family. Instead, the GEM model is run with a generic engine, and generic transmission, failing to account for the potentially differences in the number of gears, the transmission technology type, the size of the engine, and the operating range of the engine, among other factors. Since the N/V ratio is calculated using only the axle ratio and tire radius this could be viewed as a way of generating the required cycle work for use in the powertrain table lookup; except for the fact that the vehicle drive cycle, thus the total cycle work, can be impacted. This problem would further exacerbate itself should the new grade profiles presented in the NREL report be adopted, as the drivability and performance differences in powertrains would be more apparent. [EPA-HQ-OAR-2014-0827-1199-A1 p.37]

Finally, the method of calculating the gear efficiencies is based on finding the direct drive gear. The default powertrain scripts have a modifier of some "Fixed Axle/Specified \* Gear Ratios," so, unless the same axle as the Fixed Axle is used, there will be no direct drive gear and thus a penalty will be taken

on the GEM simulation for this vehicle. We view this as a bug that the agencies should address. [EPA-HQ-OAR-2014-0827-1199-A1 p.37]

Beyond everything we have mentioned, there is nothing in the record to show that powertrain testing will actually capture the benefit any better than GEM for vocational vehicles. At some point, however, a powertrain test method may be developed that, for some applications, could show results that are more sensitive than GEM. For that potential, we propose that if the powertrain option is kept, in any form, it be limited to an option for a defined application that is approved on a case-by-case basis, similar to the process for an off-cycle technology. [EPA-HQ-OAR-2014-0827-1199-A1 p.37]

The proposed powertrain certification test process used to leverage the deep integration of engine and transmission systems also fails to account for the inherent variability present in engine testing without the complexities of a transmission with a simulated or actual axle. Part 1037.550(g) calls for the development of a driver model to “mimic a human driver” which can comply with the statistical cycle validation criteria as presented in Table 4 of 1037.550. This expectation ignores the diverse range of Part 1065 capable engine/powertrain dynamometer test cell configurations currently available. [EPA-HQ-OAR-2014-0827-1199-A1 p.37]

The requirement to develop a driver model that mimics normal operation assumes that all transmissions will be either automatic or automated manual transmissions. Currently there are no provisions or available robotic drivers that can accommodate a manual transmission. This limitation effectively rules out an entire segment of medium duty and heavy duty transmissions currently available. If a technology becomes available whereby robotic manual transmission shift control is possible, a shift schedule and/or logic map would need to be created either by the test facility or the engine/transmission manufacturer. [EPA-HQ-OAR-2014-0827-1199-A1 p.37-38]

The importance of a consistent and repeatable transmission shift schedule extends to either a manual or automatic transmission. If there are changes in these calibrations or other warm up control features, the vehicle certificate holder would be required to perform additional testing to demonstrate calibration transparency and compliance. This would in turn require the transmission OEM to continuously disclose any changes that could affect the CO2 result to the GHG certification holder, prior to implementation. This continuous disclosure requirement would have the net effect of increasing deployment cost, adding compliance margin and delaying implementation. [EPA-HQ-OAR-2014-0827-1199-A1 p.38]

This concern reinforces our overall concern that powertrain testing cannot yet capture benefits over the existing engine test in conjunction with GEM in a manner that does not increase variability. In short, as stated, we do not think it is ready for adoption, other than in a specific method that can be demonstrated as reliable to the agencies and that should only be included as an optional test. [EPA-HQ-OAR-2014-0827-1199-A1 p.38]

**Organization:** Allison Transmission, Inc.

Powertrain testing should be allowed as an optional certification method, however, EPA and NHTSA should not create incentives within this rulemaking for its use. EPA and NHTSA have seriously underestimated the costs of such testing. GEM must be modified to be reasonably accurate and suitable for certifying the large majority of vehicles; overreliance on powertrain testing could have several negative impacts including increased costs, and increased limits on consumer choice. [EPA-HQ-OAR-2014-0827-1284-A1 p.2-3]

EPA and NHTSA should credit other technologies not recognized in GEM or measured in powertrain testing such as load-based and grade-based shift algorithms and acceleration rate. [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

#### EPA and NHTSA Must Not Require or Create Undue Incentives for Powertrain Testing

EPA and NHTSA are proposing to allow powertrain testing as an “optional certification path” but also request comment on whether the agencies should require such testing “more broadly.” While Allison supports retaining powertrain testing as an option, such testing should be the exception rather than the norm for certification. There are several reasons why this testing option should not be expanded. First, as EPA and NHTSA recognize, this type of testing has never before been used for vehicle certification. Instead, the Phase 1 rule only allowed for different certification under limited circumstances where normal testing procedures would not be adequate to measure emissions. [EPA-HQ-OAR-2014-0827-1284-A1 p.22]

Second, requiring powertrain testing in some circumstances or increasing the regulatory incentive for its use would substantially increase the cost of this regulatory program. As noted, EPA has estimated that the upgrade costs to an existing engine test cell is on the order of \$1.2 million and new test facility in an existing building is estimated at \$1.9 million; the estimated cost to test each powertrain family in a completed cell would be about \$69,000. Given the large variety of vehicles in the vocational vehicle area, costs for such testing could add up to substantial amounts of money, especially in relation to smaller manufacturers who build different, specialized vehicle types.<sup>42</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.23]

Third, the vocational vehicle space consists of highly varied vehicles that are tailored to meet the work needs of the vehicle. “Sub-optimizing” these configurations in order to fit within different powertrain families in order to avoid additional powertrain testing would lead to poorer fuel economy and more vehicles required to accomplish the same work. [EPA-HQ-OAR-2014-0827-1284-A1 p.23]

Finally, excessive powertrain testing could occur. For example, under the proposed regulation, Allison conventional planetary on-highway products would be classified into 10 unique transmission families. Allison hybrid transmissions would be classified into 6 unique hybrid transmission families. In 2014, in North America, Allison transmissions were used with over 30 different engine families. Thus, in combination with conventional and hybrid transmission families, there were at least 74 unique engine family/transmission family configurations. Moreover, most of these configurations are used in multiple regulatory classes which, per the test configuration proposal, would result in approximately 140 test configurations assuming a single calibration for each configuration and approximately 260 transmission family/maximum gear/engine family regulatory combinations assuming a single calibration for each configuration. Factoring in shift related calibrations, the number of unique test configurations would easily exceed 1,000. It is clearly not practical or cost-effective to conduct this level of powertrain testing each year. Thus, in order to limit the testing required, a likely result would be a reduction in consumer choices regarding vocational vehicle configurations. [EPA-HQ-OAR-2014-0827-1284-A1 p.23]

Altogether, it is critically important that GEM be reasonably accurate so the majority of vehicle configurations can be certified without powertrain testing. As discussed elsewhere in Section III, GEM does not accurately assess multiple features of ATs; this lack of accuracy creates a market disadvantage both by misinforming potential customers regarding the performance of ATs and literally “forcing” Allison to conduct powertrain testing in order to provide more accurate information regarding the performance of transmissions. In sum, Powertrain testing should be a tool that is used primarily for highly integrated powertrains that perform significantly better than non-integrated powertrains. It should

not become the de jure or de facto certification methodology. [EPA-HQ-OAR-2014-0827-1284-A1 p.23]

EPA and NHTSA must recognize that the net result of imposing powertrain testing requirements or including explicit or implicit incentives for such testing in the final rule could severely limit customer choices. This is because manufacturers seeking to avoid additional testing would have strong incentives not to specifically design systems that would either require powertrain testing or need such testing to properly account for emission improvements or efficiency gains. One concrete example of this is the Allison hybrids that are sold in transit buses. Based on the powertrain family definition, there would be 6 powertrain families to cover 2 hybrid models that work with 2 engines and are sold in Class 7 and Class 8 vehicles.<sup>43</sup> Based on our current annual volume, doing 6 unique powertrain tests would result in a cost over \$1000/unit, not covering the investment required for a powertrain test capability. Therefore, in order to better compete on price in the marketplace, a manufacturer might eliminate an offering to effectively reduce the need for powertrain testing, potentially at the expense of additional CO<sub>2</sub> reductions. [EPA-HQ-OAR-2014-0827-1284-A1 p.24]

#### EPA and NHTSA Have Underestimated Costs of Powertrain Testing

Based on the Proposed Rule's estimate of \$70,000/test and the 140 unique powertrain configurations as described above, Allison estimates that it would need to bear an annual expense of at least \$9.8 million just to test a single calibration for each configuration. Assuming one test facility and 3 tests per week, it would further require an entire year to test the 140 configurations. [EPA-HQ-OAR-2014-0827-1284-A1 p.24]

It is also unreasonable to assume a single calibration for each configuration would be acceptable so the costs would be even higher. The ability to accomplish such a testing regimen is unlikely due to test throughput, engine and transmission availability, and calibration readiness. Moreover, this level of testing would force many final powertrain configurations to be completed at least one year in advance of sales for the following year and force capital investment for multiple powertrain test cells. [EPA-HQ-OAR-2014-0827-1284-A1 p.24]

The vocational vehicle industry is highly horizontal. While the vehicle is configured by the vehicle OEM, the transmission and engine are often calibrated by the specific component supplier. Stock trucks are often built and configured to a specific vocation when sold from the dealer lot. Currently, the transmission reconfiguration is handled by the transmission supplier via their systems and tools. This will no longer be possible for powertrain tested configurations. Since the vehicle OEM factors the specific vehicle/transmission/calibration into their overall greenhouse gas compliance, they must approve and potentially manage calibration changes which will be a significant constraint to the industry and could ultimately eliminate stock truck sales. [EPA-HQ-OAR-2014-0827-1284-A1 p.24]

In the RIA Section 7.1.1.2, EPA has estimated that 11 powertrain test cells would be either constructed or upgraded. A second assumption is that 3 large manufacturers would each conduct 20 tests/year. It does not appear logical that 8 manufacturers would invest in the test capability and then not conduct a powertrain test. This puts into question the estimated costs of compliance or the assumptions regarding the frequency of powertrain testing. [EPA-HQ-OAR-2014-0827-1284-A1 p.24]

EPA has also assumed that 70% of vocational vehicles will undergo a powertrain test in 2027. Based on the 140 powertrain families (without shift calibrations) in our current product portfolio, Allison does not believe the assumption that 70% of vocational vehicles in 2027 could be achieved by conducting only

20 powertrain tests/year. Given this low estimate of the number of tests required, EPA and NHTSA's estimates of resulting costs are therefore flawed. [EPA-HQ-OAR-2014-0827-1284-A1 p.25]

#### EPA and NHTSA Should Not Replace Powertrain Testing with European Union Efficiency Test

One concept that industry has suggested that EPA and NHTSA should explore is allowing manufacturers to input the European Union ("EU") transmission efficiency data into GEM. Transmission efficiency data will be required for the EU Regulatory program either through transmission testing or extremely conservative calculations. [EPA-HQ-OAR-2014-0827-1284-A1 p.34]

Allison believes that fuel efficiency improvements that will be validated through powertrain testing will primarily come from the integrated controls of the engine and the transmission. Since transmission gear boxes are already relatively mechanically efficient, improvements in transmission efficiency will have a minimal effect on fuel consumption when compared to controls integration which determines where the engine operates in a given duty cycle. Allison also believes the overall testing costs of EU efficiency testing will not be less than powertrain testing due to Type Approval Authority involvement, long test duration and the quantity of transmission families. [EPA-HQ-OAR-2014-0827-1284-A1 p.34]

Allison is also concerned about the administrative burden that would be associated with compliance with both EU and US rules. Specifically, family definitions, alignment of certification calendars/frequency of testing, running changes, conformity of production and audits are areas where manufacturers would have manage the two extremely different regulatory programs. [EPA-HQ-OAR-2014-0827-1284-A1 p.34]

In summary, Allison believes that powertrain testing is a viable methodology to validate the GHG emissions/fuel efficiency of a powertrain and it should remain in Phase 2. The optional EU transmission testing is burdensome and offers only a minimal benefit, if such exists, when compared to the powertrain test. Therefore, Allison believes that EPA and NHTSA would be justified in relying solely on powertrain testing for validation. [EPA-HQ-OAR-2014-0827-1284-A1 p.34]

#### EPA Should Amend Proposed 40 C.F.R. 1037.231(b) Criteria for Powertrain Families

EPA and NHTSA are proposing to group powertrains in the same powertrain family if they share all of 11 different attributes. Allison is supportive of the attributes that have been defined in the proposed regulatory text to differentiate powertrain families. There are areas of the proposed regulations, however, that could benefit from further definition in order to increase the clarity of the Final Rule. Therefore, within the final regulatory text, the agencies should: [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

(1) Specify the type (and thereby the number) of clutches the proposed 40 C.F.R. 1037.231(b)(3) regulatory text refers to (e.g., starting clutches, friction plate clutches, dog clutches, torque converter lockup clutch, etc.). [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

(2) Specify the type of clutches in 40 C.F.R. 1037.231(b)(4) based on the clarification above in (1); [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

(3) Clarify that there are additional permissible architectures beyond those that are proposed in 40 C.F.R. 1037.231(b)(6)(i)-(iii) including combination of the identified architectures and Infinitely Variable. While this may be implied by the use of *exempli gratia* in the text of the regulatory

subparagraphs, EPA and NHTSA should not limit the type of architectures that are or may be available in future years; [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

(4) Specify the energy storage capacity and rated output of hybrid technology at 40 C.F.R. 1037.231(b)(10) and (11)). [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

(5) Clarify 40 C.F.R. 1037.231(b)(7) with respect to the number of forward gears and how this will be specified for different configurations (e.g., granny gears and secondary shift schedules).<sup>58</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

#### Comment on N/V Ratios on Powertrain Testing with CVTs

In Sections 1037.550 (h) (1) and 1037.550 (h) (2), the N/V determination appears to be on a fixed ratio gear reduction transmission. For continuously variable (CVT) and infinitely variable (IVT) transmissions that do not have a fixed engine speed at a set output speed, the procedure is not clear. Allison recommends the procedure be modified to use the lowest numerical gear that is available for a CVT or IVT transmission. Additional flexibility should be considered to allow a manufacturer to define the tire radius for the generic vehicle since there will be few axles available for some powertrains. [EPA-HQ-OAR-2014-0827-1284-A1 p.36]

#### Response to CARB Letter and Recommendations

With respect to the CARB letter on this matter, in order “to allow additional flexibility, ARB staff recommends allowing powertrain testing, as described in 40 Code of Federal Regulations 1037 as an option to chassis dynamometer testing. If this is done, we recommend that the Orange County Bus Cycle<sup>90</sup> or UDDS cycle be used, along with another test cycle that the certifying party believes to be more representative of the specific vocational duty cycle of the hybrid vehicle.” [EPA-HQ-OAR-2014-0827-1284-A1 p.54-55]

CARB further estimates chassis testing costs at \$30,000 not including vehicle pickup, delivery, or rental costs and recommends two options to relieve the cost of testing and the accessibility of test vehicles: [EPA-HQ-OAR-2014-0827-1284-A1 p.55]

1. If vehicle OEM is meeting Phase 2 GHG targets without the hybrids factored into their mix, then do not require the supplemental test. Instead, “U.S. EPA could require submittal of emission test data indicating NO<sub>x</sub> emissions are acceptable via another method, for example from Portable Emission Measurement Systems (PEMS) testing.” [EPA-HQ-OAR-2014-0827-1284-A1 p.55]

2. If vehicle OEM is making less than some threshold of hybrids (suggested number of vehicles is 500 vehicles per year) then do not require the supplemental test. Instead, “U.S. EPA could require submittal of emission test data indicating NO<sub>x</sub> emissions are acceptable via another method, for example from PEMS testing.”<sup>92</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.55]

To better understand the impact of the CARB recommendations, Allison has used the ratio method calculation (from the Attachment section of the letter) along with data from the June 2015 NREL report NREL/TP-5400-62009 “Data Collection, Testing, and Analysis of Hybrid Electric Trucks and Buses Operating in California Fleets.” In our calculations, we find that all of the hybrid vehicles cited and tested in the NREL/TP-5400-62009 study would fail the supplemental NO<sub>x</sub> test which is computed as a combination of grams of NO<sub>x</sub>/bhp-hr and grams of NO<sub>x</sub>/mile. Sample calculations are detailed in the attached table. In this regard, it is important to note that the NREL study data was collected on vehicles

that had low kinetic intensity, and that a low kinetic intensity cycle does not reflect well on the benefits of a hybrid powertrain. Allison is very interested in similar studies involving high kinetic intensity, but we are not familiar with any studies of recent model year vintage that includes that type of data. [EPA-HQ-OAR-2014-0827-1284-A1 p.55]

[Table, 'ARB Ratio Method Using Data from NREL Report NREL/TP-5400-62009 June 2015', can be found on p.56 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

When considering HD vehicles, Allison believes the ratio method presented by CARB is faulty. A more reasonable metric would be grams of NO<sub>x</sub> /ton-mile. In particular, for transit buses that are intended to displace multiple passenger vehicles (keeping such vehicles off the road in favor of large public transit vehicles), HD vehicles should be properly credited for the work being done to reduce overall vehicle-related emissions. Especially in the case of transit buses, an HD vehicle should not be penalized as if it were a single passenger commuter vehicle. [EPA-HQ-OAR-2014-0827-1284-A1 p.56]

In summary, Allison understands that CARB is attempting to rationalize hybrid NO<sub>x</sub> performance compared to conventional NO<sub>x</sub> performance at a vehicle level. Based on a lack of data to understand hybrid impacts on vehicle level NO<sub>x</sub> in high kinetic intensity applications, however, it is not possible to draw a conclusion this way, most especially with regard to a vehicle like a transit bus. Thus, implementation of the test protocol as proposed would be premature and unsupported in the record for this rulemaking. A more reasonable approach would be for EPA and NHTSA to gather additional data, conduct an analysis of the same and then, if necessary, propose a regulatory amendment that includes some factor of grams of NO<sub>x</sub>/ton-mile as opposed to grams of NO<sub>x</sub>/mile. [EPA-HQ-OAR-2014-0827-1284-A1 p.56]

#### Other Elements of CARB Memorandum

Despite recommending that EPA and NHTSA not include CARB recommendations Allison believes that understanding in-use NO<sub>x</sub> emissions concerns from HD hybrid vehicles is important to the future of the HD hybrid vehicle market. In this regard, Allison agrees with the following portions of the ARB memorandum: [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

1. Computing a supplemental NO<sub>x</sub> value for a hybrid vehicle can be done with a hybrid powertrain test. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

2. If a vehicle OEM is meeting GHG targets without considering hybrids in its vehicle mix, then a supplemental NO<sub>x</sub> test is not required. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

3. If a vehicle is produced by a low volume manufacturer, then a supplemental NO<sub>x</sub> test is not required. Allison suggests the threshold for an OEM should be 1,000 hybrid vehicles per year. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

4. Allison believes PEMs equipment should be used to gather in-use emissions data on a prescribed duty cycle, and that data should be considered for future rulemaking concerning a supplemental NO<sub>x</sub> test for HD hybrids. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

On the other hand, ARB states that a chassis dynamometer emissions test for HD truck can be run for “approximately \$30,000 per test vehicle or hybrid engine family, excluding vehicle pick-up and delivery service.” Allison disagrees with this specific portion of the memorandum. Allison testing experience suggests that the cost to conduct this type of vehicle test could be at least double the ARB estimate.



Also, in cases of delegated assembly, the cost of producing/acquiring a test vehicle of the fidelity required for this type of testing is an additional burden beyond the cost of the test itself. The ARB memo also contains the provision “in order to allow additional flexibility, ARB staff recommends allowing powertrain testing.” While that may allow flexibility, the EPA estimated cost of that testing is \$70,000 per powertrain family which is more than double the ARB estimate, albeit low, for a chassis test. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

#### CARB Recommendations Run Counter to Proposed Rule Advancement of Hybrid Technology

Allison would observe that the program that EPA has proposed to allow on-highway engines for specialty vehicles to be certified as non-road engines will provide meaningful advancement of the HD hybrid industry while maintaining a firm emissions standard. CARB’s proposal on NOx, however, appears to be directly at odds with this objective. The emission factor ratio application calculations essentially state that a given hybrid powertrain must equal -- or produce less -- NOx emissions than a conventional powertrain. But this requirement could easily result in hybrid powertrains that meet the NOx certification guidelines while at the same time emitting 25-35% more CO2 emissions. [EPA-HQ-OAR-2014-0827-1284-A1 p.57]

The underlying reason for this result is that hybrids have the tendency to cause engines to run at lower speeds than conventional powertrains. That is, the engines used in hybrids are certified on the FTP cycle which runs at speed/load points that are representative of a conventional powertrain that may have been used in the past. In the future, however, engines used in conventional vehicles with more transmission ranges will run at much slower speeds that the hybrid runs at today. It is expected that this migration to engine down speeding on all vehicles will have the side benefit of reducing NOx emissions on hybrid vehicles in use. [EPA-HQ-OAR-2014-0827-1284-A1 p.58]

Ultimately, Allison believes one solution could be changing the baseline FTP cycle to run closer to the lowered engine speed points that are commonly seen in the hybrid systems today and the conventional systems in the very near future. This kind of strategy will deliver both hybrid systems that reduce NOx as well as prepare for inevitable changes in conventional powertrains. Conversely, if changes in the test cycle are not made (and engine manufacturers choose to not optimize the SCR catalyst for the lower operating speeds of the hybrid) the hybrid manufacturer will be forced to sub-optimize the hybrid system. The sub-optimization of the hybrid will result in an estimated 20-30% reduction of the fuel economy gains associated with the hybrid system along with corresponding increases in CO2 emissions. [EPA-HQ-OAR-2014-0827-1284-A1 p.58]

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42 The RIA estimates that industry-wide costs associated with the Proposed Rule would amount to only 6 upgraded and 5 new powertrain test facilities. These are projected to cost \$16.6 million; operational costs for powertrain testing facilities would total \$4.1 million per year, based on an estimate of 20 tests per year for three manufacturers. RIA at 7-6. Allison believes that these estimates are very conservative and do not fully account for the need for parties to do powertrain testing. Outside of vehicle certification per se, the Proposed Rule would drive additional powertrain testing throughout the industry (e.g., in the development of new products, in order to ensure compliance, to quantify potential emission reductions for potential purchasers, etc).

43 This number could potentially double with a second battery offering.

58 See Section III comments regarding secondary shift schedules.

90 This cycle is also sometimes referred to as the OCTA cycle.

92 Note, it is not clear from the CARB letter as to what duty cycle would apply in the PEMS testing in either situation.

**Organization:** Bendix Commercial Vehicle Systems, LLC

We request comment on whether the agencies should consider requiring powertrain testing more broadly. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

Similar to the comments on chassis dynamometers, Bendix does not believe that the agencies should require powertrain testing in lieu of the vehicle simulation approach being proposed. It is our belief that the associated costs of making it a requirement are not understood well enough to assess the financial impact and testing standards are not fully developed. However, we do believe that the use of powertrain testing will increase and the resulting data should be able to be used as input to GEM. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

**Organization:** California Air Resources Board (CARB)

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Powertrain testing**

The NPRM requests comment on “if the generic powertrains should be modified according to specific aspects of the actual powertrain. For example using the engine’s rated power to scale the generic engine’s torque curve.” For hybrid technologies, CARB staff recommends that U.S. EPA and NHTSA consider the effect of the hybrid system, e.g., the work performed by the electric motor, on the generic engine’s torque curve. Because the electric motor is sharing some of the vehicle load requirements, the engine torque map will be altered from its designed targets for similar total power requirement, at least for some operating regimes. If this is not properly accounted for by the powertrain testing procedures, inaccurate fuel economy and emissions test data may likely result. [EPA-HQ-OAR-2014-0827-1265-A1 p.88]

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Powertrain testing requirement**

The NPRM requests comment on whether U.S. EPA and NHTSA should require powertrain testing more broadly. CARB staff supports the proposed use of powertrain testing, and also supports future further exploration of powertrain and powerpack testing for certification use. The demands on the GEM simulation will be reduced as more of the engine/transmission interaction is demonstrated by physical operation in test cells. In this fashion, the detailed engine/transmission interaction behavior will be directly captured rather than being potentially ignored by simplifying assumptions in the GEM model. [EPA-HQ-OAR-2014-0827-1265-A1 p.113-114]

CARB staff anticipates that growth in powertrain testing will act to encourage collaborative information exchange between engine, transmission, and hybrid powertrain development groups. Maximization of the anticipated GHG savings from advanced powertrains cannot be realized without engine, transmission and hybrid powertrain development groups affecting the designs of each other’s products.

CARB staff sees adoption of a powertrain testing pathway for certification as a possible incentive in this collaborative direction. [EPA-HQ-OAR-2014-0827-1265-A1 p.114]

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Powertrain testing in GEM (generic powertrain modification, transmission gear ratio scaling)**

The NPRM requests comment on whether the generic powertrains should be modified according to specific aspects of the actual powertrain, for example by using the engine's rated power to scale the generic engine's torque curve. CARB staff believes the generic powertrains should be modified with actual powertrain data and support the proposed efforts to include further experimental data into the GEM simulation. The interpolation of powertrain test CO2 data for advanced powertrains allows the real104 | Page behavior of the powertrain control algorithms and actuator responses to more fully manifest in the GEM evaluation while also minimizing testing burden and avoiding the need to divulge detailed proprietary powertrain control algorithms. CARB staff support gear ratio scaling as it is in line with including all trivially available powertrain parameters in the GEM simulations. [EPA-HQ-OAR-2014-0827-1265-A1 p.115-116]

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Hybrid charge sustaining operation - FTP or “City” Test and HFET or “Highway” Test: modifying the minimum and maximum allowable test vehicle accumulated mileage for both BEVs and PHEVs**

The RIA requests comment on modifying the minimum and maximum allowable test vehicle accumulated mileage for both BEVs and PHEVs. CARB staff agrees with SAE's test validity criterion of a 1 percent limit on net State of Charge compared to fuel energy. CARB staff agrees minimum and maximum test vehicle allowable mileage should have flexibility to account for unique usage and wear accumulation in plug-in and BEV vehicles. CARB staff recommends that deviations from the standard requirements be contingent on the certifying manufacturer submitting an engineering justification and the agency's subsequent approval. [EPA-HQ-OAR-2014-0827-1265-A1 p.120]

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38 (NREL, 2015b) National Renewable Energy Laboratory, “Data Collection, Testing, and Analysis of Hybrid Electric Trucks and Buses Operating in California Fleets - Final Report,” page 35, June 2015, <http://www.nrel.gov/docs/fy15osti/62009.pdf>.

**Organization:** Cummins, Inc.

*Cummins supports the powertrain testing option* [EPA-HQ-OAR-2014-0827-1298-A1 p.38]

The Phase 1 vehicle simulation utilized a generic, manual transmission model which did not capture the active nature of certain types of advanced transmissions such as automated manual transmissions (AMT) or automatic transmissions. For Phase 2, a powertrain testing option is proposed to evaluate the efficiency benefits of an integrated engine and active transmission system. Results of the powertrain test can be used in GEM in place of the engine fuel map and transmission model. Since both the engine and transmission contain highly complex controllers, a powertrain test recognizes the interaction between these two systems while avoiding the challenges associated with full vehicle testing and simulation. Furthermore, a powertrain test provides high fidelity measurement of fuel efficiency over powertrain

cycles and provides manufacturers with a clear path to demonstrate the benefits of optimized powertrain systems. [EPA-HQ-OAR-2014-0827-1298-A1 p.38]

The agencies proposed powertrain test in 40 CFR 1037.550 has been applied by Dykes and Dorobantu<sup>24</sup> to a HD diesel engine and AMT. Dykes and Dorobantu demonstrated the benefits of the powertrain procedure in capturing the improvements that would not normally be recognized in simulation and engine testing. Cummins supports the option of a powertrain test to evaluate GHG/FE benefits obtained from an integrated engine and transmission. [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

*Cummins supports powertrain families to limit the powertrain testing burden* [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

While Cummins is still evaluating application of the powertrain testing option, there is some concern regarding the powertrain family structure proposed in 40 CFR 1037.231. Grouping similar powertrains into a family structure, analogous to engine families, helps reduce the certification and testing burden to manufacturers. However, if 70% of vocational vehicles require powertrain testing as the agencies have estimated, then the powertrain test burden due to the number of engine and transmission combinations likely exceeds the agencies' assumptions. Cummins commits to working with vehicle OEMs, transmission manufacturers and the agencies to ensure a practical powertrain family structure is available for Phase 2. [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

*Cummins supports powertrain engines included in engine families* [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

Cummins supports allowing manufacturer's engine families to contain engines used in powertrain families, which helps minimize proliferation of engine families in Phase 2. Cummins urges the agencies to clarify: [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

- Engines used in powertrains shall be included in the engine program ABT for CO2 emissions certified over the FTP and/or RMCSET cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.39]
- Powertrain CO2 emissions levels only apply to engine ratings tested as part of the powertrain system when considering SEA and in-use testing (see 40 CFR 1036.630(a)). Engine certifications submitted with fuel maps are only liable for CO2 emissions measured using the fuel map procedures. [EPA-HQ-OAR-2014-0827-1298-A1 p.39]

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<sup>24</sup> Dykes, Erik and Dorobantu, Mihai, "Certification Test Approach for the Phase II Greenhouse Gas Regulations," Eaton Corporation, Southfield, Michigan, Technical Report, May, 2015. EPA-HQ-OAR-2014-0827-0130

**Organization:** Daimler Trucks North America and Detroit Diesel Company

- Oak Ridge National Laboratory powertrain data (EPA-HQ-OAR-2014-0827-1622, NHTSA-2014-0132-0183):

We continue to analyze these data to double-check ORNL's work, but it is not clear to us what conclusions the agencies expected us to draw from all of these data. [EPA-HQ-OAR-2014-0827-1918-A2 p.4.]

**Organization:** Daimler Trucks North America LLC

- **Powertrain or Chassis Dyno Testing:** The agencies discuss Powertrain testing extensively in the NPRM and we would like to provide our opinion. 1) We recommend the agencies completely remove the need for Powertrain testing, however, 2) if required, Powertrain testing as described risks not accurately capturing powertrain controls and shift strategy. The rule requires 9 different vehicle configurations. Of these 9 configurations, 8 are either at extremes of cycle work, or extremes of engine speed. Four are at extremes of both. While the final point may be considered a reasonable configuration, no consideration is given to a manufacturer's recommended configuration, or a manufacturer's specification guidelines on final drive ratio. This may upset a manufacturer's powertrain control strategy – In the cases of low speed, causing the vehicle to spend too much time in top gear minus 1, increasing cycle CO<sub>2</sub>. In the case of maximum speed, the powertrain may spend too much time in top gear, and frequently operate in the peak fuel consumption point. This is unrealistic, and again, elevates cycle CO<sub>2</sub>. These extreme speeds may also cause a transmission or axle to run outside of their designed operating envelope. This may mean that they run in a worse section of their efficiency maps, compounding the CO<sub>2</sub> penalty due to engine operating point and powertrain controls. Because the cycle CO<sub>2</sub> is interpolated from these points, it is likely that a manufacturer's best CO<sub>2</sub> powertrain will be estimated to have higher cycle CO<sub>2</sub> (from the interpolation) than if that particular powertrain configuration were tested. For example, if an OEM's best powertrain were designed to operate at an optimum speed between the min NTE speed and B speed, the cycle CO<sub>2</sub> measured in the powertrain test at the surrounding points would all be higher than the actual configuration. Therefore, it appears that sufficient resolution around actual configurations has been sacrificed to capture the breadth of all configurations, regardless of whether those configurations are allowed by the manufacturer. [EPA-HQ-OAR-2014-0827-1164-A1 p.64-65]

- **There is no need for powertrain testing for linehaul vehicles, rather we should be doing transmission efficiency test like the rear axle efficiency test:** We recognize that the agencies attribute a significant amount of the projected CO<sub>2</sub> reductions to using powertrain tests in order to show the benefits of engine and transmission (powertrain) integration. However, especially in the case of all tractor categories where the high speed cycles are weighted the highest we recommend that the agencies accept transmission efficiency testing in lieu of powertrain testing. Given the fact that most driving at high speeds incurs relatively few shift events, there is very little benefit to using powertrain testing as a means to show the benefits of improved shift strategies. The only exception would be neutral coast technologies which become more and more prevalent in the market. However, showing the benefits of i.e. DTNA's ECoast is very challenging on a test bench and would certainly not be feasible under the proposed Phase 2 powertrain test procedures. Similarly with vocational vehicle, a lot of the undefined "deep integration" benefit that the agencies seek can likely be found on a transmission efficiency test, in that manufacturers will be able to demonstrate improved gear efficiencies relative to those assumed in GEM. In our opinion it is more advantageous to capture transmission efficiency benefits with a dedicated transmission efficiency test than powertrain testing, because one transmission test can cover a broad range of powertrain configurations. Therefore, similar to our recommendation to align test procedures for axle efficiency with the ACEA approach we recommend aligning transmission test protocols as well. Given the global nature of the heavy duty truck industry DTNA would welcome the ability to leverage test results for global components in multiple regulatory areas of the world. [EPA-HQ-OAR-2014-0827-1164-A1 p.65]

- **Other Structures Considered: Powertrain Testing –** The agencies propose powertrain testing and request comment regarding what key attributes should be considered when defining a transmission family. 80 FR 40178. DTNA recommends against powertrain testing as it is a burdensome approach to measure the same results that GEM is well-crafted to simulate. In particular, we recommend transmission mapping to get realistic transmission inputs. This would require one test per transmission, rather than multiple tests per transmission—at least one for each engine family, likely many more as a manufacturer will not be able to get much value from the worst-case transmission and engine rating

combination. We certainly will not be able to show the “deep integration” that the agencies expect when we are required to test worst-case configurations. So we will need to test a lot of variants, at the expense of a lot of money and time. Better is to use GEM with transmission inputs. [EPA-HQ-OAR-2014-0827-1164-A1 p.66] That said, if the agencies plan to incorporate powertrain testing, DTNA recommends that EPA include variants of automatic transmission torque converters. It is understood that changing torque converter design on an otherwise identical powertrain configuration can drastically affect engine operating points, and change the cycle fuel economy. This is due in part to what gear the TC locks up in, idle torque requirements, and slip. It appears that EPA just wants to know if there is a torque converter, and where it’s located. But we are not certain. We wish to work further with the agencies to understand your request and how we can work toward transmission mapping without need to define transmission “families” (particularly for powertrain testing). [EPA-HQ-OAR-2014-0827-1164-A1 p.66]

- **Powertrain Testing** - If the generic powertrains should be modified according to specific aspects of the actual powertrain. - DTNA does not support that EPA promulgate rules that incentivize a preferred path for certification as it appears to have treated powertrain testing. 80 FR 40190. DTNA believes that full vehicle simulation using a verifiable suite of input values for key attributes is the most effective approach to Phase 2. Should EPA continue with offering the powertrain certification path, it should consider allowing manufacturers to establish the range of attributes that establish the matrix of configurations it plans to test. As manufacturers optimize their powertrain designs to specific applications, they should be allowed to configure the powertrain test matrix to closely bind the region of optimization. By doing so, the manufacturer can improve upon interpolation error that could otherwise be significant if the boundaries of the matrix are defined too widely as may be the case in EPAs proposed default configurations. [EPA-HQ-OAR-2014-0827-1164-A1 p.66] DTNA also questions the use of the criteria pollutant parent rating as the sole rating to establish fuel consumption characteristics for a family of ratings. It is clear that shifting patterns and engine operating speeds over a given drive cycle vary significantly with engine rating characteristics. EPA is encouraged to investigate how powertrain test results are affected as a function of engine rating. [EPA-HQ-OAR-2014-0827-1164-A1 p.66]

**Organization:** Eaton Vehicle Group

**Potential of powertrain testing:** Through prototype powertrain testing, we have data showing the incremental cost of testing is reasonable. For advanced vehicles there is no practical alternative because it is the proprietary shift logic and integrated engine-transmission controls that drive the differences between GEM-based predictions and real performance. Since the powertrain test results are a product of the engine and transmission controls, attention needs to be focused on maintaining the ability of authorized parties to modify calibrations in the field. [EPA-HQ-OAR-2014-0827-1194-A1 p.3]

**Importance of realistic GEM default values and baseline values:** GEM defaults need to be set at “slightly conservative” in all powertrain configurations. We believe there is still work to be done in choosing the default values. For transmission losses, it is important that a “slightly conservative” approach be taken so the relative ranking is preserved across different architectures. Fortunately, the EPA has developed a powertrain test capability at Southwest Research Institute and other locations, so it can collect real test data of 2015 powertrains and use this information to develop a consistent, data-driven set of MY2017 baseline assumptions and GEM defaults. [EPA-HQ-OAR-2014-0827-1194-A1 p.4]

Furthermore, we are pleased the EPA is developing a powertrain test option that accurately measures the fuel benefits of advanced technologies in realistic driving conditions. We believe that the EPA/NHTSA proposal to offer powertrain testing as an optional feature to measure the efficiencies of advanced

transmissions and powertrains is a critical expansion of its use in Phase 1 for hybrid certification. We believe the powertrain test option is an essential complement to model-based certification. The fact that the benefits of advanced transmissions and controls can be visible in the vehicle assessment, through the powertrain test option, enables OEM's to achieve compliance through these technologies, in a cost-effective fashion. Coupled with the Averaging, Banking and Trading program proposed in the rule, it offers OEMs flexibility in achieving stringent standards and allows Eaton to bring advanced technologies to the market earlier, driving further emissions and CO2 reductions on an accelerated timeline. [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

### **Value of transmissions in GEM-based certification**

Advanced transmissions, deeply integrated powertrains, and the powertrain test option, deliver a significant part of the compliance burden without significant incremental product cost, complexity, weight or vehicle architecture changes. We have provided data to the EPA showing that 25-33% of the line haul tractor compliance gap between MY2017 and MY2027 can be covered through such technologies. [EPA-HQ-OAR-2014-0827-1194-A1 p.6]

Specifically, we have compared GEM simulations and powertrain tests of identically specified vehicles. For the GEM simulation, we used the engine fuel map and for the transmission we used actual gear ratios. In the powertrain test, we looked at both a normal powertrain configuration (450 HP ISX engine and an Eaton 10-speed LAS transmission without downspeeding), as well as the deeply integrated SmartAdvantage Powertrain (ISX engine with SmartTorque 2 communicating with an Eaton FAS high efficiency 10-speed transmission with increasingly more aggressive engine downspeeding). We observed a difference on average of 6.3% (and more than 8% in a particular vehicle combination) in the powertrain test versus the GEM prediction with the identical vehicle settings and appropriate engine fuel map and default transmission model. This difference is explained by the features present in the real hardware and controls but not modeled in GEM (e.g., the specific engine dynamics and controls, the dry sump technology and advanced shift strategy in the transmission, etc). These results show that through better engine transient controls transmission controls and architecture, the integration of the two components and advanced lubrication and efficiency treatments, it is possible to cover 25-33% of the line haul tractor compliance gap between MY2017 and MY2027 (6-8% improvement on a 22-24% target improvement). These results are described in [Dykes 2015, Stoltz 2014]<sup>1,2</sup>[EPA-HQ-OAR-2014-0827-1194-A1 p.6-7]

Similarly, using the powertrain test methodology and comparing dual clutch transmissions in fuel economy mode versus incumbent technology in base mode, we have quantified the fuel advantage at 7-8%, numbers confirmed by test track tests. This shows that 33-50% of that gap in the vocational segment (14-16% improvement target can be covered by improvements in transmission efficiency and deep integration with the engine resulting in, e.g., minimizing idle losses and engine downspeeding. This value is realized assuming the GEM models are "slightly conservative" when simulating basic technologies. Specific results are presented in [Jackson 2015, Dykes 2015, Dorobantu 2014 and CBI data provided]<sup>3,1,4</sup>. [EPA-HQ-OAR-2014-0827-1194-A1 p.7]

### **Powertrain testing**

The powertrain test option is applicable to advanced vehicle features where there is no practical alternative, because it is the proprietary shift logic and integrated engine/transmission controls that drive the difference between GEM-based predictions and the real performance. Since the powertrain test results are a product of the engine and transmission controls, attention needs to be focused on maintaining the ability of authorized parties to modify calibrations in the field, within certain limits.

Without such an option, the significant impact of controls cannot be accounted for in the vehicle certification, rendering the approach useless and leading to increased cost, weight and complexity of compliance by forcing hardware-only solutions. [EPA-HQ-OAR-2014-0827-1194-A1 p.7]

### **Certification value**

As shown before, the powertrain test methodology applied to advanced transmissions and deep engine/transmission integration, can yield 6% fuel reduction in line haul tractors and 7-8% fuel reduction in vocational categories. The reductions account for engine and transmission dynamics not modeled in GEM, as well as mechanical efficiency improvements of advanced transmissions. This offers OEMs flexibility in achieving the tractor and vocational vehicle standards. [EPA-HQ-OAR-2014-0827-1194-A1 p.7]

### **Powertrain families**

We agree with the EPA's proposed definition of powertrain families and use of engineering judgment to determine the family and worst case representative. We believe that for our business, we will likely recommend splitting engine families into two groups; one with performance calibrations, the other with fuel efficient calibrations, so that the worst performing combination in each category will still provide significant certification to OEMs. We will stress that we do not believe there is significant value in powertrain testing to be applied across all powertrains. For example, using our portfolio today as a guide, we think only a few Eaton transmissions such as the FAS (as part of the SmartAdvantage package) or the Procision dual clutch (integrated with the ISB engine) will maximize the certification value through a powertrain test. For other transmissions that are mechanically more efficient than GEM defaults -such as our LAS 10-speed transmission -- we recommend a gearbox efficiency test only. Yet for another category of high performance transmissions -- the MXP 18-speed transmission, for example -- we would recommend GEM defaults. We also believe OEMs will select only higher volume powertrains for full powertrain testing, perhaps segregated into 2-3 families each. The RIA suggests that 70% of vocational powertrains will need to be powertrain tested for compliance. However, in terms of test burden, the appropriate metric is the number of distinct families that would need such testing, which needs an assessment. [EPA-HQ-OAR-2014-0827-1194-A1 p.7-8]

**Recommendation:** Continue evaluating the concept of powertrain families to assess the realistic test burden in the vocational space. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]

### **Powertrain test procedures**

We agree with the EPA description of the powertrain test procedure and we support the approach to mapping the powertrain space as a function of work and N/V ratio. We understand that the EPA is trying to define a single procedure that serves powertrain with and without the axle(s), and realizes this objective by specifying multiple tire radii. We are concerned that during a powertrain test, unrealistic an tire radius may be misinterpreted by either engine or transmission controllers resulting in erratic behavior. We believe that it is prudent to develop different (but equivalent) specifications for the powertrain test when a physical axle is present and when the axle is virtual. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]

**Recommendation:** Allow an option to use either axle ratio or tire radius for the nine vehicle configuration setup for powertrain testing. Axle ratio can be used if the physical axle is not part of the powertrain test lab. If the physical axle is part of the setup than tire radius may be used. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]



## **Powertrain cost estimates**

A significant issue around using powertrain tests is the cost of the test, assuming there is no cost in running a GEM simulation using the GEM default transmission efficiency values. Based on two years of experience with two powertrain test cells, we estimate that the unburdened incremental costs of powertrain tests are below \$10,000 for a test with an engine and a transmission that have been previously tested (i.e., fixtures, wire harnesses, etc. already exist), below \$15,000 per test with a previously tested engine but new transmission family, and below \$20,000 when a new engine is tested. The differences in costs are driven by the need to create new fixtures, harnesses, etc., and to calibrate the test cell. We have provided the EPA with a detailed cost analysis based on actual expenses [CBI data provided]. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]

At Eaton, we have converted an engine emissions test cell as a medium-duty powertrain test for work under Phase 1, and a heavy-duty test cell for studying powertrain test options in Phase 2. The incremental costs of converting the cells (new simulation software and controls, replacing the engine dynamometer with a higher torque machine and additional wiring) over the cell's emissions sensing system was under \$1,000,000. We have provided the EPA with a cost analysis based on actual spend [CBI data provided]. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]

## **Calibrations issues**

There is a significant concern around the ability to perform adjustments and running changes to the transmission controller if the powertrain testing methodology is used. [EPA-HQ-OAR-2014-0827-1194-A1 p.8]

Eaton releases annually two software updates that are flashed (sometimes remotely) onto transmission controllers with the truck in the field. The bulk of these changes are bug fixes. Also, post-sale changes to the transmissions are made, mostly focused on adjusting shift durations and clutch engagement (usually not shift tables). These changes are essential to the correct functioning of the vehicle in areas such as low speed maneuverability when backing into a dock, and even to improving vehicle safety. It is important to recognize that most U.S., non-vertically integrated OEMs are not currently aware of these changes which are usually the responsibility of independent suppliers of engines, transmissions, and soon axles. [EPA-HQ-OAR-2014-0827-1194-A1 p.8-9]

Since the powertrain test results are a product of the engine and transmission controls, attention needs to be focused on maintaining the ability of authorized parties to modify calibrations in the field within certain limits. Without such an option, the significant impact of controls cannot be accounted for in the vehicle certification, rendering the approach useless and leading to increased cost, weight and complexity of compliance by forcing hardware-only solutions. The issue is not dissimilar to engine calibration adjustments, recently reported in the press to actually drive less fuel consumption by allowing fleets to optimize stock engine parameters. [EPA-HQ-OAR-2014-0827-1194-A1 p.9]

We believe the EPA is trying to avoid situations where OEMs might sell a "fuel economy package" and account for a significant CO<sub>2</sub> credit at the sale, but then other parties change the calibration to "performance" which may impact adversely the CO<sub>2</sub> emissions. [EPA-HQ-OAR-2014-0827-1194-A1 p.9]

**Recommendation:** The EPA considers a range of options. Willfully changing from a "fuel economy calibration" to a "performance calibration" during the regulatory useful life of a vehicle certified with powertrain tests would be illegal resulting in the agency having significant enforcement opportunities in

such unlikely scenarios. However, a constant re-testing of new settings or adopting a worse-case situation would also defeat the goals of the regulations. A compromise but clearly articulated solution based on either experience in light duty CAFE with multiple powertrain settings (“comfort” versus “sport” versus “eco” modes), and/or agreed upon limits in which adjustments can be made without re-testing, should be established by the EPA in the final rule. [EPA-HQ-OAR-2014-0827-1194-A1 p.9]

### **Importance of grade sensors**

Modern transmissions have grade sensors and load sensor or estimators to determine the appropriate shift points. These tend to be proprietary algorithms as they dictate the quality and the feel of the shifts. A limitation of the powertrain test is that it cannot physically reproduce grades, and in some cases the load information is external to the powertrain (e.g., a vehicle level data and estimate). Grade is not important in the ARB cycle, but we have seen that it does make a substantial difference in the 65mph and 55mph cycles with the +/-2% grade proposed in the NPRM. Should that grade increase as the agency is suggesting up to +/-5% grade, the grade sensor data becomes a very significant part of the powertrain test. In our experience, the grade sensor is implemented as a pendulum and its readings are corrected for vehicle acceleration. Thus, in a test it will compensate for acceleration, tricking the controller into assuming a steep grade which will result in wrong gear selection. [EPA-HQ-OAR-2014-0827-1194-A1 p.9]

**Recommendation:** The EPA should allow the powertrain vehicle simulation to feed the simulated grade directly to the transmission controller, e.g., through an additional CAN signal, and allow a test version of the controller to accept that data instead of using its internal grade sensor. [EPA-HQ-OAR-2014-0827-1194-A1 p.9]

### **Simulated transmissions**

An idea developed in the industry is to perform powertrain testing on an engine test stand with simulated transmission behavior. We do not agree with this approach for several reasons: First, the powertrain test should be used to give credit to transmission controls and integrated engine/transmissions controls. If the transmission is replaced by a model controller, that purpose is defeated. Second, the powertrain test is meant to reward advanced transmission technology which would not be seen in such a test. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

A variant of this request would be to run a transmission mechanical model in GEM, but replace the transmission logic with the actual transmission controller in a hardware-in-the-loop setting. Such an endeavor is feasible in development centers and the engine transmission communications would be captured by such a test. However, the controller-in-the-loop needs to be validated that it is functioning correctly, communicating with sensors, and correctly putting loads on simulated actuators. The validation of such an approach for regulatory reasons is open to interpretation and its interfaces are extremely complex. It could be argued that the powertrain itself is in fact hardware-in-the-loop and open to the same validation issues. That, however, is not the case because the powertrain has simple interfaces with the rest of the vehicle: CAN bus communications, one load at the prop-shaft, and a few well known electrical accessory loads. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

**Recommendation:** The EPA should not implement a simulated transmission in a powertrain test. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

### **GEM default values and baseline values**

## **“Slightly conservative” GEM default efficiencies**

GEM defaults need to be set to being “slightly conservative” in all powertrain configurations. As an objective measure, we recommend defining “slightly conservative” GEM predictions relative to a powertrain test of an identically configured vehicle using the steady state engine fuel map and corresponding gear ratios. [EPA-HQ-OAR-2014-0827-1194-A1 p.13]

The behavior of the GEM transmission model is mainly driven by the power-loss models and the assumed shift controls. We believe there is still work to be done in choosing the efficiency default values. For transmission losses, it is important that a “slightly conservative” approach be taken so the integrity of the certification process is maintained. This is further complicated by the fact that there are fundamentally two different transmissions architectures available in GEM that have different modeling assumptions. [EPA-HQ-OAR-2014-0827-1194-A1 p.13]

Data that the EPA shared recently with EMA and other powertrain manufactures is encouraging in terms of the correct ranking between architectures. The earlier version of GEM had significant issues with the relative ranking of various architectures in GEM versus their relative ranking in real world conditions or on the powertrain test. For example, when simulating in GEM for the Precision DCT and the automatic transmissions without fuel efficiency calibrations, were ranked as shown in the figure below where the measured quantity is g/ton-mile. However, the powertrain test results and the test-track simulation results showed the exact opposite trend. Furthermore, the effect of downspeeding the powertrain by simulating increasingly higher speed axles was correct for the DCT, AMT and MT architectures, but incorrect for the AT architecture. [EPA-HQ-OAR-2014-0827-1194-A1 p.13]

[Figure 2, 'An early version of GEM simulations where the results are counter to physics and hardware test data', can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1194-A1]

We also have data that shows that GEM is “optimistic” in terms of fuel consumption, rather than the needed “slightly conservative” even for manual and AMT transmissions. [EPA-HQ-OAR-2014-0827-1194-A1 p.14]

We have compared a few configurations using the early publicly available GEM version, as well as accessing computations with later development code shared by the EPA with the EMA and other industry participants. Our findings are as follows: [EPA-HQ-OAR-2014-0827-1194-A1 p.14]

There are modern transmissions on the market with the overall efficiencies of 98% in direct and 96% in other gears [CBA data provided]. [EPA-HQ-OAR-2014-0827-1194-A1 p.14] There are significantly more mechanically efficient transmissions, such as the Eaton LAS 10-speed and the FAS 10-speed. Recognizing the contributions of such transmissions through either a powertrain test or overwriting the GEM defaults as described above provides an impetus to the industry to improve the technology. In the case of LAS, the GEM defaults understate the fuel consumption between 0.7% and 6.0% versus powertrain testing using different axle ratios at 55 mph and 65mph simulations with a slight grade (i.e., GEM is too optimistic instead of conservative in its fuel consumption predictions). Some of that difference is attributable to differences in shift controls and some is due to the loss model. However, these results point to a methodology to objectively tune GEM to “slightly conservative” predictions. [EPA-HQ-OAR-2014-0827-1194-A1 p.14] On the contrary, artificially inflating the default efficiencies removes the compliance incentive for better efficiency and would allow less efficient transmissions to claim fuel efficiency that is not real-world, defeating the purpose of the certification. [EPA-HQ-OAR-2014-0827-1194-A1 p.14] It is also critically important to establish a realistic baseline for the regulations using the GEM models, even if the relative change in stringency remains unchanged. We

agree with the EPA assessment that changing the standards numerical values (that are dependent on GEM tuning and choice of grade profiles in the duty cycle), while maintaining the relative stringency change in MY2021, MY2024 and MY2027 does not change the analysis of technology paths, their cost or their impact. However, it is important that the baseline is realistic because of the ability to compare against powertrain tests. [EPA-HQ-OAR-2014-0827-1194-A1 p.14]

If the baseline is too high, the standards will be automatically achieved by a simple exercise of GEM which defeats the purpose of the rule. If the baseline is too low, the standards become impossible to achieve in any powertrain test setting. Fortunately, the EPA has developed a powertrain test capability at Southwest Research Institute and other locations allowing it to collect real test data of MY2015-16 powertrains and to use these to develop the MY2017 baseline assumptions. In this way, the GEM model does not need to be tuned to road data but rather to very repeatable tests, strictly equivalent GEM, that exercise real powertrains. [EPA-HQ-OAR-2014-0827-1194-A1 p.14]

**Recommendation:** to resolve the issues of realistic baselines and “slightly conservative” GEM defaults, the EPA should consider selecting a few representative powertrains for the 2017 baseline whose performance settings are typical in the market today, and then use the SWRI powertrain test capability on vehicle configurations such that: [EPA-HQ-OAR-2014-0827-1194-A1 p.14]

GEM is tuned to reproduce the ranking of different transmission architectures when exercised over the same engine and vehicle, to avoid creating a “pull” for any particular technology based on GEM modeling assumptions and simplifications. [EPA-HQ-OAR-2014-0827-1194-A1 p.15] Ensure that GEM results are “slightly conservative” on the configurations where advanced transmission controls or deep engine/transmission integration are either nonexistent or disabled (e.g., fuel efficiency calibrations), and the degree of under-prediction is consistent across different transmission architectures. [EPA-HQ-OAR-2014-0827-1194-A1 p.15]

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1 Dykes, E., Dorobantu, M. (2015) ‘Certification Test Approach for the Phase II Greenhouse Gas Regulations’, Eaton Technical Report, Powertrain working group, May 2015 (also on EPA Phase 2 docket: EPA-HQ-OAR-2014-08270130)

2 Stoltz, T., Dorobantu, M. (2014). ‘Transmission potential to contribute to CO2 reduction: 2020 and beyond line haul perspective’. ACEEE-ICCT workshop. Washington, DC. July 22

3 Jackson, G.A. and Palazzolo, J.J. (2015) ‘Fuel economy and performance improvement enabled by medium-duty dual clutch transmissions’, Int. J. Powertrains, Vol. 4, No. 3, pp.243–262

4 Dorobantu, M. (2015) ‘Special Issue on Advanced Powertrain Testing Methodologies for Fuel-Efficient Commercial Vehicles - Editorial’, Int. J. Powertrains, Vol. 4, No. 3, pp.191–195

**Organization:** Eaton Vehicle Group

We believe that the following characteristics are critical to the success of GEM as a tool and to realizing the improvements envisioned by the rule in an efficient way for the industry: [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

- GEM needs the flexibility to include data-driven models as technology advances, so that GEM does not become a barrier to introducing new products. Powertrain test-based models and transmission power loss models are excellent options. [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

- GEM test cycles need to be representative of real-life operations, and it is critical that GEM exercise the largest part of the powertrain modes. We believe the agency has developed a data-based approach that is statistically significant and achieves the needs [EPA-HQ-OAR-2014-0827-1875-A1 p.1]

### **Representation of powertrain technologies in GEM**

Eaton has performed a number of simulations using GEM in both tractor-trailer and vocational vehicle mode. We noticed the following trends: [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM correctly captured the effects of downspeeding engines through the combined effects of transmissions and axle ratios. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM captured correctly the effects of gears designed for more down-spiced operations [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM captured correctly the differences between major transmissions architectures. For example, the impact on predictions of CO2 emissions of automatic, dual clutch and AMT transmissions are consistent with differences observed in powertrain tests or fuel tests when these technologies are compared. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM captured correctly the impact of neutral-idle and start-stop technologies on automatic transmissions. When applied to automatic transmissions, they reproduce the effect of such transmissions to gain fuel efficiency and approach the efficiency of AMT and DCT transmissions with similar gear ratios. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

### **Powertrain and efficiency test methodology**

We have performed experiments with the powertrain test methodology outlined by the EPA, and have evaluated the applicability and consistency of the results. We have established that the powertrain test is reliable in predicting the performance of real transmissions and integrated engine-transmissions. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- The methodology for deriving the powertrain representation using 9 vehicle points and testing over the three cycles is sound. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM simulations based on the powertrain test data recover the powertrain performance at the design points. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- The interpolation error is reasonable when comparing the powertrain test at a different test condition and comparing with the powertrain-based GEM model at that same condition. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

### **Consistency between GEM prediction and hardware tests**

We have also evaluated the ability of the powertrain test to quantify the advantage of advanced technology over a simulation using defaults [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- GEM simulation using transmissions default efficiencies is “slightly conservative.” We compared GEM outputs with the default transmission loss model to GEM outputs that overwrote the defaults with actual measured transmission losses. The calculations show a close match in the situation of an actual transmission in the market that is not optimized for efficiency. This allows us to conclude that the GEM default transmission losses are “slightly conservative,” in the sense that they predict correctly transmissions in the market that are not optimized for fuel economy. [EPA-HQ-OAR-2014-0827-1875-A1 p.2]

- Powertrain method quantifies correctly the benefits advanced technologies. We compared GEM predictions with default losses to powertrain tests of transmissions optimized for fuel economy. We found that the difference observed is correct and consistent with both hardware tests and fleet reports. The differences observed match and quantify, the effects of better mechanical efficiency, including dry sump, optimized shift points, and optimized engine-transmission response during shifts. We observed a

less than 1% uncertainty in the matching which we attribute to uncertainty in the auxiliary load used in the GEM assumptions and the hardware tests. [EPA-HQ-OAR-2014-0827-1875-A1 p.2-3]

**Organization:** Eaton Vehicle Group

Furthermore, we are pleased the EPA is developing a powertrain test option that accurately measures the fuel benefits of advanced technologies in realistic driving conditions. We believe that the EPA/NHTSA proposal to offer powertrain testing as an optional feature to measure the efficiencies of advanced transmissions and powertrains is a critical expansion of its use in Phase 1 for hybrid certification. We believe the powertrain test option is an essential complement to model-based certification. The fact that the benefits of advanced transmissions and controls can be visible in the vehicle assessment, through the powertrain test option, enables OEM's to achieve compliance through these technologies, in a cost-effective fashion. Coupled with the Averaging, Banking and Trading program proposed in the rule, it offers OEMs flexibility in achieving stringent standards and allows Eaton to bring advanced technologies to the market earlier, driving further emissions and CO2 reductions on an accelerated timeline. [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

**Organization:** Hino Motors, Ltd.

#### 1. Cycle Average Mapping Test and Powertrain Test

With regard to the proposed test procedures on GHG emission test specified in 40 CFR part 1036, 1037 and 1065, Hino noticed some inconsistent testing frequencies from critical emission test. According to the proposal, set point frequency and validation frequency which are specified in 40 CFR part 1036.540(b)(5) and part 1037.550(1) and (k) are excessively high compared with those of measurement system response in 40 CFR part 1065.205, 1065.512(c) and 1065.514. [EPA-HQ-OAR-2014-0827-1877-A1 p.1]

[Table can be found on p.1 of docket number EPA-HQ-OAR-2014-0827-1877-A1]

As shown in the table above, we found following issues. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

1. The response timing requirement in the GHG test is considerably fast and difficult to meet with existing test cell equipment.
2. The response timing requirement in the GHG test is not consistent with that of exhaust emission test specified in 40 CFR part 1065.

Request:

The same frequency which is proven in the FTP emission test for EPA emission test should be used in the GHG certification test. [EPA-HQ-OAR-2014-0827-1877-A1 p.2]

**Organization:** Navistar, Inc.

Navistar feels the following are key areas the agencies must address: [NHTSA-2014-0132-0094-A1 p.2]

- Powertrain testing should be optional, not mandatory, and the proposed protocol should be completely revised to be more representative of customer applications. [NHTSA-2014-0132-0094-A1 p.2]

**Organization:** PACCAR, Inc.

**Proposed Powertrain Integration Testing Requirements are Far More Burdensome than the Agencies Estimate**

The proposal also would require that any running changes to powertrain test family components that have, or may have, effects on fuel efficiency and GHG emissions must undergo powertrain integration testing before the running change could be implemented. This testing burden would make implementing necessary running changes extremely difficult, if not prohibitively expensive. [EPA-HQ-OAR-2014-0827-1204-A1 p.21]

PACCAR recommends that the agencies significantly reduce the powertrain integration testing burden by reducing penetration rates for vocational stringency determination and by limiting emissions measurements in the powertrain test cell to CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>, provided that criteria pollutants (NO<sub>x</sub>, CO, THC, PM etc.) are measured and reported as part of the engine certification process. PACCAR also recommends that the agencies provide increased flexibilities that will allow needed running changes and field fixes without the delay of additional testing and will work with the agencies to develop the best regulatory approach to support this need. [EPA-HQ-OAR-2014-0827-1204-A1 p.21]

As an additional note, the agencies' early estimate is that the transmission would not be required for confirmatory and SEA testing of deep integration technologies. However, initial assessments indicate that the transmission will be needed if an SEA is performed because the engine torque output from the engine ECU does not reflect the engine performance at a given moment of time to the accuracy necessary to replicate the test without the transmission. [EPA-HQ-OAR-2014-0827-1204-A1 p.21]

**Organization:** School Bus Manufacturers Technical Council

Powertrain Testing – The agencies have proposed powertrain testing and requested comments regarding what key attributes should be considered when defining a transmission family. SBMTC recommends against powertrain testing as it is a burdensome approach to measure the same results that GEM is well-crafted to simulate. SBMTC believes the best choice is to use GEM with both separate engine and transmission inputs. [EPA-HQ-OAR-2014-0827-1287-A1 p.1]

**Organization:** Union of Concerned Scientists (UCS)

Automated manual transmissions allow for significant application for downspeeding, and some of this is captured in the updated GEM model. However, true powertrain integration can push these reductions even further by better matching torque to the vehicle's operating conditions, as evidenced by the technical report published by Eaton and submitted to the docket (Dykes and Dorobantu 2015). In this report, the SmartAdvantage powertrain achieved a 3.4-percent improvement on the line-haul cycle and a 3.7-percent improvement on the regional-haul cycle. However, the GEM model would only capture the benefits of the top-gear being downsped by about 100 rpm. [EPA-HQ-OAR-2014-0827-1329-A2 p.11]

We calculated the impact of the 100-rpm downspeeding improvement in GEM using public data on the gear steps for the two transmissions (Eaton n.d., 2015) and the 2017 aerodynamic and tire coefficients. We've considered both the 2018 and 2027 final drive ratios to bound the problem — as mentioned above, the engine speed in 2018 is much higher than a typical engine today but is the default used by the agencies to set the regulations, while the 2027 final drive ratio leads to an engine cruise speed comparable to what the SmartAdvantage powertrain was designed for. This modeling shows that GEM is able to capture between 2.0- and 2.3-percent improvement on the line-haul cycle and just 1.6 to 2.0 percent on the regional cycle, well short of the 3.4- to 3.7-percent improvement shown in the powertrain test. Using the average result, this is 1.3-percent improvement from line-haul and 2.0-percent from day cab that is not being captured, and therefore not being incentivized, under the current regulation. [EPA-HQ-OAR-2014-0827-1329-A2 p.11-12]

Powertrain integration can provide significant fuel economy improvements, particularly in transient operation. Despite significant improvements, this is inadequately captured in the GEM model, and therefore the agencies should be moving towards a regulatory approach that captures transient operation better, such as the powertrain test. Furthermore, the agencies should ensure that the GEM model is not undercutting improvements measurable by powertrain testing by over crediting performance of conventional transmissions. [EPA-HQ-OAR-2014-0827-1329-A2 p.12]

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Dykes, E. and M. Dorobantu. 2015. Certification test approach for the phase II greenhouse gas regulations. Technical report by Eaton. Docket ID no. EPA-HQ-OAR-2014-0827-0130. Online at <http://www.regulations.gov/#!documentDetail,D=EPA-HQ-OAR-2014-0827-0130>.

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**Organization:** Volvo Group

### **Powertrain Testing**

We have had neither the time nor the resources necessary to adequately evaluate the powertrain test proposal. This is particularly troubling since much of the vocational efficiency improvement is based on “deep integration” of the powertrain that can only be demonstrated via powertrain testing. This procedure requires a thorough engineering investigation as is typically done within the EMA Emissions Measurement and Test Committee in cooperation with the agencies. In addition, a procedure for performing the powertrain testing should be established in 40 CFR Part 1065. The powertrain testing requirements in 1037.550 do not clearly define the hardware requirements for the test cell. The language is vague and could allow for inconsistent interpretation across the industry. At present, we can provide only a few observations based on a cursory review, without having had the opportunity to conduct any testing whatsoever. [EPA-HQ-OAR-2014-0827-1290-A1 p.39]

We first note that available dynamometers are not rated at the very high transmission output torque levels when in the lowest transmission gears. As an alternative, we propose to simulate the vehicle operation in the lowest gears while running in the lowest gear that maintains output torque below the dynamometer limits. Since work done while at these low speed is small, the measurement impact should be minimal. Upgrading dynamometers to have full torque capability for the proposed testing would require investment on the order of \$1,000,000 per test cell. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]

In order to properly manage transmission gear shifting, it is essential to provide the necessary inputs to the transmission controller. Currently our AMT requires road grade data that is acquired via a level sensor. This input must be simulated during the test. Without this input, the transmission controller would assume widely varying vehicle mass; and shifting would not be properly controlled. In the future, the transmission will utilize learned grade data from on-board GPS to optimize shifting on hills and we would expect this input data can also be simulated during the testing. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]



In addition, the NPRM does not adequately define the test procedure. For instance, if a manual transmission were to be employed within a given powertrain family, the method of managing the testing is left largely to the manufacturer. This could result in an OEM employing a shift strategy for the test that would be un-realistic in the real world. This could serve to lessen the real-world benefit of auto shifting transmissions. At the same time, Volvo Group believes that the Powertrain Testing provision must include manual transmissions: otherwise the high power transmission efficiency benefits of manual transmissions could be misrepresented due to the forced usage of default GEM settings while less efficient technologies (i.e. torque converted automatics) may appear to offer an advantage, which is not real, but only a product of the test protocol. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]

Volvo Group notes that while there has been a substantial penetration of auto-shifting transmissions, manual transmissions will continue to play a significant role especially in certain market segments for the foreseeable future. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]

With regard to the axle, the measured axle efficiency should be an input to the powertrain test based on the results of the axle efficiency test, if available. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]

A preferred alternative to the proposed powertrain testing procedure would be an engine test wherein the engine speed and torque is managed using the transmission control strategy such that the actual engine speed and torque is matched to how it would operate in the prescribed vehicle duty cycle. Measured axle and transmission efficiency in each gear or default values could be used as an input to the test. Volvo Group has demonstrated good correlation with vehicle tests using this method. [EPA-HQ-OAR-2014-0827-1290-A1 p.40]

### **Powertrain Family Definition**

1037.231 states the definition and structure for powertrain families. The provision at 1037.231(a) (2) (7) states that the number of forward gears is a defining factor for a Powertrain Family. This largely implies that we would have to have a separate family for every transmission and engine combination and therefore no reason even to define families. This also implies that the amount of testing needed to certify using the powertrain family would prohibit the use of the procedure. Appendix 1 provides a list of transmissions currently offered by Volvo and Mack Trucks. This includes 24 different transmission offerings with unique numbers of gears and/or gear ratios. These can be paired with as many as four different engine sizes each with many unique calibrations resulting in hundreds of powertrain families, each needing to be separately tested to arrive at representative efficiency. [EPA-HQ-OAR-2014-0827-1290-A1 p.40-41]

Volvo Group believes that Powertrain Families should be defined by logical, higher order parameters, which do not over-constrain the product offering, thus promoting the usage of this method while not sacrificing accuracy. For instance, sub-families of transmissions could be created which share architecture, but do not have the identical number of forward gears or the identical ratios. The difference in emissions from two such systems would be small when operated on the regulated duty cycles. However the impact of such provisions would be large in allowing the industry to continue to offer the broad range of systems that are needed in the diverse applications of heavy duty vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.41]

**Organization:** Volvo Group

### **Powertrain Test Data**

The agencies provided extensive data from testing performed at ORNL's (Oak Ridge National Lab) heavy duty powertrain test facility along with a summary of the results. However, it is difficult to understand all the results without more background on the testing and further discussion that has not been feasible during the NoDA review timeframe. The data set does not include key details like the transmission shift control schemes, engine torque curves, engine speed and torque plots, vehicle speed plot, transmission gear, engine fuel maps, etc. that would help explain some of the unexpected results. As a result, we are at a loss to explain possible inconsistencies with the data. For example, the number of times the truck will need to shift gears during the testing has an impact on fuel consumption that will vary with vehicle weight. [EPA-HQ-OAR-2014-0827-1928-A1 p.20]

It is unclear why fuel consumption data is presented with multiple readings for each unit tested, but with no explanation for the differences in these results that vary by as much as 7% for the same test. This certainly raises the question of which measurement methods are most accurate and meaningful and why they vary so much. [EPA-HQ-OAR-2014-0827-1928-A1 p.21]

The chart copied below is a comparison of 4 drive cycles at 41T (tons) with the 2.4 FD (final drive ratio) vs the 2.64FD and the 3.36FD respectively. [EPA-HQ-OAR-2014-0827-1928-A1 p.21]

[Figure 6 can be found on p.21 of docket number EPA-HQ-OAR-2014-0827-1928-A1]

The ARB cycle (transient) will include many shifts and speed changes and thus by conventional understanding the FC will be slightly or significantly worse depending on the shift count. There is also a concern that at 41T weight, the truck may not achieve the demanded speed during parts of the cycle and will run at full throttle during that time. But without knowing the shape of the fuel map, it is difficult to determine the validity and the magnitude of the reported differences in fuel consumption. The other vehicle weights in the study (19, 22, 32 tons) all show worse fuel consumption for the ARB cycle when the 2.4FD is used as compared to the other test ratios. This seems illogical, but without the shift strategy and other data, we cannot draw a conclusion about the validity of this result. [EPA-HQ-OAR-2014-0827-1928-A1 p.21]

The chart below provides the FC (fuel consumption) trends for the various FDs and weights on the 55 mph cycle. [EPA-HQ-OAR-2014-0827-1928-A1 p.21]

[Figure 7 can be found on p.22 of docket number EPA-HQ-OAR-2014-0827-1928-A1]

Use of the lower final drive ratios (2.4 vs the 2.64 for example) will normally reduce the engine speed on the drive cycle and should result in better FC, unless the transmission down-shifts to maintain engine speed and to increase torque to the axle. The expected lower FC is reflected here to some extent. An anomaly occurs at the 19T, 2.4FD vs the 2.64FD where FC increases by 0.75%. It does not make sense that the lighter vehicle would spend more time in a lower gear than a heavier vehicle with the same powertrain. Again, without the fuel map or shift logic it is difficult to say whether there is a reasonable explanation. The general trends seem to make sense given that as the FD decreases, the engine cruise speed also decreases resulting in a greater FC benefit at the cruise condition. [EPA-HQ-OAR-2014-0827-1928-A1 p.22]

The data for the 65mph cycle again yields trends that are in agreement with conventional intuition: decrease FD ratio; reduce engine speed at cruise; and decrease FC. However, in this chart the magnitude of the FC improvement are alarmingly high, particularly at the lower weights. [EPA-HQ-OAR-2014-0827-1928-A1 p.22]

[Figure 8 can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1928-A1]

The 19T 2.4FD has a 12% FC improvement over the 2.64FD. A truck with 2.4 FD, 512rev/mile drive tires, running at 65mph, and weighing 19T will have an engine speed of 1044 rpm. Conversely, the same spec with a 2.64FD will run at 1140rpm, a difference of 96 rpm. Typically reducing engine speed by 100 rpm would result in around 2% reduction in fuel consumption, not 12%. By comparison, the 2.4FD vs 3.00FD yields an engine speed reduction of 250 rpm but only a 7% reduction in fuel consumption. Additionally, the 3.36FD shows a more than 16% reduction in FC as compared to the 2.4FD on the same weight. These values seem unreasonably high and illogical. Volvo cannot comment effectively without much more detailed data, but with the information given, these values are out of line with what Volvo would expect. [EPA-HQ-OAR-2014-0827-1928-A1 p.23]

On the ARB cycle, the data shows that the 2.4FD is significantly worse than the other FD ratios with the exception of the 41T vehicle. The near 20% FC difference on this cycle is far too high. Volvo would expect a 5-10% difference to be more reasonable. [EPA-HQ-OAR-2014-0827-1928-A1 p.23]

Although this testing provides valuable information on powertrain test variability, many of our concerns are not addressed. These include: [EPA-HQ-OAR-2014-0827-1928-A1 p.23]

- Are the results logical and consistent with field experience? From the data, there are significant inconsistencies as already noted. This raises serious concern that a vehicle specified for optimum field fuel efficiency will perform poorly on powertrain testing, or vice-versa. [EPA-HQ-OAR-2014-0827-1928-A1 p.23]
- What is the relative difference between powertrain test result and GEM simulation? This is not addressed since no comparison to GEM is provided. This is important to help us understand the need to run powertrain tests and the associated test burden. [EPA-HQ-OAR-2014-0827-1928-A1 p.23]
- What is the impact of shift logic options on powertrain test results? This was not tested or at least not reported. As a result, we don't know how programmable shift logic will be handled or its impact. This would have large impact on the number of powertrain tests that we need to run, on the limits we might need to set on operator adjustable parameters, and on our ability to reprogram transmissions to meet field requirements. [EPA-HQ-OAR-2014-0827-1928-A1 p.24]
- What is the impact of engine power and torque rating on test results? Although, a range of 400-450 hp is tested, the data is not provided in summary form. In any case, we believe a wider range of power and torque needs to be evaluated. [EPA-HQ-OAR-2014-0827-1928-A1 p.24]
- How will these results vary once the highway grade profiles are finalized? Since grade profile is as yet not firm, the testing does not address this issue. [EPA-HQ-OAR-2014-0827-1928-A1 p.24]
- What improvement in fuel consumption should be expected from powertrain integration? We are very concerned that the level of improvement presented in the data significantly overstates what can be achieved and should not form the basis for expected stringency. [EPA-HQ-OAR-2014-0827-1928-A1 p.24]

In conclusion, while the general trends from the powertrain test seem consistent with what Volvo would expect, the magnitudes of the FC differences are too large in many cases, especially where the final engine speed difference is relatively small. In some cases, the fuel consumption trend is also illogical. There may be reasonable explanations if much more detailed data were provided. Without further

investigation and explanation, Volvo is concerned that vehicles optimized for powertrain testing may perform poorly in actual applications and that the expected improvement from powertrain integration may be much greater than what can actually be achieved. In addition, we are left with little guidance as to the relative advantage of powertrain testing over GEM simulation, how many powertrain tests may ultimately be required, or the associated test burden. [EPA-HQ-OAR-2014-0827-1928-A1 p.24]

**Response:**

The agencies appreciate all the comments on the powertrain test method, including the many comments supporting the test as an optional certification path. EPA has heard the many comments on not overly relying on or incentivizing the powertrain procedure. Due to these comments the agencies have introduced the transmission efficiency test procedure. By introducing the transmission efficiency test procedure GEM can reflect the improvements to transmission efficiency across many vehicles without having to rely solely on the powertrain test. The method is particularly beneficial for the tractor sector where much of the benefit from the powertrain test was quantifying improvements to transmission efficiency. In addition to the transmission efficiency test procedure the agencies have also added the cycle average engine mapping procedure in 40 CFR 1036.540 to measure the transient fueling of the engine. With this change the benefits of improving transient fueling can be recognized without performing the powertrain test procedure, which further reduces the reliance on the procedure.

*Validation of Powertrain Procedure*

EMA's objection to the powertrain test stated below:

*The preliminary results obtained through the powertrain test are uncertain and unproven.*

The agencies have modified the powertrain procedure for Phase 2, so that the output of the tests can be used in GEM without A to B testing for a wide range of vehicle configurations. The procedure has been tested and validated with testing at Oakridge National Laboratory (ORNL), Southwest Research Institute (SwRI) and two manufacture laboratories with parent and child ratings of the engine family. This testing has shown that the procedure can be implemented to meet all the requirements of the procedure including the speed regression of the dynamometer. From this testing the agencies have shown that the procedure is repeatable and accurate for measuring the benefits from integrated powertrains. The agencies have also observed that test-to-test variability of measured fuel of the procedure has a coefficient of variation (COV) less than 0.5%, which is at a level seen for engine testing, even though the procedure is testing the transmission with its own variability in addition to the engine. The figure below shows that powertrain testing compares on an absolute basis to chassis testing, but typical COV of chassis testing of heavy-duty vehicles is greater than 2%, due to the additional variability of the driver and the tires.

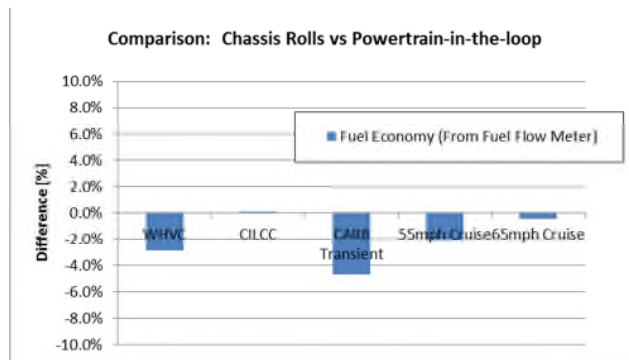


Figure 2 Comparison of chassis rolls fuel economy vs Powertrain-in-the-loop fuel economy

Regarding the use of default powertrains in GEM, the agencies have looked at this with the data collected at ORNL and have seen that GEM accurately interpolates the powertrain map even when a generic powertrain is used in GEM. The main benefit of using a default powertrain in GEM is that it gives a consistent process in GEM for all powertrains, including hybrids and transmission architectures that are not in GEM. For hybrids, the engine’s torque curve may not inform GEM of the total powertrain’s power, and for continuously variable transmissions there are no discrete gear ratios that can be put into GEM. Because of these reasons the agencies have chosen to use default powertrain parameters in GEM for vehicles that are certified with a powertrain map.

#### Powertrain testing requirements

The agencies agree that powertrain testing does add additional requirements over engine testing but our cost analysis outlined in detail in the RIA Chapter 2.9 and RIA Chapter 7.1 shows that for certain highly integrated powertrains the additional complexity and cost is justified by the benefit of being able to show the fuel savings of integrated powertrains and hybrids. As for the comments on high torque in lower gears the agencies have seen that dynamometers that are currently used for heavy-duty engine testing can be used for light-heavy and medium-heavy powertrain testing. Through our work at SwRI we have also shown that with the addition of a relatively inexpensive water brake the typical dynamometer used for heavy-duty engine testing can be adapted to test heavy-duty powertrains.<sup>33</sup> One other thing to note on the torque requirements for powertrain testing is that the powertrain doesn’t stay in lowest gears long enough to produce the theoretical peak torque for those gears. The figure below shows the torque from the Cummins ISX - Eaton USP powertrain where the output speed is changing at different rates. In the first curve in red, the speed is defined by the vehicle model simulating a full throttle acceleration with a 30,000 kg vehicle. Comparing the peak torque of this test to a very slow ramp of 8 rpm/s the powertrain produces just over half the torque. Even when a 60,000 kg vehicle is simulated the peak torque is less than 70% of near theoretical torque of the powertrain in second gear.

<sup>33</sup> Southwest Research Institute, July 2016 “Validation Testing for Phase 2 Greenhouse Gas Test Procedures and the Greenhouse Gas Emission Model (GEM) for Medium and Heavy-Duty Engines and Powertrains.”

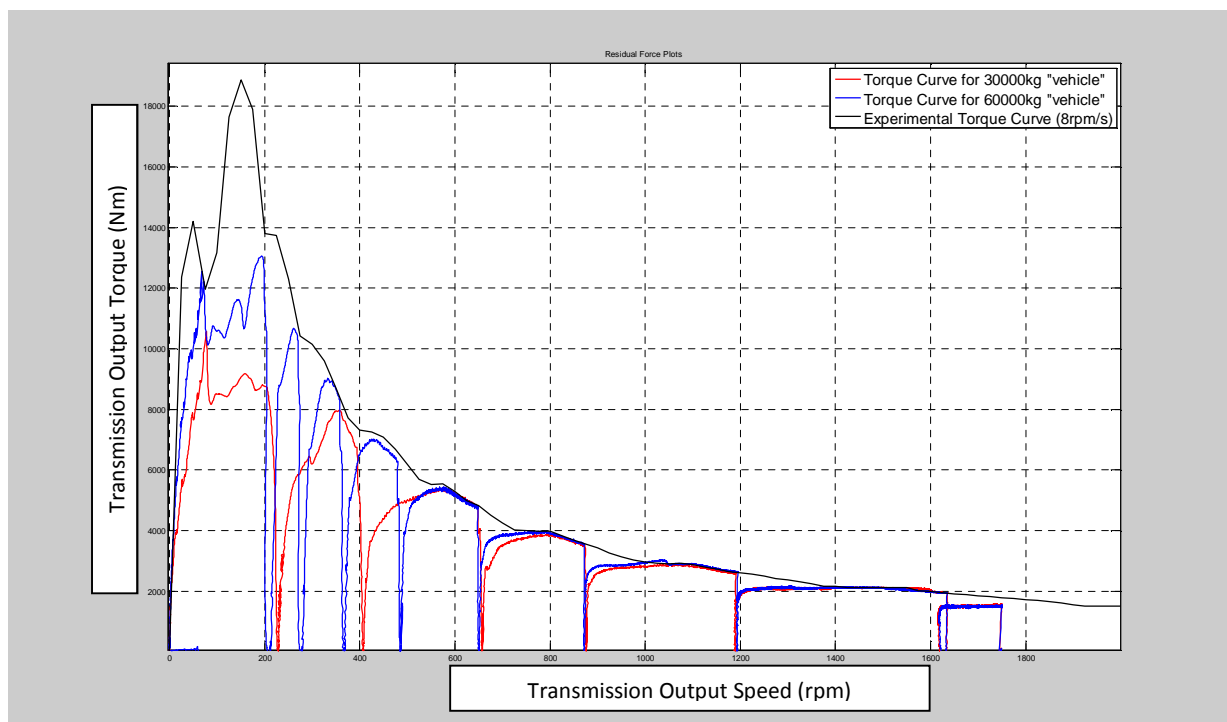


Figure 3 Comparison of theoretical torque to measured torque

#### Cost of powertrain testing

See Section 6.3.3.2 for responses to comments on costs of powertrain testing for vocational vehicles.

#### Updates to powertrain procedure from proposal

Navistar's comment on generic vehicles:

*The first issue, and likely the most complicated to resolve, is the selection of the generic vehicles with which to test in a powertrain dynamometer.*

Since the proposal the powertrain procedure has been updated to allow the manufacturer to choose the range of axles and tire sizes to test the powertrain with, to cover the full range of axles and tires that will be install on the vehicles with the powertrain. This will eliminate the problem of extrapolation while not requiring the powertrain to be tested with axles and tires that are not used with the powertrain in-use.

The agencies have also clarified 40 CFR 1037.550 to say that the vehicle model in the test cell shall run at a minimum of a 100 Hz but the dynamometer control frequency has to run at a minimum of 5 Hz.

As for the control frequency of the cycle average test procedure 40CFR 1036.540, the agencies thank you for your comment but are finalizing 10 Hz for both the cycle and the cycle validation. This is because the cycle is generated using GEM where the torque and speed change at rates of 10 Hz and higher due to transmission gear shifting and driver dynamics.

Eaton's comment on sending grade signal to powertrain controllers:

*The EPA should allow the powertrain vehicle simulation to feed the simulated grade directly to the transmission controller, e.g., through an additional CAN signal, and allow a test version of the controller to accept that data instead of using its internal grade sensor.*

EPA agrees with Eaton's comment that signal from the duty cycle including road grade should be sent to the powertrain controller if the data allows the powertrain to operate in a way that better reflects how the powertrain operates in-use.

#### *Powertrain Family definition*

Navistar's comment on family definition:

*Secondly, the family structure is ambiguously defined.*

Based on all the comment received, the agencies have concluded that the powertrain family definition is appropriately defined after the clarifications to clutch type.

Allison's comment on the number of families:

*Finally, excessive powertrain testing could occur. For example, under the proposed regulation, Allison conventional planetary on-highway products would be classified into 10 unique transmission families. Allison hybrid transmissions would be classified into 6 unique hybrid transmission families. In 2014, in North America, Allison transmissions were used with over 30 different engine families. Thus, in combination with conventional and hybrid transmission families, there were at least 74 unique engine family/transmission family configurations.*

After review all the comments on the penetration rates of powertrain testing and with the addition of the transmission efficiency test procedure the agencies are projecting lower penetration rates of powertrain testing. See chapter 2.9.3 of the RIA for the detailed discussion on penetration of powertrain testing. The amount of testing is reduced by allowing manufacturers to override the default transmission power losses by performing the test defined in 40 CFR 1037.565. The agencies agree that the transmission efficiency test has comparable cost to the powertrain procedure but the results from the test are not limited to one engine family so the overall cost is significantly less than powertrain testing for transmissions that are paired with many engines.

With regard to Cummins comment "*Powertrain CO2 emissions levels only apply to engine ratings tested as part of the powertrain system when considering SEA and in-use testing (see 40 CFR 1036.630(a)). Engine certifications submitted with fuel maps are only liable for CO2 emissions measured using the fuel map procedures.*" the agencies have clarified in 40 CFR 1036.230 that an engine family can be divided into subfamilies where only the fuel map or powertrain map are certified with the applicable subfamily. 40 CFR 1036.630 has also been updated to clarify that SEA and in-use testing will only be done with the applicable test procedures (40 CFR 1036.535, 40 CFR 1036.540 or 40 CFR 1037.550) that apply to the subfamily.

With regard to Cummins comment, "*Engines used in powertrains shall be included in the engine program ABT for CO2 emissions certified over the FTP and/or RMCSET cycles.*" the agencies are not allowing powertrain results certified under 40 CFR 1036.630 to be included in the engine ABT program for CO2. This is because powertrain results generated according to 40 CFR 1037.550, are used for vehicle certification and not engine certification over the FTP or RMCSET cycles.

#### *Modifications to calibrations*

Eaton's comment on running changes to calibrations:

*There is a significant concern around the ability to perform adjustments and running changes to the transmission controller if the powertrain testing methodology is used.*

The agencies share Eaton's concern that using the powertrain test option should not limit the manufacturer's ability to make running changes to the powertrain's calibration that don't effect fuel consumption. The agency has and will continue to work with manufacturers to streamline the process for these types of changes to the powertrain calibration.

#### *Definition of powertrain N/V and work*

For the powertrain procedure, N/V is defined by the axle ratio and tire size, because the main benefit of performing the powertrain test is to get credit for the shifting strategy of the integrated powertrain. If engine N/V is used then GEM determined N/V would be used to interpolate the powertrain map. For a powertrain that up-shifted early to operate the engine at lower engine speeds than in GEM, GEM would still be interpolating the powertrain map at the higher engine speed of the simulation. This problem becomes even more evident for hybrids where the engine N/V in GEM has no connection to the engine N/V in the powertrain procedure because GEM doesn't model hybrids. For similar reasons work has also been defined at the output of the powertrain, so that the losses of the transmission in GEM do not affect how the powertrain map is interpolated. Using the output of the powertrain also simplifies the measurement since the speed and torque measurements during that powertrain test are made at the dynamometer.

#### *ORNL Test Data*

The agencies thank commenters for comments with regard to the test data that was submitted with the NODA. The agencies have docketed the final report that covers the details of how the data was collected. The title of the report is "Powertrain Test Procedure Development for EPA GHG Certification of Medium- and Heavy-Duty Engines and Vehicles."

#### *Powertrain testing of manual transmissions*

The agencies are not allowing the powertrain procedure to be used for manual transmissions because the main purpose of the powertrain method is to recognize the integration of the transmission and engine. For improvements to the efficiency of manual transmissions the transmission efficiency procedure can be used.

## **2.5 Production Vehicle Testing for Comparison to GEM**

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

**Comment – Annual production vehicle testing for comparison to GEM requirement, chassis dynamometer testing (cost and efficacy)**

The NPRM requests comment on the proposed testing requirement for annual production vehicle testing. CARB staff supports requiring annual production vehicle testing, but wants to encourage sufficient chassis testing across the variety of vehicle types to verify that the GEM model remains robust over time in the face of shifting vehicle and engine technologies. CARB staff also prefers that the range



of technologies be represented rather than just those technologies present on the highest volume vehicle models. Restriction to only the highest volume models could blind this GEM evaluation to a large aggregate fraction of vehicle sales that will never individually rise to the popularity level necessary to qualify for chassis testing under the current vehicle selection criteria. CARB staff prefers there be some representation of non-highest-seller vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.116]

The “configuration” language is ambiguous. This GEM evaluation would be best served by spreading the sparse testing across five vehicle configurations that differ from each other as much as possible (transmission type and gearing, engine size, axle ratios, etc.) while selecting from widely used configurations. CARB staff seeks to avoid a situation where the meaning of a “configuration” is interpreted so strictly that all 12 most popular configurations, from which a manufacturer is allowed to select, may be essentially the same configuration with near trivial differences from GEM or actual GHG perspectives. [EPA-HQ-OAR-2014-0827-1265-A1 p.116] To address the concerns above, CARB staff recommends amending the regulatory language as described below: [EPA-HQ-OAR-2014-0827-1265-A1 p.117]

**§ 1037.665 In-use tractor testing.** perform in-use testing as described in this section.

(a) The following test requirements apply beginning in MY 2021:

1 or more models that you project to ~~be among~~ **represent the diversity of** your 12 highest-selling vehicle configurations for the given year.

This tractor based GEM evaluation avoids the vehicles most likely to stress the GEM model’s assumptions. Particularly avoided are vocational vehicles in heavily transient applications such as urban buses and solid waste collection vehicles, and vehicles with complex engine/transmission interactions such as advanced powertrain hybrids. CARB staff sees widespread deployment of electrified vocational vehicles (including hybrids) as central to meeting our GHG reduction goals thus lending importance to planning for their inclusion in future GEM model evaluations. CARB staff would prefer to see some representation of vocational and other non-tractor heavy-duty vehicle categories where the GEM model assumptions may not hold as well as for classic tractor vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.117]

The NPRM requests comment on the costs and efficacy of the requirement for manufacturers to annually chassis test three sleeper cab tractors and two day cab tractors and submit these data and GEM results. CARB staff feels that this testing requirement for comparison to the GEM model gathered from across the heavy-duty vehicle market is important for maintaining confidence in the certification simulation method as vehicle technology evolves. The limited amount of annual testing per manufacturer appears financially and operationally manageable while also providing an aggregate industry-wide dataset needed for evaluating correlation of actual emissions with GEM simulation results trends. [EPA-HQ-OAR-2014-0827-1265-A1 p.117]

The financial burden and operational limitation of available facilities are both eased by the relaxation of emissions measurement equipment specifications from those typical of engine emissions certification test cells. This allows any transient heavy-duty chassis dynamometer to be used by temporary placement of a PEMS unit next to it. [EPA-HQ-OAR-2014-0827-1265-A1 p.117] CARB staff agrees that for the purposes of this GEM evaluation the reduced instrumentation requirements of Subpart J are an acceptable cost savings and open many more potential chassis testing sites for consideration. [EPA-HQ-OAR-2014-0827-1265-A1 p.117]

**Response:**

The agencies agree with the comment from CARB that the vehicles that are chosen for chassis testing should reflect not only the high volume vehicles but also potentially cover the diversity of vehicles. For this reason 40 CFR 1037.665 has been written to allow the agencies to choose which vehicles are tested.

**2.6 Use of GEM in Establishing Proposed Numerical**

**Organization:** American Automotive Policy Council

**Spark Ignition (Gasoline) GEM 2 implementation concerns**

AAPC has completed detailed analysis of the Phase 2 GEM 2b-5 gasoline baseline and has concluded the baseline assumption of CO<sub>2</sub> levels is underestimated and the resulting required improvements are overly stringent relative to other regulated segments and the agencies' stated intentions. Per the summary table on the next page, the 2017MY baseline is underestimated by 10 – 15%. Further the overall Phase 2 gasoline GEM has a total CO<sub>2</sub> reduction requirement of 29% with a required improvement of 20% in 2021MY alone. This is further exacerbated due to the lack of opportunities to build credits or phase-in to the standard prior to 2021MY. Class 2b/3 chassis certified products and planned Phase 2 GEM diesel standards appear to have been well studied and evaluated, but the Phase 2 gasoline GEM baseline and standards do not appear to have been evaluated with the same rigor. [EPA-HQ-OAR-2014-0827-1238-A1 p.31]

[Tables of GEM baseline and percent improvement offsets can be found on p.32 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

AAPC requests that the Phase 2 GEM 2017MY gasoline baseline assumptions and standards be reevaluated based on a thorough analysis of all vocational vehicles with heavy-duty spark ignition engines, and we recommend the agencies set up a working group to validate GEM model assumptions and revise as additional data becomes available. [EPA-HQ-OAR-2014-0827-1238-A1 p.32]

**§ 1036.535 Determining engine fuel maps and fuel consumption at idle**

In previous comments submitted to the docket in response to the Proposed Rule, AAPC expressed concern about the baseline assumptions and standard stringency built into the revised Greenhouse Gas Emissions Model (GEM) for Phase 2 for Class 2b-5 Vocational Vehicles. In reviewing the data associated with the March 2 NoDA, AAPC was encouraged to see that EPA and NHTSA have conducted additional testing and model development work to better characterize these vehicles. Despite these improvements, AAPC believes there are still technical issues associated with the model and test procedures that must be addressed in order to have a successful and sustainable Phase 2 program for Vocational Vehicles. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]

Highlights of the AAPC's comments are as follows:

- Since the GEM model is still under active development, AAPC recommends that implementation of the GEM-based CO<sub>2</sub> standards be postponed until 2023 to allow for public review and comment on a substantially completed GEM model. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]
- The GEM 2 default assumptions for class 2b-5 truck aerodynamics, tire size, inertia weight, and axle ratio are not correct and need to be fixed to insure the model encourages manufacturers to implement technologies with real on-road CO<sub>2</sub> benefits. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]

- The baseline heavy-duty gasoline fuel map uploaded to the docket is not representative of real spark ignition engines and should be replaced with a map derived from actual engine testing. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]
- Applying diesel-derived methodologies to spark ignition GEM vehicle categorization criteria is inappropriate. Unique spark ignition methods should be developed. [EPA-HQ-OAR-2014-0827-1898-A1 p.2]

**Response:**

Many of issues mentioned by AAPC have been resolved as indicated from their NODA comments. We also made a few changes on class 2b-5 configurations, such as CdA, Crr, and axle ratio and gasoline engine fuel map, after taking many constructive comments from public as well as many CBI from individual stakeholders. Many of these changes can be seen in Chapter 4.4.1.10 of the RIA. Please see the agencies' response to the notice and comment of GEM in RTC Section 15.5.

**Organization:** Bendix Commercial Vehicle Systems, LLC

However, we encourage others to investigate this new approach in detail, and we request comment on whether or not the agencies should replace our proposed steady state operation representation of the engine in GEM with this alternative approach. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

As the agencies are aware, there are many simplifications made when only steady state fuel maps are used to simulate the engine fuel consumption in vehicle operation. Bendix believes that the GEM3 should be made flexible enough to accept engine data that has been collected via engine dyno testing over the GEM duty cycles over a range of simulated vehicle configurations which would include transient conditions. In addition, we believe engine accessories which are typically excluded from engine testing, should be included in the data collection. Examples include the engine cooling fan, air compressor, air conditioning compressor and power steering pump. [EPA-HQ-OAR-2014-0827-1241-A1 p.2-3]

**Response:**

We have made many improvements on GEM. On the transient condition, we introduced the cycle average approach to replace the steady-state engine fuel map to better and more accurately account for transient operations. The detailed test procedure can be seen in 40 CFR 1036.540. We do not believe that it would be a simple task or even practical to include all major vehicle accessory losses, such as engine cooling fan, air compressor, air conditioning compressor and power steering pump into the engine dynamometer. Rather, we continue using the pre-defined accessory loss into GEM, as in Phase 1 GEM. However, we did take a further step to first collect the accessory power loss data from engine and vehicle manufacturers, and then implement the values into GEM.

**Organization:** California Air Resources Board (CARB)

**Support Comment**

**Comment – Fuel map requirements**

U.S. EPA and NHTSA are proposing that engine manufacturers must certify fuel maps as part of their certification to engine standards, except in cases where they certify based on powertrain testing, and that engine manufacturers be required to provide these fuel maps to vehicle manufacturers beginning with

MY 2020 engines, since MY 2020 engines may be used in MY 2021 vehicles. Vehicle manufacturers may not develop their own fuel maps for engines they do not manufacturer. For Phase 2, GEM will allow the input of engines-specific fuel maps, which will increase accuracy. CARB staff supports these requirements as stated. [EPA-HQ-OAR-2014-0827-1265-A1 p.124-125]

**Response:**

Thank you for your support.

**Organization:** Cummins, Inc.

*Cummins opposes use of a steady-state engine fuel map to provide engine information into GEM* [EPA-HQ-OAR-2014-0827-1298-A1 p.22]

The agencies are proposing that engine manufacturers provide a very detailed steady-state fuel map to vehicle manufacturers to incorporate specific engine information into the vehicle simulation. The proposed steady-state engine fuel map is flawed for at least three reasons. First, the proposal requires engine manufacturers to release trade secret and confidential business information (CBI) to the public and competitors alike. Second, the proposed steady-state engine fuel map does not adequately represent true engine performance. Third, the proposed steady-state engine fuel map potentially gives CO2 credit at the cost of NOx emissions. Cummins understands the desire to include engine performance in the vehicle program, but in order to perform that function fairly and practically, some key principles must be met: [EPA-HQ-OAR-2014-0827-1298-A1 p.22-23]

- Manufacturers' trade secrets and CBI must be protected. EPA has long recognized that manufacturers rely on EPA's regulations (40 CFR Part 2) to protect proprietary information related to engine operation, such as steady-state fuel maps, calibrations and controls information, etc. submitted to the Agency as CBI. Cummins is aware of no circumstances in which the agencies have publicly released such information claimed confidential by a manufacturer. Whether disclosed in terms of CO2 or fueling values (which are directly correlatable), the proposed steady-state engine map would provide the public and competitors CBI that EPA and manufacturers have long held secret. [EPA-HQ-OAR-2014-0827-1298-A1 p.23]

Further, engine manufacturers have historically competed on the basis of optimizing fuel economy and criteria emissions control over the operating range of the engine. Requiring disclosure of steady-state fuel maps for vehicle certification in GEM would force engine manufacturers (who are not always the vehicle manufacturer) to divulge proprietary information, well ahead of production, to competing manufacturers. Those competitors could use the trade secret information to gain an unfair advantage by exploiting the research and development efforts of the engine manufacturer rather than investing their own resources in developing and optimizing such systems. Forcing that disclosure violates the principles of market integrity that have been the cornerstone of EPA regulations for decades and reduces marketplace competition, providing a disservice to the customers. A reasonable alternative to protect CBI contained in steady-state engine maps is the cycle-average map approach discussed below. [EPA-HQ-OAR-2014-0827-1298-A1 p.23]

- The engine information should be accurate, including accurately representing transient engine performance. In order to meet the accuracy need, the engine should be evaluated in a manner consistent with how it will be used in the vehicle regulation, such as transient operation simulated across a range of vehicle configurations. The steady-state engine fuel map does not

meet this requirement. Transient engine operation is not well represented by the steady-state engine fuel map as indicated by the agencies' use of a transient correction factor and described in more detail below. The appropriateness of the transient correction factor for all engines and engine technologies until 2030 is questionable, especially considering the implementation of model-based controls in this timeframe as recognized and projected by the agencies in this proposal. [EPA-HQ-OAR-2014-0827-1298-A1 p.23]

- The CO<sub>2</sub> evaluation of the engine for use in the vehicle program should be consistent with the criteria emissions regulation protocol. If the protocol for generating credit for engine CO<sub>2</sub> in the vehicle program is not consistent with the protocol for engine regulation for NO<sub>x</sub>, then manufacturers will have an incentive to create systems that perform well on CO<sub>2</sub> at the expense of NO<sub>x</sub> when certified separately and differently for CO<sub>2</sub>. These systems will not drive both NO<sub>x</sub> and CO<sub>2</sub> control in the real world. Conversely, the cycle-average map, as discussed below, provides the opportunity in the future to re-align both transient and steady-state GHG and criteria emissions, thus addressing this issue. [EPA-HQ-OAR-2014-0827-1298-A1 p.24]

*The agencies should implement the alternative (“cycle-average”) map approach in lieu of the steady-state fuel map in the final rule [EPA-HQ-OAR-2014-0827-1298-A1 p.24]*

In the Preamble (see 80 FR 40179), the agencies request comment on replacing the steady-state fuel map with an alternative mapping approach that tests the engine over “the GEM duty cycles over a range of vehicle configurations.” The result of this testing is a set of “cycle-average map” CO<sub>2</sub> values that can be used in GEM to represent the engine. EPA has been working with a group of companies to develop and validate the cycle-average map approach, described in the Draft RIA at Section 3.10, and results show good correlation between this alternative method and experimental results (see Figure 12). Further details of the cycle-average map validation work can be found in Zhang et al.<sup>22</sup> and Salemmme et al.<sup>23</sup>. [EPA-HQ-OAR-2014-0827-1298-A1 p.24]

The use of cycle-average CO<sub>2</sub> values resolves many of the issues identified above with the steady-state engine fuel map. The benefits of the cycle-average approach are: [EPA-HQ-OAR-2014-0827-1298-A1 p.24]

- Disclosure of CO<sub>2</sub> over the cycle-average map does not expose manufacturers' CBI that would put them at a competitive disadvantage. Cycle-average test results have historically been reported to the agencies and available to the public. The CO<sub>2</sub> values from the cycle average map approach are a collection of cycle test results and can be treated the same. [EPA-HQ-OAR-2014-0827-1298-A1 p.24]
- It is more accurate. This approach is inherently testing the engine through a transient drive cycle, so the engine is operating as it will in the vehicle, with all of the transient controls in operation on realistic maneuvers. Including transient behavior in the cycle-average map approach removes the need for a transient correction factor that is necessary with the steady-state engine fuel map and the concerns and difficulty with determining the correct factor. Figure 12 compares the correlation of the two mapping approaches to the measured values. The cycle-average map approach shows good accuracy without the need for a transient correction factor. [EPA-HQ-OAR-2014-0827-1298-A1 p.25][Figure 12 can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1298-A1]
- Auditing of the cycle-average CO<sub>2</sub> values can be accomplished by using any one of the pre-defined vehicle configurations. This approach defines a clear and consistent audit test cycle for manufacturers to evaluate production variation and product improvement changes. [EPA-HQ-OAR-2014-0827-1298-A1 p.25]

- The cycle-average map provides a framework of transient engine testing that could be utilized in the future to link criteria emissions and GHG certification approaches. For example, current engine FTP and RMCSET cycles could be replaced with cycles generated using predefined vehicles, and both criteria emissions and GHG/FE engine standards could be established over these cycles. Such a change should only be undertaken if both engine criteria emissions and GHG/FE are simultaneously shifted to the new certification cycles to maintain the linkage between all engine emissions. [EPA-HQ-OAR-2014-0827-1298-A1 p.26]
- The engine cycle-average map approach utilizes a similar mapping approach as the agencies proposed for the powertrain test option. This provides consistency in the evaluation of engines and powertrains used in the vehicle program. [EPA-HQ-OAR-2014-0827-1298-A1 p.26]

The agencies have also suggested the possibility of combining the cycle-average map and steady-state engine fuel map in a hybrid approach to supplying engine information to the vehicle simulation. Cummins does not support this hybrid approach as issues with the steady-state engine fuel map, mentioned earlier, will remain (e.g., pre-production disclosure of CBI to competitors). Cummins urges the agencies to implement the cycle-average map as the sole engine mapping approach for Phase 2 in the Final Rule, and we commit to continued collaboration to refine the cycle-average mapping procedures. [EPA-HQ-OAR-2014-0827-1298-A1 p.26]

*Cummins does not support requiring a fuel map for MY20 engines used in MY21 vehicles* [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

Cummins opposes requiring MY20 engines to generate engine fuel maps. The agencies' proposal attempts to address MY mismatch between engines and vehicles that occurs in practice today. This requirement may effectively pull forward the MY21 engine standards as MY21 vehicles with MY20 engines would still be expected to meet vehicle standards that are premised on MY21 compliant engines. To account for this, vehicle manufacturers may require engine makers' MY20 engines to perform at MY21 standards to ensure vehicle fleet compliance. Similar situations will also occur at the MY24 and MY27 standard changes. Cummins is willing to work with the agencies and industry on a better remedy for MY mismatch that will not disrupt market dynamics and inadvertently pull ahead engine standards. [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

*Cummins supports the option of a generic fuel map in GEM that can be overridden by vehicle manufacturers* [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

In the Preamble, the agencies request comments on providing default GEM maps for vehicle certification (80 FR 40184): [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

*We also request comment as to whether or not the agencies should provide default generic engine maps in GEM for Phase 2 and allow manufacturers to optionally override these generic maps with their own maps, which would be generated according to our proposed engine dynamometer steady-state test procedure.* [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

Cummins supports this provision as it helps maintain the integrity of the engine ABT program. For example, an engine manufacturer can elect to certify some engines using CO<sub>2</sub> credits. Since the engine program ABT has already accounted for the excess CO<sub>2</sub> emissions, there is no need to also account for the engine CO<sub>2</sub> emissions levels in the vehicle program. Therefore, allowing a manufacturer to apply a default map would preserve the value of engine credits and ABT program. [EPA-HQ-OAR-2014-0827-1298-A1 p.41]

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<sup>22</sup> Zhang, H., Sanchez, J., and Spears, M., “Alternative Heavy-Duty Engine Test Procedure for Full Vehicle Certification,” *SAE Int. J. Commer. Veh.* 8(2):2015, [doi:10.4271/2015-01-2768](https://doi.org/10.4271/2015-01-2768).

<sup>23</sup> Salemme, G., Dykes, E., Kieffer, D., Howenstein, M. et al., 'An Engine and Powertrain Mapping Approach for Simulation of Vehicle CO2 Emissions,' *SAE Int. J. Commer. Veh.* 8(2):2015, [doi:10.4271/2015-01-2777](https://doi.org/10.4271/2015-01-2777)

**Response:**

We have made significant changes on the engine fuel map used for GEM since NPRM. First of all, as Cummins urges, the final rule uses the cycle average approach to replace the steady state engine fuel map for the transient ARB cycle in GEM runs, and allows manufacturers the option to either use the cycle average approach or steady state engine fuel maps during the simulation of the 55 mph and 65 mph cruise cycles in GEM.

Manufacturers that certify vocational vehicles to the custom-chassis standards are required to use the agencies’ default engine fuel maps, and they are not allowed to overwrite the default fuel maps with their own maps. The certification of all other vocational vehicles and tractors requires the use of the actual fuel map in GEM.

Regarding fuel map for MY20 engines used in MY21 vehicles, we have decided that it would be more appropriate to harmonize the engine and vehicle model years, starting in MY 2021 so that vehicle manufacturers will not need fuel maps for MY 2020 engines (see 40 CFR 1037.150(n) and the definition of “model year” in 40 CFR 1037.801). Thus, we are not finalizing the requirement to provide fuel maps for MY 2020 engines. However, we are requiring fuel maps for all MY 2021 engines, even those (e.g., small businesses) for which the Phase 2 engine and vehicle standards have been delayed. See 40 CFR 1036.150(n).

**Organization:** Cummins, Inc.

## **II. Engine Fuel Map Input to GEM**

### *1. Cummins supports use of a cycle average map for evaluating the ARB transient cycle in GEM in the final rule*

In the time since the proposal, EPA and manufacturers have completed significant additional testing and analysis to validate the use of a cycle average fuel map as input to the Greenhouse Gas Emissions Model (GEM) used for vehicle certification. The NODA contains some of the new data related to the cycle average approach originally described in the NPRM, including test results from Southwest Research Institute (SwRI) in EPA-HQ-OAR-2014-0827-1619 and NHTSA-2014-0132-0184 on more engine models (Cummins ISB and Navistar N13 engines) and ratings (ISB 300 and 200 hp) and comparisons of various numerical methods for using the cycle average map to predict engine fuel consumption across a variety of vehicle configurations. [EPA-HQ-OAR-2014-0827-1927-A1 p.2]

The results from SwRI and from other EPA and industry tests continue to show that the cycle average map is accurate in predicting engine fuel consumption on the ARB transient cycle and that robust numerical methods such as global regression models can be implemented in GEM. As a result, the latest version P2v2.1 of GEM released with the NODA at EPA-HQ-OAR-2014-0827-1626 and NHTSA-

2014-0132-0181 now accepts a cycle average map as the fuel map input for evaluating vehicles over the ARB transient cycle. [EPA-HQ-OAR-2014-0827-1927-A1 p.2]

As noted in our NPRM comments, Cummins supports using a cycle average map for evaluating vehicles over the ARB transient cycle in GEM in the final rule. Because the cycle average map consists of data obtained from running the engine on transient cycles, it is more accurate than using a steady state engine fuel map and removes the need for the 1.05 transient correction factor proposed by the agencies in the NRPM. The cycle average fuel map should be the only engine fuel map allowed for evaluating the ARB transient cycle. [EPA-HQ-OAR-2014-0827-1927-A1 p.1-2]

## *2. Cummins supports use of a cycle average map for evaluating the 55 and 65 mph cruise cycles in GEM in the final rule*

The latest version of GEM released with the NODA still requires a steady state engine fuel map for evaluating vehicles on the 55 and 65 mph cruise cycles. As noted in our NPRM comments, Cummins opposes the use of a steady state map due to issues such as requiring engine manufacturers to provide such trade secret and confidential business information (CBI) to competitors and the public and also poor accuracy on current and future engines. Transient accuracy can be addressed by moving to the cycle average map for the ARB transient cycle as discussed above, but disclosure of CBI is still an issue that warrants fully removing the steady state map as a required input to GEM from the final rule. The cycle average map is a reasonable alternative to address the competitive disadvantage that could result from requiring disclosure of a steady state map. [EPA-HQ-OAR-2014-0827-1927-A1 p.3]

EPA or other stakeholders have expressed the following concerns with using the cycle average map approach for the GEM cruise cycles: [EPA-HQ-OAR-2014-0827-1927-A1 p.3]

- Accuracy on child ratings
- N/V overlap on generic vehicles (where N/V is the ratio of average engine speed to average vehicle speed)
- Issues with vehicles that cannot follow the cycles
- Other needs for a steady state map within GEM

Each of these concerns will be addressed here, including presenting additional data or recommendations for resolving them such that the cycle average map can be implemented for the GEM cruise cycles in the final rule. [EPA-HQ-OAR-2014-0827-1927-A1 p.3]

### (a) Accuracy on child ratings

EPA expressed concern with accuracy of the cycle average map for child ratings for 55 and 65 mph cruise cycles based on results of the testing performed by SwRI on the Cummins ISB 200 hp rating. That analysis used the cycle average map created from the “parent” ISB 300 hp engine to simulate the performance of the “child” ISB 200 hp engine and found poor correlation between measured and predicted results for the ISB 200 on the cruise cycles. However, when Cummins compared steady state fuel maps for the ISB 300 and ISB 200, we discovered the two ratings had different fuel rates for the same speed and load points. The analysis released in the NODA did not assess the steady state map performance on the ISB child rating. Cummins’ own analysis shows that performance of the cycle average map on the cruise cycles is similar to the steady state map when the same certification process



of applying the parent map to the child rating is applied in both cases. See Figure 1 which compares the ISB 200 fuel consumption using the ISB 300 parent steady state map to the ISB 200 fuel consumption using the ISB 300 parent cycle average map. [EPA-HQ-OAR-2014-0827-1927-A1 p.3-4]

[Figure 1 can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

Another issue contributing to poor correlation is due to the vehicle configurations chosen to assess the ISB cycle average map on the 65 mph cruise cycle. Four of the six additional vehicle configurations chosen to evaluate accuracy (different from the generic vehicle definitions used to generate the map itself), shown in Figure 2, had unrealistically low axle ratios such that the vehicles did not meet Cummins recommended gearing guidelines. These unrealistic configurations are not valid vehicles to use in assessing accuracy of a certification protocol. [EPA-HQ-OAR-2014-0827-1927-A1 p.4]

[Figure 2 can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

No cruise cycle concerns were raised regarding performance of the cycle average map for the ISB parent rating. Figures 3 and 4 show good correlation associated with using the cycle average map approach for the parent ISB 300 rating on the cruise cycles. Cycle average map accuracy is as good as or better than the steady state map. [EPA-HQ-OAR-2014-0827-1927-A1 p.5]

[Figure 3 can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

[Figure 4 can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

To further evaluate child rating accuracy, Cummins recently completed testing of a Cummins ISL engine. Figures 5 and 6 again show good accuracy using the cycle average map on the parent rating, the ISL 450 hp, for the cruise cycles. [EPA-HQ-OAR-2014-0827-1927-A1 p.6]

[Figure 5 can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1927-A1]x

[Figure 6 can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

When we used the procedure which would be used in the certification process to apply the ISL 450 parent maps to an ISL 300 hp child rating, the GEM output was equivalent between the cycle average map and the steady state fuel map approaches, as shown in Figure 7. [EPA-HQ-OAR-2014-0827-1927-A1 p.7]

[Figure 7 can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

(b) N/V overlap on generic vehicles Some stakeholders have encountered issues with the proposed generic vehicle definitions used to generate the 55 mph engine cycles for populating the cycle average map with results over an appropriate range of N/V. The N/V of a lower axle ratio vehicle configuration has “overlapped” with the N/V of a higher axle ratio vehicle configuration, resulting in poor coverage in N/V space by the cycle average map. (While the lower axle ratio vehicles are included to reach lower N/V values, in some cases the lower axle ratio results in a change in shifting that causes a higher N/V which overlaps with the N/V of the higher axle ratio). [EPA-HQ-OAR-2014-0827-1927-A1 p.8]

Some revision of the generic vehicle definitions is needed. Currently, axle ratio for each test cycle is calculated based on running at 65 mph in top gear at various defined engine speeds. Those same axle

ratios are also applied in generating the 55 mph cycles. Revising the definitions to use a different axle ratio calculation based on 55 mph in top gear (instead of 65 mph) can prevent N/V overlap for the 55 mph cycle. Considering the purpose of defining generic vehicles is to develop the cycle average map over a suitable range of engine operation, revising the definitions in this way is appropriate. [EPA-HQ-OAR-2014-0827-1927-A1 p.8]

Cummins demonstrates successful use of the revised definitions in Figure 8, which shows an improvement in the range of N/V covered and no overlap compared to the generic vehicle definitions from the NPRM. [EPA-HQ-OAR-2014-0827-1927-A1 p.8] [Figure 8 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

(c) Issues with vehicles that cannot follow the cycles Other cycle average map accuracy issues can be traced to vehicle configurations that do not follow the cycle. For example, certain vehicle specifications are not geared to run at 65 or even 55 mph. Since such a vehicle is likely to be a low speed/urban vocational vehicle, the weightings of the cruise cycles would be low. These vehicles should not be used to assess cycle average map accuracy on the cruise cycles and would need to be handled uniquely for certification. The question of whether a 65 mph cycle should be used to certify a vehicle that cannot run 65 mph is valid no matter what fuel map approach is used. [EPA-HQ-OAR-2014-0827-1927-A1 p.9]

(d) Other needs for a steady state map within GEM Other arguments that have been stated for requiring an engine-specific steady state map in GEM are that it is necessary for GEM to execute shift logic or to generate the engine speed and torque cycles for cycle average mapping. Cummins has completed analysis to show that for these purposes, using a generic steady state map has minimal effect on vehicle fuel consumption or engine cycle work and N/V compared to using an engine-specific steady state map. [EPA-HQ-OAR-2014-0827-1927-A1 p.9]

Cummins ran GEM for eight vehicle configurations to compare the GEM output when the transmission used an engine-specific steady state map for shifting versus when the transmission used a generic steady state map for shifting. The two maps were different in their shapes and fuel consumption values. The maximum differences in GEM outputs for two key parameters are shown in Figure 9. There is no significant change in vehicle fuel consumption when the generic steady state map is used to execute shift logic in GEM. [EPA-HQ-OAR-2014-0827-1927-A1 p.9]

[Figure 9 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

Cummins also investigated the impact of using a generic steady state fuel map in GEM for generating the engine speed and torque cycles needed to create cycle average maps. Figures 10-12 show no significant changes in N/V or cycle work space compared to using an engine-specific steady state map. Many of the points align exactly, and any slight movement of points is inconsequential because the purpose is to generate the map, not to hit a specific target N/V or cycle work. These two analyses confirm that an engine-specific steady state map is not needed in GEM. A generic steady state map is sufficient and a reasonable alternative that would not require manufacturers to disclose CBI. [EPA-HQ-OAR-2014-0827-1927-A1 p.10]

[Figures 10-12 can be found on p.10-11 of docket number EPA-HQ-OAR-2014-0827-1927-A1]

Cummins sees no technical or policy reasons for the agencies to require a steady state fuel map as an input to GEM. Cummins is also not aware of any progress in protecting the confidentiality of a manufacturer's steady state engine fuel map. Given the unresolved issues with requiring disclosure of CBI associated with the steady state map, we urge the agencies to implement only the cycle average

map in the final rule. If the agencies do not remove the steady state map as a required input to GEM, they should at least allow engine manufacturers the option of providing a cycle average map for evaluating the 55 and 65 mph cruise cycles instead of a steady state map. With such an option, use of a generic steady state fuel map should also be allowed for executing shifting within GEM and generating engine cycles. [EPA-HQ-OAR-2014-0827-1927-A1 p.12]

Finally, using the cycle average approach to represent the engine in GEM cruise cycles is consistent with the powertrain test option, which has already been proposed to use cycle average maps to evaluate both the transient and cruise GEM cycles. [EPA-HQ-OAR-2014-0827-1927-A1 p.12]

### **III. Conclusion**

Significant progress has been made by the agencies and industry in answering open questions outlined in the NPRM and elsewhere regarding the cycle average map approach. Its accuracy has been validated across multiple engine models including child ratings. The cycle average map has been shown to be just as accurate (and more accurate in the case of transients) as a steady state map. Additionally, robust regression models have been developed for predicting points inside and outside the mapped regions, and improvements related to generic vehicle definitions and vehicles that cannot follow the cycles are being discussed. Cummins remains committed to collaborating with the agencies and industry to finalize a rule that fully and successfully implements the cycle average map approach. [EPA-HQ-OAR-2014-0827-1927-A1 p.12]

#### **Response:**

In the final rule, we use cycle average approach to replace steady state engine fuel map for the transient ARB cycle in GEM runs, and then we allow manufacturers to have an option to either use the cycle average approach or steady state engine fuel maps for certification using GEM. The testing data obtained from many different engines show that the regression model used for cycle average approach can be effectively used to address parent/child rating issues. We also recognize the issue with N/V overlap, specifically on 55mph cruise speed cycle. Consequently, we allow different axle ratio between 55 and 65mph cycles. Most of technical information and improvements on parent/child rating, N/V overlap and steady state maps issues can be seen in details from SAE paper 2016-01-8018<sup>34</sup>. These improvements were also reflected in the changes made to 40 CFR 1036.540.

With regard to vehicles that cannot meet the trace, these vehicles map qualify to be except from the vehicle standards if they meet the requirements defined in 40 CFR 1037.631. One of the criteria of this section is that the vehicle has a maximum speed at or below 54 mi/hr.

For vehicles that use the cycle average mapping procedure in 40 CFR 1036.540 for the cruise cycle the steady-state fuel map that is needed by GEM for the shift strategy is defined in the Appendix of 40 CFR part 1036.

**Organization:** Daimler Trucks North America and Detroit Diesel Company

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<sup>34</sup> H. Zhang, J., Sanchez, M, Spear, J. Sarlashkar and D. Robertson, M. Ross, " Cycle-Average Heavy-duty Engine Test Procedure for Full Vehicle Certification - Numerical Algorithms for Interpreting Cycle-Average Fuel Maps", SAE paper 2016-01-8018, October, 2016.

- Default gasoline engine fuel map for use in GEM (EPA-HQ-OAR-2014-0827-1620, NHTSA-2014-0132-0182): [EPA-HQ-OAR-2014-0827-1918-A2 p.3]

[Redacted]

Here is the engine the agencies assumed:

[Figure can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1918-A2]

[Redacted]

In short, we have significant concerns about the agencies' standards for the gasoline powered HDVs. [EPA-HQ-OAR-2014-0827-1918-A2 p.4]

**Response:**

The agencies' 2018 baseline engine fuel map was developed based on a 2015 MY HD gasoline engine with low pressure loop exhaust gas recirculation (LPL-EGR) and cam phasing technology, which could be representative of a technology baseline in 2018 MY. EGR can improve efficiency in several ways. It enables full-map stoichiometric operation, improves the ratio of specific heats of the working fluid, lowers heat loss in-cylinder due to reduced combustion temperatures and reduces knock tendency which allows more favorable combustion phasing and/or an increase in compression ratio. All of these effects can be observed in the test cell. Cam phasing was altered from baseline cam timing based upon our EGR experience. At low loads, normal to late cam phasing was used. At mid-loads, late cam phasing was used. Cam phasing for high loads was selected for best volumetric efficiency. Because of these technologies applied to the existing engine, the characteristics of the fuel map have been altered from the 2015 MY fuel map. We believe that this engine technology package only represents one of many potential paths to achieve the gasoline vocational vehicle standard. More detailed explanation and derivation on the gasoline engine map can be seen in the SwRI final report titled "Validation Testing for Phase 2 Greenhouse Gas Test Procedures and The Greenhouse Gas Emissions Model (GEM) for Medium- and Heavy Duty Engines and Powertrains" [EPA-HQ-OAR-2014-0827].

**Organization:** Daimler Trucks North America LLC

**GEM Software Bugs** - The agencies request for us to identify GEM software bugs, which would lead EPA to make additional changes to GEM before the Final Rule. 80 FR 40191. We have worked extensively with the agencies since the NPRM's publication and have shown them some bugs. We continue to find them, however, due to the complexity of the program and the fact that the agencies continue to change it. We strongly recommend that the agencies try to lock down GEM then set a thirty day period for GEM power users to test this new version and submit comments. [EPA-HQ-OAR-2014-0827-1164-A1 p.43]

**Fuel map measurement** - The agencies propose a procedure for measuring fuel maps for use in GEM. We agree with this procedure. [EPA-HQ-OAR-2014-0827-1164-A1 p.44]

**Response:**

We appreciate DTNA's comments. We have been considering all comments obtained from all of our stakeholders through multiple GEM power user releases including pre-NODA and post-NODA releases,

allowing users to have ample notices and time to respond and help the agencies to debug GEM. This process allows us to lock down a version that can model vehicles in a most realistic way. Please see the agencies' response in RTC Section 15.5 regarding the notice and comment of GEM versions.

**Organization:** Eaton Vehicle Group

### **Performance-based standards**

The EPA has adopted a computer model simulation approach to vehicle certification that in principle drives performance-based standards. However, we recognize that it is impossible to simulate all technologies that contribute to fuel efficiency and that at some point a limit is reached between the accuracy of physics-based models coded in GEM, their fundamental modeling assumptions, and the quality of measured data in the lab. These limit the ability to measure the performance of some technologies (e.g., predictive controls or the effect of automation on drivers). Other technologies become either computationally intractable or require a complex modeling framework that make model validation impossible (e.g., sophisticated engine and shift controls). Furthermore, it is impossible to predict all of the technologies that might be relevant to certification through 2030. We believe the powertrain test can be used to quantify the benefits of many technologies. In rare cases, such as predictive powertrain management, post-processing the GEM results is appropriate with a "slightly conservative" offset based on industry best practice (sometimes referred to as "Drop-down menus"). However, these should rarely be used so they do not compete unfairly with technologies that should legitimately be recognized through a powertrain test. [EPA-HQ-OAR-2014-0827-1194-A1 p.15]

We recognize the need to expedite the certification process and simplify the test and administrative burden. It may be tempting to achieve these goals through higher use of "drop-down menus." We are concerned that such an approach may drive the wrong technologies in the market by chipping away from the performance-based standards approach and replacing it with a features-based approach. Higher grades in the regulatory cycles and the consistent treatment of manual drivers described below are examples of how the "drop-down menu" or post-GEM simulation feature-based efficiency credits may be avoided. [EPA-HQ-OAR-2014-0827-1194-A1 p.15]

### **Response:**

We agree that the powertrain test can be used as one of the most effective approaches to quantify the benefits of many technologies. We also recognize that it would still be expensive to use this approach to quantify all technologies if there are alternatives to simplify the process with a simpler and effective approach. That is the reason why we derived an approach using technology improvement inputs in GEM to account for those technologies that cannot be easily modeled but whose effectiveness can be quantified today without the need to be evaluated with the powertrain test or other test method. Detailed technology improvement inputs are included in 40 CFR 1037.520(j). We have carefully considered the public comments as well as CBI to determine the value of the technology improvement inputs that we adopted. We are confident that those values for the technology improvement inputs used in GEM can simplify the process to recognize those technologies. However, as the commenter states, it is impossible to predict all of the technologies that may be relevant in the future years. Therefore, the agencies are maintaining the off-cycle credit provisions (see 40 CFR 1036.610 and 1037.610).

**Organization:** GILLIG LLC

GILLIG is very concerned with the timing required for the proposed certification process and the impact it would have on our business, employee jobs, delivery of replacement buses to municipalities, jobs at those municipalities, and those who use public transportation daily. Although not addressed in the proposed rule, it would make sense to us that the engine fuel maps that we would enter into GEM would be from fully certified engines. It is common that certification for our engines has come in Q4 and many of those in December of the year preceding the engine model year change. We see acquiring these fuel maps, running GEM, submitting our request for our vehicle certificates of conformance, EPA processing of those submissions and subsequent granting of the certificates extremely difficult to accomplish in time for an early vehicle model year changeover. Delay of these certifications will also delay processing of our applications for CARB EO's. Not having certified vehicle configurations to build would bring transit bus production at GILLIG to a standstill, delay delivery of replacement buses to municipalities responsible for sustaining transportation services, impact jobs at those municipalities, inconvenience those who travel and depend on public transportation, and be financially devastating for our business and our employees. We request the Agencies consider eliminating the Phase 2 proposal for entering engine fuel maps in GEM and consider continuing the Phase 1 approach using a standard engine in GEM for transit buses. [EPA-HQ-OAR-2014-0827-1156-A1 p.5]

**Response:**

The final rule includes several provisions to address the timing concerns raised by the commenter. Manufacturers of transit bus chassis have the option in the final rule to certify to the custom-chassis standards which use a default engine fuel map defined by the agencies in GEM. In addition, the agencies have harmonized the vehicle model years to align with the engine model years (see 40 CFR 1037.150(n) and the definition of "model year" in 40 CFR 1037.801). Finally, the agencies streamlined the certification requirements during the application of certification and only require GEM simulations of ten vehicle configurations covering the range of CO<sub>2</sub> emissions expected during the year's production (see 40 CFR 1037.205(o)).

Additional response to GILLIG's related comments regarding stockpiling are included in RTC Section 13.2.5.

**Organization:** Isuzu Motors Limited

(1) GEM model results are inaccurate compared to actual (real world) test results due to rolling resistance and Aerodynamic Value (CdA) being a fixed number in GEM. These physical parameters can vary for different vehicles and applications. Therefore Isuzu believes CdA needs to be reconsidered for all truck classifications and we are willing to meet with the agencies to discuss our results. [EPA-HQ-OAR-2014-0827-1263-A1 p.2]

**Response:**

We have validated GEM against many testing data, including extensive comparisons over vehicle chassis dynamometer, powertrain tests, and real world driving conditions over two very well controlled trucks. The detailed comparisons and discussion can be seen in Chapter 4 of the RIA.

Please see the agencies' response to CdA for vocational vehicles in RTC Section 6.2.1.

**Organization:** Navistar, Inc.

As the Proposed Rule is currently structured the engine standard is effectively pulled ahead of its nominal start date. Engine fuel maps are now part of the GEM input process. That means, to run GEM for each individual vehicle, and to determine fleet-wide averages for overall compliance, a compliant fuel map for an engine must be available. Of necessity, therefore, this pulls ahead the requirement to develop the MY2021 engine since the fuel map is a key component that must be developed well before MY2021. Essentially, manufacturers have to obtain the fuel map for the engine we believe a full 15 months before the actual standard comes into effect in model year 2021. The result is effectively a staggered compliance deadline, which differs by engine and vehicle. [EPA-HQ-OAR-2014-0827-1199-A1 p.7]

The data requirements of GEM cannot effectively drive the compliance dates. First, this would have obvious lead time implications where less than four years lead time and three years of stability is provided.<sup>10</sup> This is as applicable for the second and third tier implementation dates as for the first. Second, it essentially renders much of the Preamble NPRM misleading at best. For instance, the NPRM states that “[E]PA considered proposing Phase 2 standards that would begin before MY 2021—that is with less lead time.” The NPRM also states that, with regard to the engine standard, the “EPA determined that earlier model year standards *would not be appropriate*, especially given the value of harmonizing the NHTSA and EPA standards.” And yet, as a practical matter, that is exactly what the Proposed Rule does—namely provide less lead time—since the regulation effectively forces development of that engine at least one year prior to 2021. Navistar agrees with EPA that a requirement that effectively forces the industry to develop a compliant engine 15 months prior to the nominal effective period is not appropriate. To do so would be arbitrary and capricious. [EPA-HQ-OAR-2014-0827-1199-A1 p.8]

Moreover, for a vehicle manufacturer that acquires engines from a third party supplier, the vehicle manufacturer is left at the mercy of the third party manufacturer. The Proposed Regulation requires the manufacturer provide MY2020 fuel maps, but the MY2019 maps will also be needed for the first few month of calendar 2020 (MY2021 for the vehicle). There is no requirement, however, that a third party supplier to provide a *MY2021* compliant engine within the regulation. Similarly, this could drive the costs up for engines if third party manufacturers charge higher prices to deliver engines or fuel maps significantly ahead of the regulatory deadline. Using the engine model year to define the GHG model year for both engine and vehicle will ensure that the standards align for a given vehicle. [EPA-HQ-OAR-2014-0827-1199-A1 p.8]

In addition, the model year definition will cause significant disruption in certain industries, school bus manufacturing in particular. School buses are ordered and manufactured on a specific schedule that is dictated by the school year. In most cases, the buses are ordered for delivery over a short period in the summer, between school years. As a result, common industry practice is to have a nominal model year for school buses that can be a full model year before other vehicles. To change this would cause significant disruption which could, among other things, impact the resale value of the vehicles due to a potential model year skip or overlap as manufacturers are forced to adjust model years. In recognition of this and other pre-existing industry standards, the agencies should adopt a provision that allows model year modifications where there are specific industry conditions that justify a departure from normal model year designations or to recognize a “regulatory only” model year for certain vehicle classes. [EPA-HQ-OAR-2014-0827-1199-A1 p.8]

One of the primary concerns with the fuel mapping approach—namely its impact on timing—is addressed elsewhere in these Comments. Navistar also opposes the adoption of a cycle average map in this

Proposed Rule. This is not actually proposed within the NPRM, but is discussed generally in the RIA. We have, as a result, have not seen the regulatory language that would implement the procedure and, frankly, do not fully understand what the procedure would involve. As a result, almost by definition, the agencies should not proceed with adopting such a procedure without further opportunity for notice and comment, including disclosure of the potential language. Regarding the uncertainties of this approach, we could not have stated them any better than the agencies in this quote from the RIA: [EPA-HQ-OAR-2014-0827-1199-A1 p.19]

The following questions are only a subset of the questions that need to be answered:[EPA-HQ-OAR-2014-0827-1199-A1 p.19-20]

-How does this alternative approach address parent and child rating? Would nine points be adequate to cover the practical range of the vehicle operation on the road?

-How can this approach address those points that may be out of map ranges with much higher or lower N/V?

-What kinds of numerical schemes, interpolation or surface fitting, shall be used to interpolate those points that are located between testing points?

-What the numerical scheme shall be used to extrapolate those points outside the maps?

-How robust are these numerical schemes?

-Can what we have learned so far be applied to other engines?

-How the single engineering certification point shall be selected among the number of engine tests?

-Are there potential unintended consequences? [EPA-HQ-OAR-2014-0827-1199-A1 p.20]

These are all excellent, very much open, questions that we feel preclude the option of this alternative being adopted during this rulemaking. They are also not fully reflective of the other questions that may be raised by this alternative. [EPA-HQ-OAR-2014-0827-1199-A1 p.20]

Though these questions remain open, the insights we have gathered so far indicate that this may be a highly burdensome procedure. Analysis of prior year's sales data shows that the alternative engine mapping approach would require almost three times as many engine tests as the proposed BSFC map approach. The increase in the number of tests is due to the fact that engines can be used across vehicle classifications and, as currently defined, would require a separate test for each vehicle sub-family (class 8 tractor and vocational, class 2b-7 vocational, and Class 8 HH). By contrast, the BSFC map approach requires one engine test and that map is applicable across all vehicles without the need for extrapolation of points outside the generic vehicle test points. In addition, Navistar is not in favor of measuring NOx or other constituents not directly addressed by this rulemaking. In this regard, we fully agree with EMA's comments on this point. [EPA-HQ-OAR-2014-0827-1199-A1 p.20]

**Response:**

We have decided that it would be more appropriate to harmonize the engine and vehicle model years, starting in MY 2021 so that vehicle manufacturers will not need fuel maps for MY 2020 engines (see 40



CFR 1037.150(n) and the definition of “model year” in 40 CFR 1037.801). Thus, we are not finalizing the requirement to provide fuel maps for MY 2020 engines. However, we are requiring fuel maps for all MY 2021 engines, even those (e.g., small businesses) for which the Phase 2 engine and vehicle standards have been delayed. See 40 CFR 1036.150(n).

We understand Navistar concerns on cycle average approach. However, we initiated this approach in the fall of 2014, in collaboration with five manufactures, one of which was Navistar. Since then, we have received strong support from most of the major engine and HD vehicle manufacturers. More importantly, significant progresses have been made in both the engine dynamometer tests and the test procedure development.<sup>35</sup> Six different engine platforms including Cummins ISX, ISB, ISL engines, Navistar N13 engines, Volvo D13 engines and a Ford gasoline engine, some of which were conducted at the manufacturer’s site. Parent and child ratings were also extensively tested. More information on cycle average approach related to parent/child rating, N/V overlap issues, and the accuracy of the regression models can be seen in details from the SAE paper 2016-01-8018<sup>34</sup>. All the results point to the same direction – cycle average approach is more accurate than the steady state map approach, specifically in the transient cycle even with a transient correction factor. Regarding test burden, we have reduced numbers of the engine test points to determine the steady state fuel map used with the two cruise cycles in GEM from 143 in the NPRM to 100 points in the final rule, thus reducing significantly the test burden. In addition to reducing the number of steady-state test points 40 CFR 1036.540 allows test points to be consolidated so that only 9 points are needed to cover the full range of vehicles the engine will be installed in. According to our assessment, we expect that the cycle average approach testing time plus the steady state engine fuel map testing time based on the procedures adopted for the final rule to be similar in the time that would have been required to conduct the steady state fuel mapping process included in the NPRM. With regard to the question if 9 points are enough, this was looked at with the test data collected Oakridge National Laboratory and doubling the number of points from 9 to 18 had minor effect on the accuracy of the method.<sup>36</sup> In summary, we believe that use of cycle average approach is the best approach with respect to evaluating performance on the transient cycle, and a reasonable alternative for evaluating steady state cycle performance. With this change, we removed the transient correction factor proposed in NPRM.

**Organization:** PACCAR, Inc.

#### **Engine Mapping for Vehicle Assessments in GEM May Need Revision**

PACCAR has reviewed both the primary Steady-State Fuel Map approach and the alternative Cycle Average approach for generating fueling data that would be used in GEM’s vehicle assessment. Advantages and disadvantages with both were found. [EPA-HQ-OAR-2014-0827-1204-A1 p.21]

PACCAR will continue to work with the agencies to assess these methods and ensure that unintended consequences are avoided. [EPA-HQ-OAR-2014-0827-1204-A1 p.22]

The alternate method provides a viable option of quantifying CO<sub>2</sub> for specific vehicle configurations using the Phase 2 GEM model, but has some concerns as detailed below. As noted in the draft Regulatory Impact Analysis (RIA), the method can only be applied to each specific cycle. That is, the

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<sup>35</sup> Memos to Docket, “Test Procedure Review with Cummins, Volvo, Navistar, Paccar, Daimler Eaton and Allison.”

<sup>36</sup> Oakridge National Laboratory, July 2016, paragraph 2.2.2 of “Powertrain Test Procedure Development for EPA GHG Certification of Medium- and Heavy-Duty Engines and Vehicles”

transient, 55 MPH, and 65 MPH cycles must each have a separate CO2 surface generated and used independently. The range of input values provided for the nine (9) sample configurations provided in Table 3-32 in the draft RIA requires more study to verify that it sufficiently spans the operating space in terms of N/V (engine RPM per km/h) and cycle work (horsepower hour) for all available vehicle configurations. It is recommended that the range of axle ratios and especially CdA values be expanded slightly. In particular, vehicle configurations having higher cycle work than those shown in the draft RIA must be accounted for. [EPA-HQ-OAR-2014-0827-1204-A1 p.22]

**Response:**

We appreciate Paccar's support on this matter. We did consider Paccar's specific recommendations on increasing the axle ratio range and CdA values to make the cycle average approach more robust, and consequently we revise the test procedure to reflect these changes (40 CFR Part 1036.540). As Paccar is aware, we initiated this approach in the fall of 2014. Since then, we have received strong support from most of the major engine and HD vehicle manufacturers. More importantly, significant progresses have been made in both the engine dynamometer tests and the test procedure development<sup>35</sup>. Six different engine platforms including Cummins ISX, ISB, ISL engines, Navistar N13 engines, Volvo D13 engines and a Ford gasoline engine, some of which were conducted at the manufacturer's site. Parent and child ratings were also extensively tested. More information on cycle average approach related to parent/child rating, N/V overlap issues, and the accuracy of the regression models can be seen in details from the SAE paper 2016-01-8018<sup>34</sup>. All the results point to the same direction – cycle average approach is more accurate than the steady state map approach, specifically in the transient cycle even with a transient correction factor. Regarding test burden, we have reduced numbers of the engine test points to determine the steady state fuel map used with the two cruise cycles in GEM from 143 in the NPRM to 100 points in the final rule, thus reducing significantly the test burden. According to our assessment, we expect that the cycle average approach testing time plus the steady state engine fuel map testing time based on the procedures adopted for the final rule to be similar in the time that would have been required to conduct the steady state fuel mapping process included in the NPRM. In summary, we believe that use of cycle average approach is the best approach with respect to evaluating performance on the transient cycle, and a reasonable alternative for evaluating steady state cycle performance. With this change, we removed the transient correction factor proposed in NPRM.

**Organization:** Truck & Engine Manufacturers Association (EMA)

Cycle-Average Engine Map

The agencies have requested comment on a potential alternative to the proposed 143-point steady-state engine fuel map, referred to as a "cycle-average map," in an effort to address confidentiality, accuracy, and other concerns relating to the proposed 143-point map approach. (See 80 FR at 40193, and RIA Section 3.10). Open questions around the treatment of child engine ratings, applicability across various engine/vehicle configurations, and test procedures for the alternative approach are being assessed by several manufacturers and the agencies. EMA is evaluating the concept. [EPA-HQ-OAR-2014-0827-1269-A1 p.26]

**Response:**

Regarding cycle average engine map, we initiated this approach in the fall of 2014. Since then, we have received strong support from most of the major engine and HD vehicle manufacturers. More importantly, significant progresses have been made in both the engine dynamometer tests and the test procedure development<sup>35</sup>. Six different engine platforms including Cummins ISX, ISB, ISL engines,

Navistar N13 engines, Volvo D13 engines and a Ford gasoline engine, some of which were conducted at the manufacturer's site. Parent and child ratings were also extensively tested. More information on cycle average approach related to parent/child rating, N/V overlap issues, and the accuracy of the regression models can be seen in details from the SAE paper 2016-01-8018<sup>34</sup>. All the results point to the same direction – cycle average approach is more accurate than the steady state map approach, specifically in the transient cycle even with a transient correction factor. Regarding test burden, we have reduced numbers of the engine test points to determine the steady state fuel map used with the two cruise cycles in GEM from 143 in the NPRM to 100 points in the final rule, thus reducing significantly the test burden. According to our assessment, we expect that the cycle average approach testing time plus the steady state engine fuel map testing time based on the procedures adopted for the final rule to be similar in the time that would have been required to conduct the steady state fuel mapping process included in the NPRM. In summary, we believe that use of cycle average approach is the best approach with respect to evaluating performance on the transient cycle, and a reasonable alternative for evaluating steady state cycle performance. With this change, we removed the transient correction factor proposed in NPRM.

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### **4. Default Engines in GEM**

The updated version of GEM does not include generic engine fuel maps for 2021, 2024 and 2027. Manufacturers need the generic fuel maps to evaluate the vehicle-level custom chassis vocational vehicle technology packages outlined in EPA's February 12, 2016, memorandum, which was released with the NODA. Additionally, the generic engine fuel maps are needed to evaluate the GEM output improvements from vehicle technologies that will be deployed in other vehicle categories. To isolate and assess the GEM contributions from different vehicle technologies, manufacturers must be able to input a generic engine fuel map for each stringency step in the proposed regulation. [EPA-HQ-OAR-2014-0827-1891-A1 p.4]

#### **Response:**

We have provided adequate notice on the GEM features and detailed source code with multiple power user pre-NODA and post NODA releases, allowing users to understand how the engine fuel maps are interacted with vehicles. Please see the agencies' responses to the GEM releases in RTC Section 15.5. Providing generic engine fuel maps would not help the manufacturers to understand how the engine would contribute the total vehicle performance for the primary vocational vehicle and tractor programs. Rather, users can use their own engine fuel maps to achieve the same goal. In addition, releasing 2021, 2024 and 2027 maps to public means that we will release the engine standards for the final rule before the rule is signed. For the vehicle-level custom chassis vocational vehicle, we provided the default engine fuel maps.

**Organization:** Volvo Group

#### Engine Mapping

The engine fuel and torque map used in GEM is truncated above the maximum mapping test speed as shown in the plot below. To properly evaluate urban vehicles that are gear bound below 65 MPH, the torque and fuel map should be extended linearly to zero at the high idle point for each engine. Otherwise vehicle speed for a gear-bound driveline is truncated and will not run on the governor droop under light

load conditions (such as moderate down-hill) as is the case in actual operation. [EPA-HQ-OAR-2014-0827-1290-A1 p.52-53]

#### Alternative Engine Certification via Cycle Average Method

EPA has been working with a number of manufacturers (not including Volvo Group) for more than a year on an alternative process to conventional engine mapping. A conventional engine fuel map has been used for many years by all manufacturers for vehicle simulation. This is the method proposed in NPRM section 1036.535. Given our long experience with vehicle simulation using this type of fuel map, we are confident that we understand how the method works and its limitations. One such limitation is variation between transient fuel consumption and the steady state consumption measured in the mapping process. We had previously discussed the possibility to run a typical engine transient test which could be the FTP or a test based on a typical vehicle set-up using the GEM ARB cycle output (engine torque and speed vs. time) to establish the engine's transient efficiency that could be compared to the output using the steady state map to establish a transient correction factor. [EPA-HQ-OAR-2014-0827-1290-A1 p.53]

Further extension of these ideas led to the concept of eliminating the steady state fuel map and establishing a new concept wherein the engine is tested over a number of cycles based on GEM output for a range of vehicle load factors, driveline set-ups, and each of the regulatory duty cycles (ARB, 55 MPH, 65 MPH). The result is a matrix of 27 engine test cycles (3 load factors x 3 drivelines x 3 duty cycles). This output is used to create a 3 dimensional map plotting cycle work, cycle average engine fuel consumption, and N/V (average ratio of engine speed to vehicle speed based on GEM output for each cycle). [EPA-HQ-OAR-2014-0827-1290-A1 p.53]

Volvo Group recently began investigating this proposal because EPA stated that they are seriously considering this method or possibly a "hybrid method" where cycle average is used for the ARB transient cycle and conventional fuel mapping is used for highway cycles with constant speed targets. Our efforts have been hampered because the method is not clearly documented in any one place in EPA's proposal that allows for complete analysis and comment. There is no test description with regulatory details. Instead, limited discussion is found in the RIA and certain technical papers. We also have received some limited information from discussions with various regulatory staff. Based on this information, we have attempted to glean what we believe is a somewhat representative picture of the intended process. From this, we provide some preliminary comments on our observations. We note, however, that Volvo Group has not been provided sufficient information to comment fully or adequately on this provision. [EPA-HQ-OAR-2014-0827-1290-A1 p.53-54]

It is unclear how the "parent" rating within an engine family should be defined when using this process. Whereas a maximum torque rating would typically produce the best brake specific fuel consumption (BSFC) on an engine emissions test cycle, it may well result in the highest fuel consumption on a vehicle cycle based test. Also, we question how various transmission types might impact the results. We can envision a vehicle with a transmission with many gears or even a continuously variable transmission that would operate an engine over a very narrow operating speed range. We could also envision a similar vehicle with a transmission with few gears that required the engine to operate over a wide speed range but with an axle ratio that resulted in the same N/V as the first vehicle. These two vehicles would have similar cycle work and similar N/V but significantly different engine operation and efficiency. Yet this method would simulate both with the same efficiency. We do not believe the testing has adequately addressed the range of possible drivetrains and efficiency outcomes. [EPA-HQ-OAR-2014-0827-1290-A1 p.54]

Because GEM does not include an engine torque response function, torque changes in the GEM output are instantaneous. But real engines have a torque lag due to the need to develop boost from the turbocharger and to manage emissions. Hence the engines cannot actually follow the engine cycle output from GEM. This means that the engine test results in somewhat lower cycle work than the GEM output. [EPA-HQ-OAR-2014-0827-1290-A1 p.54]

GEM shift management resulted in the engine running at speeds well below low idle where the engine would stall out. The Agency recommended that we ignore these test areas and run at the closest speed and load that the engine could sustain. [EPA-HQ-OAR-2014-0827-1290-A1 p.54]

Using the vehicle configurations prescribed to develop the engine test cycles resulted in GEM downshifting (appropriately) at low axle ratio on the 55 MPH cycle. This resulted in an N/V that essentially overlaid the 65 MPH cycle with a higher axle ratio which (appropriately) ran in top gear. This, in turn, resulted in the software being forced to extrapolate into an N/V and cycle work range that was never tested resulting in inaccurate results when tested against a vehicle driveline that was not part of the mapping matrix. [EPA-HQ-OAR-2014-0827-1290-A1 p.54]

All these results were shared with EPA and quite possibly corrections can be devised. Nonetheless, we have little doubt that additional issues will surface as the full range of transmissions, axles, engines and vehicle configurations are run through this method. Our conclusion is that the method is not adequately developed to be used as the test method in the final rule. We note in particular that EPA has failed to provide adequate notice of the method, and an adequate description of what it is proposing, sufficient to allow for meaningful comment. [EPA-HQ-OAR-2014-0827-1290-A1 p.54]

If the agencies intend to pursue this approach, it must be done as a revision to the final rule or perhaps as a technical amendment, when and if it is thoroughly tested and demonstrated to be effective and robust. In addition, any change of this magnitude will have a significant effect on the GEM outcomes. Regulatory standards must be adjusted if such a change is promulgated. [EPA-HQ-OAR-2014-0827-1290-A1 p.54-55]

**Response:**

The full torque curves for all the engine fuel maps includes zero torque point at the highest possible engine speed. We added transient torque response to the engine model in GEM. The torque response is determined from the engine's displacement and the torque curve of the parent engine rating of the engine family. We also significantly improved GEM's shifting strategy when operating at low idle speed. We improve our test procedure to mitigate N/V overlap issues in 40 CFR part 1036.540.

Regarding cycle average engine map, we initiated this approach in the fall of 2014. Since then, we have received strong support from most of the major engine and HD vehicle manufacturers. More importantly, significant progress has been made in both the engine dynamometer tests and the test procedure development<sup>35</sup>. Six different engine platforms including Cummins ISX, ISB, ISL engines, Navistar N13 engines, Volvo D13 engines and a Ford gasoline engine, some of which were conducted at the manufacturer's site. Parent and child ratings were also extensively tested. More information on cycle average approach related to parent/child rating, N/V overlap issues, and the accuracy of the regression models can be seen in details from the SAE paper 2016-01-8018<sup>34</sup>. All the results point to the same direction – cycle average approach is more accurate than the steady state map approach, specifically in the transient cycle even with a transient correction factor. Regarding test burden, we have reduced numbers of the engine test points to determine the steady state fuel map used with the two cruise cycles in GEM from 143 in the NPRM to 100 points in the final rule, thus reducing significantly

the test burden. According to our assessment, we expect that the cycle average approach testing time plus the steady state engine fuel map testing time based on the procedures adopted for the final rule to be similar in the time that would have been required to conduct the steady state fuel mapping process included in the NPRM. In summary, we believe that use of cycle average approach is the best approach with respect to evaluating performance on the transient cycle, and a reasonable alternative for evaluating steady state cycle performance. With this change, we removed the transient correction factor proposed in NPRM.

Please see the agencies' responses related to GEM notice and comment in RTC Section 15.5

### 3 Test Procedures and Engine

#### 3.1 General Comments

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The draft proposal calls for a whole vehicle and separate engine standard. The final regulations should not include an engine standard that OEMs will have a difficult time complying with. It is a consolidated market place and an overly stringent standard could lead to monopoly pricing. An overly stringent engine standard could also lead to the very boom bust cycle we are seeking to avoid. There is nothing in this regulation to prevent OEMs from investing in more efficient engines and gaining credits that could be applied to meet stringency requirements. OEMs should be free to meet the stringency standards in the way that best suits their business model. These regulations rightfully should offer pathways on how to meet the standard but should not dictate the path a given company takes. [EPA-HQ-OAR-2014-0827-1248-A2 p.9-10]

**Organization:** Mass Comment Campaign sponsored by anonymous 1 (email) - (23)

Specifically, I ask for stronger engine standards to further reduce climate pollution and protect our children and families. Please finalize engine standards several times stronger than the weak standards proposed. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

With stronger engine standards that take effect no later than model year 2024, our communities will be better protected from the harmful pollution emitted by big freight trucks and buses. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by Sierra Club (email) - (26,917)

It is critical that the agencies strengthen these standards, particularly the engine standard, to ensure efficiency improvements throughout freight trucks. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Maintain Existing Regulatory Framework** [EPA-HQ-OAR-2014-0827-1274-A1 p.2]

**Provide More Flexibilities to Ensure Engine Technologies are Utilized** [EPA-HQ-OAR-2014-0827-1274-A1 p.4]

There may be some opportunities to further drive innovation and technology for engines that are still achievable in the Phase 2 timeframe. Under different aspects of the NPRM, the agencies did propose various ways to try and better represent real-world service applications and MEMA commends these revisions to the Phase 2 program. For example, under the engine component of the proposed rule, the agencies did make some adjustments to the Phase 2 SET cycle weighting. The agencies acknowledge that the task to represent all real-world applications is difficult and they seek feedback from stakeholders on ways to achieve as broad a representation as possible, while still allowing for the recognition of real-world service and the beneficial impacts from various technologies and systems. With regards to the SET cycle, MEMA believes the agencies' revisions are generally tracking in the right direction and we do not take issue with the test procedures themselves. As an example, real world

engines operate at a lower operating RPM levels than what the proposed test cycle emphasizes (with a lower operating RPM range, the result is a gap between real world operations and test settings). MEMA encourages the agencies to identify potential gaps and make them as small as possible. Bringing the gap closer to real-world operating conditions will help the agencies avoid either unintentionally disincentivizing operational improvements that could have real impact on optimizing engine efficiencies or, conversely, potentially drive technologies that do not result in CO<sub>2</sub> reductions. [EPA-HQ-OAR-2014-0827-1274-A1 p.5]

MEMA anticipates that some of our member companies will address these issues more specifically in their comments. [EPA-HQ-OAR-2014-0827-1274-A1 p.5]

**Organization:** Navistar, Inc.

Navistar feels the following are key areas the agencies must address: [NHTSA-2014-0132-0094-A1 p.2]

- Engine standards must be adjusted to account for the cumulative impact of the various requirements, including N<sub>2</sub>O, and their feasibility is also predicated on the stability of other emission requirements, such as NO<sub>x</sub>. [NHTSA-2014-0132-0094-A1 p.2]

**Organization:** Robert Bosch LLC

Bosch also opposes the proposed rule's uneven handling of vocational vehicle engines. Just as there should be technology neutrality in the HD pickup truck and van sector, so, too, should there be neutrality under Phase 2 for vocational vehicle engines. [EPA-HQ-OAR-2014-0827-1466-A2 p.8]

**Response:**

As reflected later in the context of more detailed comments, the agencies recognize the need to balance the benefits of establishing stringent engine standards against the risks of setting standards that are too stringent. This is true both in the context of the diesel engine standards by themselves and in the context of the SI engine standards relative to the diesel engine standards.

### **3.2 Regulatory Structure - Separate Engine Standards**

**Organization:** Achates Power, Inc.

We recognize the importance of a separate engine efficiency standards, for a number of reasons: [NHTSA-2014-0132-0049-A1 p.2]

- The EPA has a robust compliance program based on engine testing, making it straightforward to hold engine manufacturers accountable. Without a separate engine standard, in-use compliance becomes more subjective. Having clearly defined compliance responsibilities is important to both the government agencies and market participants. [NHTSA-2014-0132-0049-A1 p.2]
- Engine standards for CO<sub>2</sub> require engine manufacturers to optimize engines for both efficiency and for non-CO<sub>2</sub> emissions, particularly for NO, emissions given the strong counter-dependency between engine-out NO, and fuel consumption. By requiring engine to meet both NO, and CO<sub>2</sub> standards, manufacturers will include technologies that optimize for both rather than alternative



calibrations that would trade lower NO<sub>x</sub> emissions for higher CO<sub>2</sub> emissions depending on how the engine and vehicle is tested. [NHTSA-2014-0132-0049-A1 p.2]

- Because engine fuel consumption can vary significantly between transient and steady-state operations, only steady-state engine data is required for chassis certification. The separate engine standard for vocational vehicles provides the only measure of engine fuel consumption under transient conditions. [NHTSA-2014-0132-0049-A1 p.2]
- A separate engine standard enables the federal agencies to exempt certain vehicle classes from some or all of the vehicle standards without foregoing efficiency improvements. [NHTSA-2014-0132-0049-A1 p.2]

To be effective in achieving these benefits, however, the separate engine standard must not only be commercially acceptable and reasonable, but also meaningful. The new MDV and HDV standards are designed to 'spur innovation, encouraging the development of and deployment of existing and advanced cost-effective technologies for a new generation of cleaner, more fuel-efficient commercial trucks....' The standards are meant to be set 'not only on currently available technologies but also on utilization of technologies now under development or not yet widely deployed while providing significant lead time to assure adequate time to develop, test, and phase in these [technologies].' [NHTSA-2014-0132-0049-A1 p.2-3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.287.]]

**Organization:** Advanced Engine System Institute (AESI)

AESI is pleased that the Agency has proposed to retain the basic regulatory structure used in Phase 1, including a separate engine standard and similar testing and certification procedures. Our industry has invested heavily in research and systems to deliver cost-effective greenhouse gas reductions to meet the Phase 1 schedule while meeting the 2010 standards for NO<sub>x</sub> and PM. Retaining a separate engine standard with the appropriate compliance enforcement will help ensure the long term environmental integrity of the program. [EPA-HQ-OAR-2014-0827-1152-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.289.]]

**Organization:** American Automotive Policy Council

Model Approach for Vocational Vehicles while AAPC has concerns about the technical details of the proposed Phase 2 GEM model which will be detailed below, we believe that a model-based approach that looks at the powertrain and chassis as a whole can be an effective way to drive CO<sub>2</sub> and fuel consumption improvements through the vocational vehicle fleet. While engine standards should be maintained as a "no-backsliding" provision (hold engine standards at 2017 levels), the inclusion of the engine, transmission, and chassis as a system in a more sophisticated GEM model more accurately reflects the ways in which manufacturers deliver on-road CO<sub>2</sub> and fuel consumption benefits to their customers. [EPA-HQ-OAR-2014-0827-1238-A1 p.31]

Conceptually, this could be an improvement over the Phase 1 approach in which only tire rolling resistance was reflected in the model for vocational vehicles and key components such as transmissions were not included at all. Assuming our concerns with the technical details of the model can be addressed, an accurate GEM model-based approach will drive efficiency improvements to engines, transmissions, and chassis technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.31]

**Organization:** Association for the Work Truck Industry (NTEA)

## **Regulatory Structure**

The NTEA supports the Agencies' structural approach to the rules. It is logical to separate out the four vehicle categories as they tend to be both built and utilized in different manners. Of the categories, vocational trucks will be the most diverse vehicle population, as noted by the possible chassis, body and equipment configurations available in the marketplace. This diversity also continues in the manufacture process. [EPA-HQ-OAR-2014-0827-1187-A1 p.2]

**Organization:** Autocar, LLC

### **Autocar Supports Separate Engine and Vehicle Standards**

Autocar supports the Agencies' proposal to maintain separate engine and vehicle standards in Phase 2 for vocational vehicles. For Low-speed/Frequent-stop Vehicles in particular, the engine offers the greatest potential for reducing GHG emissions and fuel consumption. Such vehicles have no opportunity for fuel consumption improvement through aerodynamics and other highway-speed technologies. Maintaining standards at the engine level facilitates the Agencies' and Autocar's proposed exemptions and exceptions for certain vehicle and manufacturer types without foregoing the engine improvements, ensuring positive environmental impact across a broader range of applications. [EPA-HQ-OAR-2014-0827-1233-A1 p.16]

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Separate engine and vehicle standards**

The NPRM requests comment on the choice to maintain separate engine and vehicle standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.29]

CARB staff strongly agrees with U.S. EPA and NHTSA's choice to maintain separate engine standards for the following reasons.

-Engine standards directly address the source of GHG emissions and ensure some efficiency improvements at the engine level will be achieved over the useful life of the vehicle. Without an engine standard, some vehicle manufacturers could elect to rely more heavily on vehicle technologies to meet emission standards. These technologies may prove to be less effective at reducing emissions as the vehicles' vocation changes over time. For example, line-haul tractors with aerodynamic technologies would see less of a benefit from the aerodynamic technologies if placed into local-haul service by a second owner. [EPA-HQ-OAR-2014-0827-1265-A1 p.30]

-Separate engine standards based on the direct measurement of GHG emissions from engines can be directly verified for compliance using existing engine test protocols: U.S. EPA's heavy-duty engine ramped-modal Supplemental Emission Test (SET) and heavy-duty engine transient emissions test, i.e., the Federal Test procedure (FTP). [EPA-HQ-OAR-2014-0827-1265-A1 p.30]

-The SET and FTP would continue to be used to certify heavy-duty engines to GHG emission standards, as well as the criteria pollutant emission standards. This provides a direct link between the

GHG emission measurement and NOx emission measurement methods for certification. [EPA-HQ-OAR-2014-0827-1265-A1 p.30]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Full vehicle simulation approach (advantages and disadvantages)**

The NPRM requests comment on the proposed approach for full vehicle simulation. CARB staff generally supports the proposed full vehicle simulation approach, and is in favor of GEM including additional subsystems to provide manufacturers greater design flexibility and incentivize the development of vehicles that fully realize the GHG benefits of well-integrated systems. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]

Additionally, the NPRM requests comment on whether the Phase 2 full vehicle simulation proposal, which potentially requires engine manufacturers to disclose proprietary engine performance information to vehicle manufacturers long before production, would enable the “reverse engineering” of engine manufacturers’ intellectual property, and if so, what steps U.S. EPA and NHTSA could take to address this issue. While CARB staff recognizes that this proposed approach will likely require engine manufacturers to disclose more detailed engine design and performance information early in production cycles, certainly earlier than currently occurs, CARB staff believes this will be a positive development that will facilitate better engine, component, and vehicle integration necessary for achieving maximum, cost-effective fuel efficiency improvements and GHG benefits. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Chassis dynamometer test procedure**

The NPRM requests comment on whether a chassis dynamometer test procedure should be required in lieu of the proposed vehicle simulation approach. CARB staff supports chassis testing for vehicles that are already emissions certified on chassis dynamometers and provisions for similar vehicles that can also be tested using widely available chassis dynamometer testing resources, as proposed in the NPRM. These are the lighter end of the heavy-duty vehicle range. [EPA-HQ-OAR-2014-0827-1265-A1 p.113]

The NPRM’s proposed chassis dynamometer testing requirements will expand the data set of chassis dynamometer emissions measurements, which will help provide data needed to evaluate vehicle integration success. CARB staff believes chassis dynamometer testing is critical for assessing engine, powertrain, and vehicle integration effects on GHG emission levels. For its own testing needs, CARB staff is committed to developing a robust in-house test program by aggressively working to expand its heavy-duty chassis dynamometer testing capacity for the comparison of chassis data with simulation, PEMS, and engine/powertrain test data. [EPA-HQ-OAR-2014-0827-1265-A1 p.113]

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20 See page 40195 of the NPRM for more details of the technology

21 See page 40195 to 40196 of the NPRM for more details of the technology

**Organization:** Caterpillar Inc.

## **PROMOTE INNOVATION— FOCUS ON FULL VEHICLE OPTIMIZATION BY ELIMINATING ENGINE-BASED STANDARDS**

As we examine new, fuel-saving technologies for heavy-duty vehicles, Caterpillar believes vehicle manufacturers must be allowed to focus design efforts on the complete vehicle in order to optimize fuel economy, without the incremental constraint of engine-based standards. Based on our extensive experiences with nonroad equipment, both the opportunities and magnitude of vehicle GHG reductions significantly outweigh possible engine-based GHG reductions. A total systems perspective, considering application variability and appropriately tailoring technologies, provides a broader landscape to advance the optimization of fuel efficiency, productivity, and cost – factors which all lead to a win-win result for both the environment and customers. [EPA-HQ-OAR-2014-0827-1189-A1 p.3]

As an efficiency and productivity proof point, this total systems approach has allowed Caterpillar to be recognized as a major innovator of fuel-saving and GHG-reducing technologies in nonroad equipment. For example, our Caterpillar model 336E H hydraulic hybrid excavator has been demonstrated through a grant from the California Energy Commission to reduce fuel consumption by 30 percent on a per-ton basis. Similarly, our Caterpillar D7E track-type tractor was awarded the 2008 EPA Clean Air Excellence Award for reducing fuel consumption by 10 to 30 percent (depending on work load/cycle) and increasing dozing efficiency by 25 percent (cubic yards moved/gallon of fuel) compared to previous models. These are just two examples of where a system focus rather than an engine focus resulted in substantial efficiency gains. [EPA-HQ-OAR-2014-0827-1189-A1 p.3]

From a cost efficiency perspective, vehicle-based GHG reductions are expected to be lower cost than engine-based reductions. Cost is a key customer buying criteria. The engine should not be treated differently from a GHG perspective than any other vehicle component. There are many components and design selections that must be made on a vehicle. If the EPA constrained each component to certain parameters, (i.e. engine, transmissions, driveshaft, axles, differential, rims, tires, cab, HVAC, APU, etc.) the likely result is that vehicle design would be tightly controlled using components that have essentially been prescribed by EPA. Vehicle manufacturers would have to focus vehicle design efforts on ensuring each individual component met EPA standards rather than spending development efforts on optimizing the system as a whole. The cost of GHG reduction would be higher, and the amount of GHG reduction achievable would be hindered. [EPA-HQ-OAR-2014-0827-1189-A1 p.3]

We urge EPA to allow vehicle manufacturers to fully optimize the entire vehicle as this greatly improves GHG opportunities, and decreases the cost of such reductions. [EPA-HQ-OAR-2014-0827-1189-A1 p.3]

**Organization:** Caterpillar Inc., et al.

Engines are best evaluated based on how they operate in the vehicle, considering the engine size and power output, the vehicle power demand, and the driveline characteristics – that is, by the full vehicle approach. The engine's operating efficiency is fully accounted for in the complete vehicle evaluation, rendering separate engine standards redundant. The Agencies, however, have proposed in the NPRM to establish separate engine standards. It's absolutely essential that the Agencies avoid setting overly stringent engine standards to avoid repeating the market disruptions the industry experienced when introducing diesel particulate (DPF) technology in 2007. To this end, we are opposed to any decrease in the engine standards as proposed. [EPA-HQ-OAR-2014-0827-1215-A1 p.4]

**Organization:** Cummins, Inc.

The Agencies recognize that separate engine standards have been successfully used to “achieve emissions reductions from complete vehicles that operate on road,” while providing a “well-established, representative, and robust set of engine test procedures” for emissions compliance enforcement (80 FR 40147, 40181). Using the same protocols for criteria and GHG emissions ensures linkage between all pollutants, forcing consideration of all constituents when optimizing engine performance and emissions. With differing certification cycles, one could trade-off GHG improvement at the expense of nitrogen oxides (NO<sub>x</sub>) increases. Such a situation would undermine regulatory integrity and environmental benefits from criteria emission reductions achieved over the years. Furthermore, engine certification captures both steady-state and transient behavior that is absent in the vehicle program. Advantages of separate engine standards are identified in the Preamble (80 FR 40181-182) and detailed further in Cummins oral arguments<sup>1</sup> and comments to NHTSA<sup>3</sup>. [EPA-HQ-OAR-2014-0827-1298-A1 p.6]

For Phase 2, EPA and NHTSA are proposing to maintain dividing the commercial vehicle industry into three categories (combination tractors, vocational vehicles and HD pickups and vans), while continuing separate engine and vehicle standards for combination tractors and vocational vehicles. The Phase 2 regulatory proposal adds a fourth category for trailers to establish standards for this component of tractor vehicles. Cummins fully supports this regulatory structure, especially the separate engine program. [EPA-HQ-OAR-2014-0827-1298-A1 p.6]

Engine standards also acknowledge the non-integrated nature of the commercial vehicle market and allow for multiple suppliers of engines and powertrain options for a given vehicle original equipment manufacturer (OEM). Customers can continue to buy a common certified engine and use it in a wide range of vehicle applications, ensuring emissions reductions and economic and regulatory efficiencies across the diversity of vehicles that exist in the marketplace. [EPA-HQ-OAR-2014-0827-1298-A1 p.6-7]

*Cummins opposes features of the proposed rule that undermine regulatory integrity* [EPA-HQ-OAR-2014-0827-1298-A1 p.7]

Regulatory integrity means that the intended improvements in emissions are assigned appropriately and directly to the engine and vehicle, are realized in real-world use and can be physically verified and enforced. [EPA-HQ-OAR-2014-0827-1298-A1 p.7]

The biggest threat to regulatory integrity is a disconnect between engine NO<sub>x</sub> and CO<sub>2</sub> regulations. This can arise in several ways, including: (a) different test protocols for each pollutant; (b) significant engine operation outside the criteria-emission<sup>4</sup> Not-To-Exceed (NTE) zone; (c) implicit engine emissions stringency at the vehicle level that is not recognized in engine testing; and (d) lack of robust means to assure compliance in-use and to link NO<sub>x</sub> with CO<sub>2</sub> at the vehicle level. [EPA-HQ-OAR-2014-0827-1298-A1 p.7]

[Figure 1 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

The 55 MPH cycle is outside the NTE zone, suggesting that future vehicles are expected to operate a considerable amount of time outside of this emissions control zone. This means a vehicle could emit higher NO<sub>x</sub> emissions which would not be assessed during the in-use enforcement program. Furthermore, since the NTE region is tied to the engine torque curve, there is an incentive for engine manufacturers to skew the torque curve to higher speeds to draw the NO<sub>x</sub> NTE zone farther away from the cruising engine speed. This concern could be addressed in a future criteria emissions rulemaking by expanding the NTE zone as defined in 40 CFR 86.1370(b) for engines with transmissions such as Continuously Variable Transmissions (CVT). [EPA-HQ-OAR-2014-0827-1298-A1 p.8-9]

[Figure 2 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

*Cummins cautions the Agencies against this approach. First, implicit engine stringency in the vehicle program decouples engine CO<sub>2</sub> improvements from compliance with standards for oxides of nitrogen (NO<sub>x</sub>). This threatens the regulatory integrity of the rule by creating a structure in which in-use NO<sub>x</sub> emissions can be increased by operation outside expected NO<sub>x</sub> regulatory limits while in-use CO<sub>2</sub> emissions are reduced. Second, it allows trading of directly measurable and enforceable improvements at the engine level for less certain and unenforceable improvements at the vehicle level. Third, implied standards lack the regulatory clarity required for focused and sustained innovation in engine technology. For these reasons, required engine CO<sub>2</sub> reductions should be explicit in the engine standard, and engine procedures should continue to link CO<sub>2</sub> with criteria emissions.* [EPA-HQ-OAR-2014-0827-1298-A1 p.10 and 12] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.47-48.]]

(d) The vehicle standard in Phase 2 employs computer simulation to calculate the integrated effect of all component improvements. This is useful for all applications but also problematic for translating apparent benefits for line-haul trucks into real-world effects. To be sure, there are “vehicle”-level technologies that will convey real CO<sub>2</sub> benefit, but there are no existing integrated-vehicle test protocols that can be used to validate real-world performance and assure in-use compliance. For this reason, all CO<sub>2</sub> reduction that is expected and required from the engine should be assigned explicitly to the engine in the engine standard. It can be physically verified and enforced with protocols that have been honed by EPA and industry over three decades. And by using these established engine certification protocols for both CO<sub>2</sub> and criteria emissions, regulators can also assure continued compliance with current and future criteria emission standards as greenhouse gases are reduced. This is an especially important point to protect against increases in NO<sub>x</sub> emissions as CO<sub>2</sub> is being reduced and to ensure CO<sub>2</sub> reductions are protected as future reductions in NO<sub>x</sub> emissions are contemplated. [EPA-HQ-OAR-2014-0827-1298-A1 p.12-13]

In addition to enabling direct assurance of performance, assignment of all required engine CO<sub>2</sub> reductions explicitly in the engine standard also provides clear direction to engine manufacturers for technology investment and innovation required to meet future GHG goals. [EPA-HQ-OAR-2014-0827-1298-A1 p.13]

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1 See Appendix A for the full text of the testimony. [p.44 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

3 See Appendix B. [p.48 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

4 Criteria emissions are HD exhaust emissions controlled under the Clean Air Act and include oxides of nitrogen (NO<sub>x</sub>), particulate matter (PM), hydrocarbons (HC) and carbon monoxide (CO).

**Organization:** Daimler Trucks North America LLC

**Basing vehicle and engine standards on the same technologies** - EPA requests comment on whether the engine and vehicle standards should be based on the same projected technologies. 80 FR 40191. DTNA has maintained that the best approach to Phase 2 is for the standards to be based on complete vehicle fuel efficiency wherein technologies that are applied to the engine are integral to complete vehicle package. The separation of standards between the engine and the vehicle creates a number of

problems. The most significant problem (which EPA has attempted to at least partially correct with their proposed revisions to the SET test procedure) is the problem of defining an engine test cycle that truly represents the engine operation across a range of powertrain configurations anticipated when Phase 2 takes effect and for powertrains beyond that time. Clearly, no such cycle exists since differing power train designs will result in differing engine operating points. Consequently, the level of improvement from a given technology that is projected onto a fixed engine test cycle will differ from the level of improvement when the technology is projected in simulation across a range of vehicle configurations. This leads to the problem that as powertrains diverge actual engine operation from the fixed test cycle, and as the stringency of the engine certification standards increases, engine manufacturers become driven to apply technologies to improve efficiency on the test cycle but which may derive little benefit in real use. For these reasons and others that DTNA believes that complete vehicle certification where the actual fuel map is included in the simulation is the strongly preferred path. DTNA agrees that engine and vehicle standards should be based on the same technologies but that the magnitude of improvements of each for a given technology need to consider where in the engines operating map the improvements are realized and the differences in how the test cycles operate the engine within the operating map. [EPA-HQ-OAR-2014-0827-1164-A1 p.15]

**Mutual exclusivity of engine standard and GEM:** EPA states that the use of a fuel map in GEM should eliminate concerns that a separate engine standard and a full vehicle standard are mutually exclusive. 80 FR 40180. While the inclusion of the engine map in GEM helps alleviate some concerns, the existence of the separate engine standard still carries with it this concern. An engine improvement can conflict with a vehicle improvement despite the engine being in GEM. For example, if an engine manufacturer optimizes the engine around the A speed such that vehicles using that engine can be very heavily downspped, the result will likely be lower fuel consumption on the road and in GEM--even if the A-speed optimization harmed B and C speed fuel consumption to a greater extent. It is possible to see technologies that show in-vehicle/real-world improvements that do not show up on the cycle. If this means that the engine OEM with the better real-world performing engine does not meet the standard, but then has to add significant technologies to either meet the engine test-cycle or that don't actually provide the customer real-world benefit, then either way the cost of this engine has to increase which means in reality a less expensive and less efficient engine becomes more attractive. The agencies should recognize when an engine configuration results in improved on-road fuel efficiency but worse engine dynamometer test results, and the agencies should exempt such engines from strict compliance with the engine test standards--knowing that the ultimate concern is fuel consumption and GHG emissions on real roads not in a test cell. [EPA-HQ-OAR-2014-0827-1164-A1 p.15-16]

**Preface** - DTNA fundamentally disagrees that separate engine standards are needed in Phase 2 but nonetheless provides comments in response to EPA's request for comment on engine-side stringency. 80 FR 40156. [EPA-HQ-OAR-2014-0827-1164-A1 P.19]

**Other Structures Considered: Chassis Dyno Testing** – The agencies request comment on whether a chassis dynamometer test procedure should be required in lieu of the vehicle simulation approach being proposed. 80 FR 40178. EPA requests comment regarding the alternative of chassis dynamometer testing in lieu of the simulation approach that is proposed (80 FR 40178). DTNA is strongly in favor of the proposed simulation approach for multiple reasons many of which led EPA to the conclusion that a simulation approach was most appropriate in Phase 1, and now again in Phase 2. Chassis dynamometer testing as a path for vehicle certification is highly impractical considering the tremendous burden of testing the large number of powertrain and vehicle variants as compared to the simulation approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.67]

**More on EPA Alternatives** - The agencies have presented a sufficiently wide range of alternatives representing various approaches to further regulating the heavy-duty industry, with the exception of one alternative that was not presented and should be – namely not having a separate engine standard. The agencies should add to their current discussions on the pros and cons of maintaining a separate engine standard, and add an alternative that estimates the benefits and costs of not including a separate engine standard. An additional alternative could be presented on including an anti-backsliding engine standard as opposed to the technology-forcing standard proposed in Alternative 3/the preferred approach. [EPA-HQ-OAR-2014-0827-1164-A1 p.73]

**Technology neutral standards:** The EPA proposes technology neutral standards. We agree that this is the right approach. Prescribing technology to vehicle manufacturers is not the right role for the EPA. That said, the agencies should recognize that—although they purport to create technology neutral standards—in creating a separate engine standard alongside a vehicle standard, the agencies depart from technology neutrality, forcing technology onto the engine even if the same net emissions impact on-road could be achieved through vehicle-side technologies. We recommend that, upon a showing from a manufacturer that a vehicle-side technology creates extra emission reductions beyond those necessary for vehicle-side compliance, that the manufacturer be able to convert those extra emission reductions into an engine-side credit (and vice versa). Only with such an allowance will the agencies truly achieve the technology neutrality that they claim their regulations have. [EPA-HQ-OAR-2014-0827-1164-A1 p.116]

**Organization:** Daimler Trucks North America, Navistar Inc., Paccar Inc., and the Volvo Group

#### Recommendation

EPA and NHTSA should not increase the engine efficiency targets proposed in the NPRM. As a fundamental principle, separate engine standards provide no environmental or energy efficiency benefit because the GHG reduction benefits are calculated only with the engine incorporated into the vehicle. Therefore increasing the stringency of a separate engine standard provides no direct environmental benefit. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

Consequently, the separate engine standards should be set at a level that avoids unintended consequences. EPA and NHTSA should recognize the importance of considering the engine as an integrated part of a complete vehicle. With this approach, the agencies can avoid forcing engine optimization on fixed test cycles that do not, and cannot, replicate how the engine operates in each vehicle. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

The conflicting arguments in the subject paper demonstrate that overly stringent separate engine standards are inappropriate, unnecessary, and counterproductive. As we have argued, it is fundamental that the engine influence on the vehicle (size, weight, cooling demand, and cost) and the vehicle influence on the engine (power demand, gearing, and controls) must be considered. Furthermore, from a purely economic perspective, OEMs should be able to develop and choose the efficiency technologies that best fit with their capabilities and expertise to meet regulatory GHG objectives and customer requirements. This will increase competition and innovative approaches while providing optimized products with greater market acceptance. EPA should support this and acknowledge that the engine specific regulation is meant to ensure a level of improvement to be achieved with minimal potential tradeoffs on other vehicle efficiency features, and to ensure some continued link to criteria emissions testing. [EPA-HQ-OAR-2014-0827-1894-A1 p.4-5]

Conclusion:



Furthermore, there is no efficiency or GHG contribution from a separate engine standard that is not already included in the complete vehicle standard. The logical and appropriate conclusion is that engine improvements should be driven from the complete vehicle standard and any separate engine standard should represent a level that can be achieved without compromise in vehicle efficiency or lowest total cost of vehicle operation, not an aggressive limit that forces manufacturer to focus on the engine over other potential efficiencies. EPA and NHTSA have accomplished this in their phase 2 proposal. These engine targets should not be made more stringent. [EPA-HQ-OAR-2014-0827-1894-A1 p.20]

**Organization:** Eaton Vehicle Group

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, pp. 38-39.]

Eaton believes that the separate engine and vehicle standards found in Phase 1 should be maintained in Phase 2. The separate standards reflect the reality of the commercial vehicle market, drive adoption of efficient technologies, and provide a structure that is proven and accepted in the U.S. market today.

**Organization:** Engine Research Center

I applaud the agencies in recognizing the importance of a separate engine efficiency standards, for a number of reasons: [EPA-HQ-OAR-2014-0827-1141-A1 p.1]

- The EPA has a robust compliance program based on engine testing, making it straightforward to hold engine manufacturers accountable. Without a separate engine standard, in-use compliance becomes more subjective. Having clearly defined compliance responsibilities is important to both the government agencies and market participants. [EPA-HQ-OAR-2014-0827-1141-A1 p.1]
- Engine standards for CO<sub>2</sub> require engine manufacturers to optimize engines for both efficiency and for non-CO<sub>2</sub> emissions, particularly for NO<sub>x</sub> emissions given the strong counter-dependency between engine-out NO<sub>x</sub> and fuel consumption. By requiring engine to meet both NO<sub>x</sub> and CO<sub>2</sub> standards, manufacturers will include technologies that optimize for both rather than alternative calibrations that would trade lower NO<sub>x</sub> emissions for higher CO<sub>2</sub> emissions depending on how the engine and vehicle is tested. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]
- Because engine fuel consumption can vary significantly between transient and steady state operations, only steady-state engine data is required for chassis certification. The separate engine standard for vocational vehicles provides the only measure of engine fuel consumption under transient conditions. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]
- A separate engine standard enables the federal agencies to exempt certain vehicle classes from some or all of the vehicle standards without foregoing efficiency improvements. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]

**Organization:** Environmental Defense Fund (EDF)

### **1. Strong engine standards are critical to a meaningful program**

We reiterate our strong support for the Agencies' proposed structure of the rule – separate engine standards are imperative to drive innovative engine technology and provide proven, measureable and

durable real-world emissions reductions. However, these benefits can only be realized through robust engine standards. Weak standards, as proposed by the Agencies, do not drive advanced technologies and fall short of unlocking the full capabilities of existing technologies. Additionally, limited engine standards do not take advantage of the robust in-use enforcement provisions of the engine program. These provisions provide high confidence that GHG reductions demonstrated on new engines actually occur in the real world. In order to secure the significant benefits afforded by separate engine standards, the Agencies' must finalize far more meaningful standards that drive technology and allow for robust enforcement. [EPA-HQ-OAR-2014-0827-1886-A1 p.3]

**EDF supports a separate engine standard as a key element of a strong rule**

EDF fully supports the proposed inclusion of a separate engine performance standard and full vehicle performance standard. An engine performance standard for each vehicle class is an essential element of a well-designed heavy-duty fuel efficiency program for several reasons. First, engine standards provide proven, measureable and durable real-world emissions reductions. Engine standards also help to drive development of advanced engine technologies, which can provide a significant proportion of total vehicle fuel efficiency potential. An engine standard also allows EPA and manufacturers to simultaneously evaluate oxides of nitrogen (NOx) and carbon dioxide (CO2) emissions, ensuring efficiency improvements do not result in higher NOx emissions and vice versa. We encourage the agencies to finalize a robust separate engine standard (see Section VI below). In addition to an engine standard, EDF supports a rigorous full vehicle standard to drive technology advancements across the rest of the vehicle, including the transmission, aerodynamic improvements, idle reduction, and more. [EPA-HQ-OAR-2014-0827-1312-A1 p.15]

**Organization:** Honeywell Transportation System (HTS)

We strongly support the separate engine standard reflected in the current proposal, as we believe a vehicle-only standard creates problems of sustainability and enforcement. For example, while tractor aerodynamic solutions can provide a tangible benefit for applications that travel long distances at sustained speeds, studies<sup>1</sup> have shown that these require precise adjustment which can be adversely affected in real world situations (aftermarket modifications, improper adjustment) and could negatively impact payload capability due to the increased weight. This increases an operator's maintenance costs, increases compliance complexity for Original Equipment Manufacturers (OEMs), and creates enforcement challenges for the agencies due to additional application-specific testing, diagnostic, and inspection criteria. [EPA-HQ-OAR-2014-0827-1230-A1 p.2]

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1 Ricardo. Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles – Lot 1: Strategy Final Report to the European Commission – DG Climate Action Ref: DG ENV. 070307/2009/548572/SER/C3

**Organization:** Manufacturers of Emission Controls Association (MECA)

MECA strongly supports EPA's decision to retain the Phase 2 regulatory structure based on separate engine and vehicle standards that has been proven effective under the Phase 1 heavy-duty GHG standards. [EPA-HQ-OAR-2014-0827-1210-A3 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.96.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.211.]]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

Although we recognize that many vehicle manufacturers are recommending elimination of the separate engine standard and removal of the alternative engine mapping approach, MEMA represents many suppliers that provide technologies that will have a direct impact at achieving the NPRM targets by having separate vehicle and engine requirements. Therefore, we support retaining separate vehicle and engine requirements to provide continuity of the standards' regulatory structures and strike a balance between compliance and market latitude. Additionally, the longer timeframe of the Phase 2 standards provides the industry foresight to develop the technologies needed to continue to meet the standards, particularly during the middle and latter stages of the rule. These approaches are vital to the long-term success of the standards. [EPA-HQ-OAR-2014-0827-1274-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.193.]]

**Organization:** National Association of Clean Air Agencies (NACAA)

We strongly endorse the continued inclusion of separate but complementary standards for engines and whole vehicles – this is a fundamental aspect of the rule. [EPA-HQ-OAR-2014-0827-1157-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.51.]]

Separate engine standards are critical for the Phase 2 program because they directly address the source of GHG emissions and ensure that engine manufacturers will incorporate some level of engine efficiency improvements that will reduce GHG emissions over the useful life of the vehicle. Engine test procedures and methods have been refined over decades of implementation and provide high certainty that verifiable emission reductions will occur when engines are in use. Separate engine standards are also important because engine GHG emission levels can be directly verified through the existing engine certification test protocols: the Supplemental Emission Test (SET) and Federal Test Procedure (FTP). The SET and FTP used to certify engines to GHG and criteria pollutant emission standards, such as for oxides of nitrogen (NO<sub>x</sub>), provide a direct link between GHG and NO<sub>x</sub> emission measurement methods. Further, separate engine standards prompt development of advanced engine technologies that, in turn, can offer a substantial improvement in a vehicle's fuel efficiency. In the absence of separate engine standards, some vehicle manufacturers may rely more heavily on vehicle improvements, such as aerodynamic technologies, that are less effective at reducing fuel consumption and emissions, particularly as vehicles change vocations, or functions, over time. [EPA-HQ-OAR-2014-0827-1157-A1 p.2]

**Organization:** National Automobile Dealers Association (NADA)

As with Phase 1, the Phase 2 proposal includes separate standards for tractor and vocational engines. The goal of the diesel engine mandates is to reduce GHG emissions and fuel consumption by some 4 percent over Phase 1. Consequently, 4.2 of the 24 percent improvement sought for large tractors and 4 of the 16 percent improvement for vocational vehicles must come from engine improvements by MY 2027. [EPA-HQ-OAR-2014-0827-1309-A1 p.10]

The Phase 2 proposal's long list of potential improvements for compression (CI) and spark ignition (SI) engines generally fall into the categories of combustion optimization, improved air handling, reduced friction, improved emissions after-treatment, and waste heat recovery.<sup>11</sup> NADA/ATD recognizes that most, if not all, OEMs will rely on engine performance improvements to achieve compliance with the Phase 2 program. But, NADA/ATD is concerned that some of these strategies could involve disproportionately high costs as measured on a unit of benefit realized basis. Consequently, ATD urges EPA and NHTSA to: [EPA-HQ-OAR-2014-0827-1309-A1 p.10]

1. Not to include engine-only mandates in the final rule. Manufacturers should have the ability to choose the most cost-effective compliance strategies from the basket of all available options. [EPA-HQ-OAR-2014-0827-1309-A1 p.10]

2. Alternatively, engine-specific mandates should be designed only to prevent back-sliding from the Phase 1 MY 2018 standards. Moreover, manufacturers involved in both engine and vehicle manufacturing should be free to apply credits generated by “over performing” with “non-engine” strategies against their engine compliance obligations, and should be able to provide credits generated in one vehicle class or category against their compliance obligations for another. Providing OEMs with such flexibility will maximize compliance and economic efficiencies, bringing to market the most affordable compliant vehicles and engines. Since a gallon of fuel is a gallon of fuel and a gram of GHGs is a gram of GHGs, what matters most is the performance outcome, not how compliance is achieved. [EPA-HQ-OAR-2014-0827-1309-A1 p.10]

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11 Advanced technology strategies include: SI engines: cylinder deactivation, direct injection, turbocharging/downsizing, and cooled exhaust gas recirculation. CI: automatic transmissions, hybridization,

**Organization:** Natural Resources Defense Council (NRDC)

**The Proposal Advances Improvements in the Structure of the Standards; The Agencies Should Maintain the Separate Engine Standard** [EPA-HQ-OAR-2014-0827-1220-A1 p.6]

NRDC also supports the agencies’ proposal to maintain separate engine standards. NRDC believes that the separate standard is necessary to ensure that all feasible and cost-effective advancements are made in the engine to lower carbon pollution and fuel consumption. As we noted previously, there are important opportunities for advancements in tractor engines and vocational gasoline engines. NRDC agrees with the agencies that there are advantages with maintaining separate engine standards including consistent testing with non-GHG emissions requirements that will prevent any trade-offs between carbon dioxide and emissions such as nitrogen oxides. [EPA-HQ-OAR-2014-0827-1220-A1 p.6]

**Organization:** Power Solutions International (PSI)

We applaud the agencies recognition for the need to have separate efficiency standards applicable to engines. Engine manufacturers are required to meet criteria emission standards and imposing the GHG emission standards on the engine allows manufacturers the opportunity to optimize the engine for fuel efficiency while developing the engine to meet criteria emissions, specifically, NO<sub>x</sub>, NMHC and CO. [EPA-HQ-OAR-2014-0827-1161-A1 p.1]

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<sup>1</sup> <http://www.epa.gov/otaq/documents/eng-cert/on-hwy-2014e.xls>, 2015 and 2016MY files posted appear to be incomplete

**Organization:** Shahed, SM

I applaud the agencies in recognizing the importance of a separate engine efficiency standards, for a number of reasons: [NHTSA-2014-0132-0033-A1 p.1]

- The EPA has a robust compliance program based on engine testing, making it straightforward to hold engine manufacturers accountable. Without a separate engine standard, in-use compliance becomes more subjective. Having clearly defined compliance responsibilities is important to both the government agencies and market participants. [NHTSA-2014-0132-0033-A1 p.1]
- Engine standards for CO2 require engine manufacturers to optimize engines for both efficiency and for non-CO2 emissions, particularly for NOx emissions given the strong counter-dependency between engine-out NOx and fuel consumption. By requiring engine to meet both NOx and CO2 standards, manufacturers will include technologies that optimize for both rather than alternative calibrations that would trade lower NOx emissions for higher CO2 emissions depending on how the engine and vehicle is tested. [NHTSA-2014-0132-0033-A1 p.1-2]
- Because engine fuel consumption can vary significantly between transient and steady-state operations, only steady-state engine data is required for chassis certification. The separate engine standard for vocational vehicles provides the only measure of engine fuel consumption under transient conditions. [NHTSA-2014-0132-0033-A1 p.2]
- A separate engine standard enables the federal agencies to exempt certain vehicle classes from some or all of the vehicle standards without foregoing efficiency improvements. [NHTSA-2014-0132-0033-A1 p.2]

To be effective in achieving these benefits, however, the separate engine standard must not only be commercially acceptable and reasonable, but also meaningful. The new MDV and HDV standards are designed to “spur innovation, encouraging the development of and deployment of existing and advanced cost-effective technologies for a new generation of cleaner, more fuel-efficient commercial trucks...” The standard are meant to be set “not only on currently available technologies but also on utilization of technologies now under development or not yet widely deployed while providing significant lead time to assure adequate time to develop, test, and phase in these [technologies].” [NHTSA-2014-0132-0033-A1 p.2]

**Organization:** South Coast Air Quality Management District (SCAQMD)

U.S. EPA and NHTSA Proposed Greenhouse Gas Emissions and Fuel Efficiency Standards

In addition, we strongly support having separate emissions standards for engines and full vehicles. Without separate standards, there are no guarantees that even modest enhancements that will provide engine efficiency improvements to reduce greenhouse gas emissions over the useful life of the vehicle are made. As an example, with the recent certification of a 8.9 liter natural gas engine (see Attachment 2 and discussion below), the engine manufacturer implemented a modest enhancement of having closed crankcase ventilation system, which resulted in lower methane emissions. Other technology enhancements that can potentially result in lowering greenhouse gas emissions including improvements in combustion efficiencies, can lead to lowered greenhouse gas emissions directly from the engine. [EPA-HQ-OAR-2014-0827-1181-A1 p.2]

[Attachment 2 can be found on p.15 of this docket]

**Organization:** Union of Concerned Scientists (UCS)

THE NEED FOR SEPARATE ENGINE STANDARD

We agree with the agencies' proposed structure of the rule, with separate standards for both heavy-duty engines and the vehicles that use these engines, for three reasons: 1) verifiable emissions; 2) compatibility with criteria emissions regulations; and 3) ensured investment in efficiency technologies. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

While ultimately the emissions of use occur at the vehicle level, the current regulations are measured by simulation with the GEM model, not a true full vehicle test. Therefore, the engine standard provides the closest measure of true real world emissions reductions. Furthermore, unlike many other technologies which may not last the lifetime of the vehicle, such as low-rolling resistance tires or some aerodynamic add-ons, the engine cannot be tampered with nor replaced without meeting a similar level of efficiency. This helps set a guaranteed threshold of fuel savings and global warming emissions reductions throughout the entire vehicle lifetime without relying solely upon the agencies' ability to enforce the regulations. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

Currently, manufacturers must already perform a separate engine test to certify compliance with existing criteria pollution standards. Therefore, an engine test adds no additional test burden. Furthermore, this helps to ensure that vehicles are achieving reductions in global warming emissions without compromising criteria pollution standards. In addition to the engine standard test procedure, in the agencies' proposed vehicle standard, engines used in GEM must already go through an additional engine map certification—we therefore recommend that the agencies collect this additional data on the criteria emissions during this engine mapping procedure to inform future pollution standards and further ensure that vehicles continue to achieve reductions in both criteria and global warming emissions. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

The structure of the tractor market also lends itself to a separate engine standard. The largest supplier of tractor engines is independent of the four vehicle manufacturers because of the long-standing desire for vehicle purchasers to fully customize vehicles down to the precise engine, transmission, and axles offered by all suppliers. Currently, the vehicle manufacturers are split between those who are more vertically integrated and those who continue to operate in the way that the market has traditionally behaved. Given this heterogeneous network of suppliers, a separate standard for engines helps ensure that all vehicle manufacturers will be able to rely on technology innovation from individual suppliers by providing the overall certainty that a distributed marketplace cannot. This is exceptionally important in the case of engines, which have significant complexity and heightened research costs compared to many other aspects of the vehicle. This will help ensure that vehicle purchasers will continue to have a wide assortment of compliant, customizable vehicles from all makes. [EPA-HQ-OAR-2014-0827-1329-A2 p.5-6]

**Organization:** Volvo Group

We fully agree that evaluating vehicle technology as an integrated package is the only effective way to approximate real world results. The Agencies' proposal provides appropriate credits to promote development and deployment of many important efficiency technologies. Since the engine is fully included in the vehicle evaluation, there is no need for, or benefit from, setting separate engine standards. [EPA-HQ-OAR-2014-0827-1290-A1 p.9]

Complete Vehicle Regulation

Volvo Group greatly appreciates that the proposed rule incorporates a complete vehicle approach utilizing a vehicle simulation (GEM) that incorporates the engine, driveline, and other key inputs that impact efficiency. GEM determines the fuel consumption and GHG emissions over an assigned road

cycle for each vehicle type. The customer's choice of aero fairings, tire type, engine, powertrain, and other details are entered as inputs to the tool, and the output is compared to the regulated target for that vehicle category for the purpose of credit tracking and averaging. This type of modeling has been done successfully by all major heavy-duty vehicle manufacturers, by Argonne National Lab, and in the regulatory vehicle model (GEM) proposed for the Phase 2 rule. It is a proven technique that correlates well with on-road testing. In fact, modeling is a much more accurate approach than in-use or chassis dyno testing to measure efficiency differences between vehicles because test variables, such as driver differences, traffic, wind, and weather, are eliminated. Even in chassis dyno testing, driver variability is significant, key load factors (rolling resistance and aerodynamics) must be measured and simulated, and testers must compensate for tires interacting with dyno rollers. Simulation offers the most efficient, accurate, robust and repeatable means for assessing vehicle efficiency, and is therefore the ideal tool for certification to efficiency and GHG standards. [EPA-HQ-OAR-2014-0827-1290-A1 p.13-14]

### Engines should not be Separately Regulated

In the Phase 1 rule, the engine is separately regulated and not included in the vehicle evaluation. Engine efficiency is measured on the test cycles developed some 30 years ago for criteria emissions evaluation, cycles that no longer reflect how engines operate in today's vehicles. These tests do not consider the size and power output of the engine relative to the vehicle's power demand, the installation impact of the engine system, or the impact of the powertrain on how the engine operates. Instead, each engine's test points are based on its power and torque capability. A larger engine is tested at higher power and torque, regardless of the actual power needed for vehicles in which it will be installed. [EPA-HQ-OAR-2014-0827-1290-A1 p.14]

In recent years, Class 8 tractors (the vehicles that consume most of the commercial fleet fuel) are increasingly using automated manual transmissions or AMTs. These transmissions retain the high efficiency of a manual gearbox but use computer control to precisely and automatically shift gears without the driver operating a clutch or shift lever. Some of these, including the Volvo I-shift and Mack M-drive, sense vehicle load and road grade to optimize shifts points for maximum efficiency. Because shifting is fully automatic, drivers are no longer troubled if a downshift is required on a road grade. This has allowed the industry to increase fuel efficiency by running a lower overall gear ratio, thereby slowing the engine down at typical highway speeds. Engines have been re-optimized to increase low speed torque and to maximize efficiency at these lower speeds. This is one example of vehicle technology changing how engines operate that is reflected in a complete vehicle regulation but not in a separate engine test. The regulatory engine test cycles, even considering the reweighted RMC, would reward optimizing the engine for higher speeds where it rarely even operates in today's trucks. An engine optimized for the regulatory cycles gets higher efficiency in the regulatory test but potentially worse efficiency on the road in service. [EPA-HQ-OAR-2014-0827-1290-A1 p.14]

In addition, as improvements are made to the aerodynamic of tractors and trailers, as tire rolling resistance is reduced, and as accessory loads are reduced, the cruise power demand of vehicles is reduced. This reduced power demand could allow for use of smaller engines or further down-speeding the engine. But bigger engines tend to be more efficient on separate engine tests due to fundamental engine thermodynamics while smaller engines tend to do better on vehicle efficiency because they operate closer to their peak efficiency torque and speed, in addition to the advantages they offer in weight and limiting inefficient driving habits. [EPA-HQ-OAR-2014-0827-1290-A1 p.14]

Perhaps the most significant problem with separately regulating an engine is the failure to consider the installation impacts of the engine and related technology. Bigger engines obviously take up more space and demand more cooling capacity that can only be efficiently provided by forcing ram air through the

radiator and charge air cooler. One of the proposed engine efficiency technologies is known as Rankine waste heat recovery. This system is much like a steam engine, using a working fluid that is pumped under pressure through a heat exchanger (or boiler) in the exhaust gas to boil the fluid. The pressurized gas is expanded through a turbine or other mechanical device to produce power that must be delivered back to the vehicle's powertrain either mechanically through a complex gear train or electrically via a generator-motor system. The expanded gas must then be cooled back to liquid state using a condenser prior to re-entering the pumping stage. Beyond the obvious complexity, the whole system adds weight and requires space on the vehicle. Both space requirements and weight distribution can force tractor manufacturers to extend the wheel base, which may increase the trailer gap (particularly for day cabs and short sleepers) resulting in increased aerodynamic drag. Equally concerning is the substantial increase in cooling required by the condenser, resulting in further increase in aerodynamic drag that can negate any benefits of the engine efficiency. Another issue with this type system is the substantial lag time between increased power demand and power availability due to the thermal inertia of the system. In sum, the system can deliver measurable efficiency in an engine test, but may not deliver in the vehicle. The whole industry is evaluating the merits of waste heat recovery, but a lot of research is still needed to determine if this technology is worthy of industrialization. Only then should manufacturers commit to the intensive effort to make this technology reliable, durable, and cost-effective. Even so, it will only work well when it is fully developed and when it is applied with the appropriate engine and vehicle combinations to maximize its efficiency and minimize negative vehicle impacts. [EPA-HQ-OAR-2014-0827-1290-A1 p.14-15]

Engines should only be evaluated based on how they operate in vehicles, not on a fixed cycle in a test cell. Proponents of engine efficiency regulation argue that such testing is more accurate and verifiable than a complete vehicle approach. They fail to consider, however, that, the correlation between these engine tests and the desired in-use fuel efficiency is tenuous at best and may even be inverted. There is little value to highly accurate measurement of a parameter that does not correlate well with the desired goal. When the engine is measured as part of the full vehicle approach, its efficiency is mapped at more than 100 points (compared to only 13 test points in the tractor engine test) that feed into a vehicle model that exercises the engine at the speed and load points dictated by the vehicle's power demand and drivetrain running on an appropriate road cycle, i.e. like it actually runs in the vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.15]

Some have argued that it is important to include a separate engine standard so that manufacturers don't neglect enhancement opportunities from the component that actually burns the fuel. The problem is that engineers have been squeezing blood from this stone for decades; this is precisely why the next level of research is aimed at evaluating technologies as exotic as waste heat recovery to eke out a few more percent from a highly mature technology. The fact that OEMs are doing this is strong evidence that OEMs are not neglecting and would not neglect engine technology without the specter of an engine standard. Furthermore, technologies integrated into the engine itself have to operate in the harshest environment found on the vehicle; if such measures are unnecessary, it does not make sense for EPA to insist that manufacturers integrate new technology into this environment. This is especially true in this rulemaking, where other opportunities for efficiency improvement exist elsewhere on the vehicle. In fact, any competitive manufacturer must look at all efficiency technologies and select those that deliver the highest customer value and meet regulatory requirements for the complete vehicle. This is amply demonstrated in the automobile market, where engine improvements are a huge part of the technology deployed to meet regulated efficiency without any requirement specifically regulating engines. [EPA-HQ-OAR-2014-0827-1290-A1 p.15]

Aside from the technical issues related to engine efficiency regulation, we note the typically high cost associated with complex engine system development and deployment. These costs include engineering



development, product cost, and manufacturing costs. More concerning however, are on-going costs and operational impacts associated with maintenance and down-time. Such costs and impacts have typically been grossly underestimated by regulators, yet they are the primary reasons customers have been reluctant to purchase such technologies. [EPA-HQ-OAR-2014-0827-1290-A1 p.15-16]

We note that there is no benefit accrued from regulating engine efficiency once the engine has been fully accounted for in the vehicle efficiency evaluation. Unlike the current (Phase 1) rule, wherein the engine is isolated from the vehicle, all benefits accrued under the Phase 2 proposal are based on reductions in fuel used and GHGs emitted from complete vehicles. There is no basis or justification for continued engine regulation. The Agencies have failed to do any assessment of the cost of engine efficiency regulation considering the loss of vehicle design flexibility, on-going testing and reporting requirements, and increased total cost of operation for vehicles. However, since there is no assignable benefit to regulating engines, any cost cannot be justified. [EPA-HQ-OAR-2014-0827-1290-A1 p.16]

### Engine Efficiency

Recognizing that the Agencies have chosen to include a separate engine efficiency regulation, we encourage them not to increase stringency beyond the proposed levels. Maintaining engine stringency at these levels pushes the envelope of engine technology without forcing the many negative consequences we have outlined in these comments. Furthermore, we are very concerned that an engine manufacturer could generate significant credits (for example by selling alternatively fueled engines) so that they could avoid selling undesirable, complex, expensive engine technology, while competitors, lacking such credits, would be pushed out of the market. [EPA-HQ-OAR-2014-0827-1290-A1 p.19-20]

### **Response:**

#### *Separate Engine Standards*

The agencies receive many comments on the proposed regulatory structure, primarily related to the need for separate engine standards. Those supporting the separate engine standards largely agreed with the agencies' reasons given in the NPRM (80 FR 40181), that they would:

- Enhance the agencies' compliance efforts
- Maintain a connection between GHGs and criteria pollutants (such as NOx)
- Measure transient fuel consumption control
- Enable simpler vehicle requirements for small volume and specialty vehicles

With respect to the compliance advantages, we also see a benefit to having a compliance program that is not entirely dependent upon computer simulations. ACEEE also supported separate engine standards "to set out direct, multiyear targets for engine performance sufficient to promote substantial, sustained investment in engine efficiency." They argued that if "the only signal to improve engine efficiency is filtered through the lens of whole vehicle efficiency, there will remain uncertainty about how much of the improvement will fall to the engine."

Those opposing separate engine standards did not dispute these advantages. Instead they expressed concerns similar to those the agencies discussed in the NPRM. However, commenters opposing separate engine standards appear to actually oppose separate engine standards *that are too stringent* rather than separate engine standards *per se*. Volvo acknowledged that the proposed stringency would not cause the adverse consequences. We addressed this issue in the NPRM (80 FR 40182):

*Note that commenters opposing separate engine standards should also be careful distinguish between concerns related to the stringency of the proposed engine standards, from concerns inherent to any separate engine standards whatsoever. When meeting with manufacturers prior to this proposal, the agencies heard many concerns about the potential problems with separate engines standards that were actually concerns about separate engine standards that are too stringent. However, we see these as two different issues. The agencies do recognize that setting engine standards at a high stringency could increase the cost to comply with the vehicle standard, if lower-cost vehicle technologies are available. Additionally, the agencies recognize that setting engine standards at a high stringency may promote the use of large-displacement engines, which have inherent heat transfer and efficiency advantages over smaller displacement engines over the engine test cycles, though a smaller engine may be more efficient for a given vehicle application. Thus we encourage commenters supporting the separate engine standards to address the possibility of unintended consequences such as these.*

In addition, the agencies pointed out that:

*In the past there has been some confusion about the Phase 1 separate engine standards somehow preventing the recognition of engine-vehicle optimization that vehicle manufacturers perform to minimize a vehicle's overall fuel consumption. It was not the existence of separate engine standards that prevented recognition of this optimization. Rather it was that the agencies did not allow manufacturers to enter input into GEM that characterized unique engine performance. For Phase 2 we are proposing to require that manufacturers input such data because we intend GEM to recognize this engine-vehicle optimization. The continuation of separate engine standards in Phase 2 does not undermine in any way the recognition of this optimization in GEM.*

To address these opposing comments, it is helpful to consider them in the context of three relative engine stringency scenarios. For each scenario, the engine stringency is compared to levels vehicle manufacturers would choose if there were no separate engine standards.

1. For the first case, assume the engine standards were low enough that they required less technology than vehicle manufacturers would choose to apply to meet the vehicle standards. In this scenario, the concerns raised in the opposing comments would not apply. However, the benefits of having separate engine standards would occur.
2. For the second case, assume the engine standards were set so they required the same technology that vehicle manufacturers would choose to apply to meet the vehicle standards. Like the first scenario, the concerns raised in the opposing comments would not apply, but the benefits of having separate engine standards would occur.
3. For the third case, assume the engine standards were set stringent enough that they required more technology than vehicle manufacturers would choose to apply to meet the vehicle standards. Only in this scenario, would the concerns raised in the opposing comments would apply. However, since the benefits of having separate engine standards would also occur, the agencies would need to balance these against one another.

In neither the first case nor the second case would the concerns raised in the comments apply at all, so they clearly could not justify sacrificing the benefits of having separate engine standards (benefits which commenters did not dispute) under those scenarios. Thus, only under the third scenario would the

opposing comments be relevant. This is the concern raised by the vehicle OEMs. However, the agencies do not believe the standards being set are too stringent. As described elsewhere, the tractor and vocational *vehicle* standards are stringent, technology-forcing standards that will require vehicle manufacturers to make extensive use of available engine and vehicle technologies, including integration of the two. Although the feasibility analyses for those vehicle standards project some technological flexibility for vehicle manufacturers, we believe it to be very unlikely that manufacturers would be able to achieve the final vehicle standards with engines that significantly exceed the engine standards.

It is important to also note that we project the engine standards to be both feasible and very cost-effective. Caterpillar claimed that engine-based controls are expected to be more expensive than vehicle-based controls. We disagree. For example, we project the 2027 heavy heavy-duty tractor standards to cost \$1,579 per engine to achieve a 5.1% reduction, which is comparable to the cost-effectiveness of other projected vehicle standards. Thus, if a vehicle manufacturer were to identify some less expensive vehicle technologies, it is not clear that the vehicle manufacturer's preferred path would be to scale back these cost-effective engine reductions.

Volvo overstates the risks associated with the regulatory engine test cycles, when they argue that the reweighted RMCSET would reward optimizing tractor engines for higher speeds than are common in today's trucks. This ignores the full range of the impacts of engine speeds, including those associated with the shape of the torque curve. We do not believe manufacturers will intentionally sacrifice in-use fuel efficiency to gain a false benefit on the engine test cycle.

Finally, even if having separate engine standards resulted in marginally higher costs than would have occurred without engine standards, the benefits of having the separate standards would still justify the costs. Therefore, the agencies are finalizing separate engine standards.

#### *Including Engines in GEM*

The agencies are finalizing the regulatory structure that includes both separate engine standards and a recognition of engine fuel maps in GEM. Some commenters expressed explicit support for including engine fuel maps in GEM to achieve full vehicle simulation. In addition, other commenters who focused their structural comments on the need for separate engine standards generally did not oppose the inclusion of engine fuel maps in GEM.

Some of the arguments raised in opposition to separate engines standards seemed to assume that having separate engine standards precluded including engine technologies in GEM. However, the final structure accomplishes both.

#### *Chassis Testing*

We are finalizing the proposed chassis testing requirements, which will:

- Continue to require chassis-testing for certification of complete HD pickups and vans.
- Add a new requirement for tractor manufacturers to perform demonstration chassis testing on a small sample of production tractors.

CARB supported expanded use of chassis testing. However, Daimler commented that chassis dynamometer is highly impractical. While we understand the potential benefits of expanded chassis testing, we also recognize the practical obstacles to widespread chassis testing. We believe the requirements being finalized strike the proper balance.

### *Other Regulatory Structure Issues*

It is worth noting that the agencies regard the standards for pickups and vans, vocational vehicles, tractors, trailers and engines as independent of each other, functioning sensibly on their own. Thus, for example, the standard for tractors is not dependent on the engine standards (engine standards are separately implemented by engine dynamometer testing, whereas the tractor standards are implemented via GEM);<sup>37</sup> the trailer standard has no relation to the vocational vehicle standard (these are separate averaging sets even after ABT is available for trailers). Also, the NHTSA fuel consumption standards are independent of the EPA greenhouse gas standards and vice versa. Each standard implements, and is justified by, each agency's respective and distinct statutory authority. See preamble Section I.E. and *Delta Construction Co. v. EPA*, 783 F. 3d 1291, 1297-98 (D.C. Cir. 2015). The agencies therefore regard each of these standards as legally severable.

Although the FRM generally discusses these components separately by category, many if not all the subcategories are also legally severable. Certainly, anything separated by an averaging set would be equally severable. For example, standards for heavy heavy-duty engines and vehicles are independent of the standards for smaller engines and vehicles.

EPA has also issued engine standards for greenhouse gases other than CO<sub>2</sub>, namely N<sub>2</sub>O and CH<sub>4</sub>. These standards are independent of the engine CO<sub>2</sub> standards. Those CO<sub>2</sub> standards function identically whether or not there were the standards for N<sub>2</sub>O and CH<sub>4</sub>, and vice versa.

Finally, EPA has taken certain final actions which are exclusive to EPA programs. These include actions relating to rebuilt engines used in new chassis (i.e. glider vehicles) and certain additional actions described in Section XIII of the Preamble to the final rule. These actions are independent of the greenhouse gas standards. (The final rule indicates that glider vehicles must meet greenhouse gas standards, but the rules are structured so this requirement functions independently of the requirements providing allowances for usage of engines not meeting criteria pollutant standards for the model year the glider vehicle is assembled.)

### **3.3 Proposed Engine Standards for CO<sub>2</sub> and Fuel Consumption**

EPA and NHTSA project that CO<sub>2</sub> emissions and fuel consumption reductions can be feasibly and cost-effectively met through technological improvements to diesel engines. The agencies also discussed several alternatives in the proposal. When considering alternatives, it is necessary to evaluate the impact of a regulation in terms of CO<sub>2</sub> emission reductions, fuel consumption reductions, technical feasibility and technology costs. However, it is also necessary to consider other aspects related to feasibility and cost, such as manufacturers' research and development resources, the impact on purchase price, and the impact on purchasers. Manufacturers are limited in their ability to develop and implement new technologies due to their human resources and budget constraints. This has a direct impact on the amount of lead time that is required to meet any new standards.

The agencies received some general comments on the overall stringency of the proposed Phase 2 diesel engine standards. Several entities encouraged the agencies to adopt more stringent standards, while other commenters cautioned the agencies from adopting final standards that are more stringent than those proposed. The agencies considered all of the general comments associated with the proposed

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<sup>37</sup> GEM requires a measured engine fuel map, which would also be collected using an engine dynamometer; the mapping procedure is independent of the engine standards.

engine standards and the more detailed comments. We believe there is merit in many of the detailed comments and these are discussed in detail below. Instead of merely choosing from among the proposed alternatives, the agencies have developed a set of final engine standards that reflect our reevaluation of the technologies, as well as the test procedures. Readers are encouraged to see Chapter 2 of the RIA (especially Chapters 2.6 and 2.7) which includes more detailed discussions of each technology, updated to reflect new information provided in the comments.

As can be seen from the comments, there is uncertainty and a wide range of opinions regarding the extent to which these technologies can be applied to heavy-duty engines. Vehicle manufacturers tended to take the conservative position for each technology and argue that the agencies should not project effectiveness or adoption rates beyond that which is certain. Many other commenters took a more optimistic view and argued for the agencies to assume that each potential technology will be highly effective. However the agencies believe the most likely outcome will be that some technologies will work out better than expected while others will be slightly more challenging than projected. Thus, the agencies have tended to make balanced projections for the various technologies, although some may be slightly optimistic while others are somewhat conservative. We believe the overall effect of this approach will be standards that achieve large reductions with minimal reliability risks to the industry.

Although the standards are stringent and technology-forcing (since they are based in part on technologies not fully commercialized at this moment), the agencies project manufacturers will have some technological flexibility. However, it is important to emphasize that we expect this flexibility to be constrained by manufacturers' financial abilities to invest in the new technologies. The choice is less likely to be between doing more or less, and more likely to be between how heavily to invest in each technology. Manufacturers will probably also need to make choices between developing technologies themselves, and purchasing technologies developed by suppliers.

The individual comments on the engine standards and responses are presented below. These responses to the individual comments must be read in the context of the preceding paragraphs, which explains that the agencies balanced the feasibility, costs, benefits, and risks for the various technologies. For example, without this context, responses to comments arguing for more stringent standards could be misread to question the feasibility of the standards. Such responses necessarily focus on the challenges that engine manufacturers will face in improving their engines, and may not emphasize that the standards are nevertheless feasible.

Because so many of these comments address the "stringency" of the engine standards, it is also worth noting the three different ways in which the term "stringency" can be used. It can refer to the level of technology required to meet the standards. It can also refer to the percent reduction from the baseline. When used in this context, it is critical to also consider the baseline from which the reductions are measured. Finally, it can refer to the numerical levels of the standards. When used in this numerical context, it is critical to also consider the test procedures associated with the numerical standards. As is discussed the responses below, changes to the baselines and the test procedures being made for the FRM have resulted in numerically lower emission standards. However, the agencies generally do not consider these changes to be true changes in stringency because they are independent of the projected technology. Nevertheless, we are also projecting the feasibility of increasing technological effectiveness and adoption, which represents a true increase in the stringency of the standards.

**Organization:** Achates Power, et al.

The proposal issued jointly by EPA and the National Highway Transportation Safety Administration ("the Agencies") in June 2015 failed to adequately take into account existing and emerging technologies from suppliers like us. The proposed 4.1% heavy-duty engine efficiency improvement does not reflect

the full potential of available technologies on the shelf today, nor does it take into account the current state of advanced engine technology development. Indeed, it falls below the historical competitive pace of improvement achieved in the absence of regulation. The Agencies are proposing a standard that is less than half the improvement required under Phase 1, with more than twice the lead time to comply. Manufacturers have already demonstrated, with on the road trucks, the potential to reduce fuel consumption and CO2 emissions from engines used in heavy-haul and line-haul applications by more than 15 percent. Consequently, the standards as proposed are missing a unique opportunity to promote the further development and encourage the deployment of promising advanced technologies. [EPA-HQ-OAR-2014-0827-1762-A2 p.1]

More stringent engine standards are imperative to scale the fuel-saving solutions our companies are creating today. This rulemaking should set the regulatory landscape to drive American innovation further, not just to maintain the status quo. If the agencies choose to push innovation, our companies and others will be able to bring new, cost-effective solutions to market. We urge the Agencies to adopt increased engine stringency standards consistent with the demonstrated capabilities of emerging technologies. Such standards should be set for vocational vehicles and for heavy-duty trucks and vans while providing for adequate incentives and averaging, banking, and trading flexibility. [EPA-HQ-OAR-2014-0827-1762-A2 p.1]

Compared to Phase 1, the proposed Phase 2 standards only require a 4% reduction in fuel consumption and CO2 emissions of engines through 2027. This 4% requirement may be met with technology that has already been demonstrated. If the standard is set too low, it presents a risk that the agencies' goal of spurring development and deployment of advanced technology may not be met, and it may render the separate engine requirement largely meaningless. [NHTSA-2014-0132-0049-A1 p.3]

We respectfully recommend the Phase 2 engine standard require a greater reduction in fuel consumption. Enough promising technologies and time exist to provide compliance at a cost increase that meets the payback scenarios outlined in the proposed standard. A more stringent standard will spur more earnest evaluation and development of promising new technologies that provide the required efficiency improvement in a cost-effective manner to spur even faster adoption of the new generation of commercial vehicle technology. Based on extensive testing and measured results, we estimate that the heavy duty version of our opposed piston engine will have 15% lower cycle average fuel consumption than the Phase 1 standards. Nearly all the advanced engine technologies being developed in the Department of Energy's SuperTruck program and independently by leading OEMs and suppliers can be applied to the opposed piston engine for further efficiency improvement. As a result, we propose that at least a 15% decrease in cycle average fuel consumption compared to the Phase 1 standard be required for Phase 2. [NHTSA-2014-0132-0049-A1 p.3]

**Response:**

In response to comment, the agencies have made a number of changes from the proposal. On the vocational side, we changed the baseline engine to reflect the most recent certification data, making vocational engine standards more stringent numerically than proposed, while relying on performance of similar technologies to those proposed to develop the stringency of the final standard. The detailed vocational engine standard stringency and the baseline to which that stringency is applied is described fully in Chapter 2.7.4 of the RIA. The final tractor engine standards likewise reflect some changes from proposal. We increased the dis-synergy factor from 0.85 to 0.9, and, for the final MY 2027 standard, increased the projected market penetration for WHR Rankine cycle technology from 15% to 25%, and included down speed benefits on the engine. As a result, the projected improvements over the baseline for the 2027 tractor engine standards increased from 4.2% estimated at proposal to 5.1%. Chapters 2.3 and 2.7 of the RIA provide detailed justification of these changes from the proposal. With respect to comments referring to even greater engine improvements under the DOE SuperTruck program, those technology demonstrations only focus on a single operating point in an R/D environment. However, since these engines do not operate at a single operating point in use, we necessarily considered 13 composite modes in deriving standard stringency. This stringency, not surprisingly, is less than that based on a single, optimized operating point.

**Organization:** Advanced Engine System Institute (AESI)

There appears to be ample evidence to indicate that, of the options considered by the agencies, Alternative 4's timeline comes closest to striking the right balance though it does appear greater reductions than the 4.2% in the proposal could well be feasible now and still be quite cost-effective. There are now a multitude of technologies, including waste heat recovery, turbo-compounding, advanced downspeeding, hybridization, etc. that can be ready to deploy in the Alternative 4 timeframe or sooner at still reasonable cost, provided the right policy or market signal and some combination of incentives or credits. EPA may want to consider whether such incentives or credits, particularly in an era of low fuel prices, might expedite the development and commercialization of these technologies and promote earlier and more cost-effective achievement of the program goals. If the Agency chooses not to adopt a technology-driving engine standard in this rulemaking cycle, it may make sense to incorporate a Mid-term Review or evaluation of engine related technologies in the not too distant future so the standards can be adjusted and updated to keep pace with innovation and the growing need to reduce carbon emissions. [EPA-HQ-OAR-2014-0827-1152-A1 p.2 [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.290-291.]]

Our members have been working with the Department of Energy's Super Truck program to demonstrate the magnitude of carbon dioxide reductions that engine and vehicle technologies can deliver while improving criteria pollution control systems. From this advanced research and development program as well as the independent investment our companies are making with EPA and the California Air Resources Board at the Southwest Research Institute, we are increasingly confident that there is a fuel economy/greenhouse gas optimization 'bonus' to be realized from integrating rapidly emerging and cost-effective NOx control strategies into heavy-duty manufacturers' engines and powertrain designs. [EPA-HQ-OAR-2014-0827-1152-A1 p.] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.291.]]

There no longer needs to be the once evident tradeoff between engine efficiency and tailpipe NOx emissions. The presentation attached (attachment 1) illustrates many of the newest NOx and GHG reducing technologies and the continually declining NOx emissions rates of the more recent and more efficient engine certifications. Basically, as engine manufacturers have been, with the able assistance of AESI companies, certifying their engines to tighter criteria pollutant standards and simultaneously

integrating carbon emissions reduction as a design priority, both categories of pollution have been dropping. However, without the appropriate policy signal, the newest and most promising NOx control technologies may not manifest on the right timescale to comport with the Phase 2 proposal and thus could leave significant fuel economy gains until a future time. [EPA-HQ-OAR-2014-0827-1152-A1 p.2]

Because California, as well as other states, continues and will continue to have very serious ozone nonattainment problems due mainly to NOx pollution from vehicles, that state is seriously considering an additional 90% reduction in NOx emissions beyond the 2010 standards for medium and heavy duty vehicles. Should that state, states in the Ozone Transport Commission region or the Northeast, or EPA, choose to formally adopt that standard, AESI members will work very hard with our customers to ensure that that standard can be achieved and to realize the optimization 'bonus' that would make fuel economy/greenhouse gas targets easier to achieve. [EPA-HQ-OAR-2014-0827-1152-A1 p.2-3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.291-292.]]

**Response:**

In response to comment, the agencies have made a number of changes from the proposal. On the vocational side, we changed the baseline engine to reflect the most recent certification data, making vocational engine standards more stringent numerically than those proposed, and then determining standard stringency to reflect performance of technologies similar to those on which the proposed standard was predicated. See RIA chapter 2.7.4. As noted in the previous response, we also made certain changes in the tractor engine standard following proposal, with the result that the projected improvements over the baseline for the 2027 tractor engine standards increased from 4.2% estimated at proposal to 5.1%. Chapters 2.3 and 2.7 of the RIA provide detailed justification of these changes from proposal. We have responded in the previous comment to arguments that standard stringency should reflect the results of the SuperTruck program, and why such stringency is not fully representative of in use drive cycles or performance.

We envision that future NOx reduction will be possible with minimal to no effect on fuel consumption, especially if the reductions in NOx are achieved via optimizations of NOx aftertreatment that improve overall NOx reduction efficiency across all operating ranges. See e.g. RTC Response 15.8.1.

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

While we support implementation of consistent IRAF procedures and methodologies, we do not support the inclusion of CO2 into IRAF emissions calculations and reporting for any vehicle or engine segment. [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

**Response:**

Please see Response 3.3.4 for a more detailed discussion of infrequent regeneration adjustment factors (IRAFs). As there stated, we do not believe inclusion of IRAF CO2 emissions significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the frequency and impact of regeneration emissions since 2007. Rather, the agencies are including IRAF CO2 emissions for Phase 2 to prevent these emissions from increasing in the future to the point where they would otherwise become significant. In their comments on the NPRM, manufacturers qualitatively acknowledged the likely already small and decreasing magnitude of IRAF CO2 emissions in their comments. For example, EMA stated, “the rates of infrequent regenerations have been going down since the adoption of the Phase 1 standards” and that IRAF “contributions are minor.” Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting



criteria emissions compliance strategies that could reverse this trend. Manufacturers expressed concern about the additional test burden, but the only additional requirement would be to measure and report CO<sub>2</sub> emissions for the same tests they are already performing to determine IRAFs for other pollutants.

At the time of the proposal, we did not specifically adjust baseline levels to include additional IRAF emissions because we believed them to be negligible and decreasing. Commenters opposing this proposed provision provided no data to dispute this belief. We continue to believe that regeneration strategies can be engineered to maintain these negligible rates. Note, however, the agencies did consider potential IRAF impacts when establishing the final FTP and SET baselines. Highway operation includes enough high temperature operation to make active regenerations unnecessary. Furthermore, recent improvements in exhaust after-treatment catalyst formulations and exhaust temperature thermal management strategies, such as intake air throttling, minimize CO<sub>2</sub> IRAF impacts during non-highway operation, where active regeneration might be required. k

**Organization:** Allison Transmission, Inc.

#### EPA and NHTSA Should Not Incentivize Larger Engines

EPA and NHTSA have expressed concern that setting engine standards at high stringency could produce counterproductive results, e.g., that such standards “may promote the use of large displacement engines, which have inherent heat transfer and efficiency advantages over smaller displacement engines over the engine test cycles, though a smaller engine may be more efficient for a given vehicle application.” In general, Allison supports the proposal to maintain separate engine standards. However, Allison shares the agencies’ concerns that if standards are too stringent then incentives could be created to use larger engines in order to pass certification tests. [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

Specifically, we would note that power shifting Allison ATs actively enable the use of smaller engines -- in place of larger engines for AMT/MT equipped powertrains -- while achieving the same amount of work in the same amount of time. A documented customer fleet test over a 1 year period of time comparing an 11L engine/AMT vs 7L engine/Allison AT on same daily route, indicates the same level of performance at GVW and 22% better fuel economy for the 7L engine/Allison powertrain. The parameters and results of this testing are submitted below: [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

- Two 42,000 lb GVW pickup and delivery trucks, identical except for power pack and rear axle [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

- AT vehicle: 7L engine, 320 HP with Allison 3000 Series and 4th Gen predecessor of FuelSense® Plus [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

- AMT Vehicle: 11L engine, 379 HP with 12-speed AMT [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

- Same daily route over 1 year period in service [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

- AT vehicle with smaller engine achieved 28% better fuel economy (equivalent to 22% reduction in fuel consumption) with equivalent performance to AMT vehicle with larger engine [EPA-HQ-OAR-2014-0827-1284-A1 p.17]

[Table, 'Results of Performance Testing Between Smaller and Larger Engines', can be found on p.17 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

**Response:**

We understand Allison's concern. We do not believe that the current engine standards would incentivize large displacement engines. As a matter of fact, the engine technology road map we are adopting as a potential compliance pathway includes a path for the engine downsizing together with down speeding. See RIA Chapter 2.3.9 and Table 2-11 in that chapter. In addition, we believe including the fuel map in GEM provides a strong incentive to not oversize engines.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Separate engine standards

ACEEE has supported maintaining standards for tractor and vocational truck engines in Phase 2. The primary reason for such standards in our view is to set out direct, multiyear targets for engine performance sufficient to promote substantial, sustained investment in engine efficiency. So long as the only signal to improve engine efficiency is filtered through the lens of whole vehicle efficiency, there will remain uncertainty about how much of the improvement will fall to the engine. This is especially problematic for engines not produced by vehicle OEMs, which play a prominent role in the U.S. market. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

The 4.2% engine efficiency improvement over the 2017 standard proposed by the agencies for 2027 represents such a modest gain as to undermine the argument for the engine standard. An engine standard that achieves 10% fuel consumption reduction by 2027, which we recommend in these comments, has a much clearer justification. Other rationales cited for engine standards include ensuring that criteria pollutant and greenhouse gas emissions for engines remain linked, so that these two types of emissions can be brought down in tandem. However, given the proposed changes to the weighting of the test point in the supplemental emissions test (SET) cycle for engines and the possibility that engine certification will move to a drive-cycle-based approach, the link between GHG and criteria pollutant testing may be in jeopardy even assuming the separate engine standard is maintained. EPA should consider adjustments to the criteria emissions program at the earliest opportunity to address this issue and ensure that reductions in one set of pollutant emissions do not come at the expense of reductions in the other. [EPA-HQ-OAR-2014-0827-1280-A1 p.8-9]

*Recommendations: Separate engine standards*

- Maintain separate engine standards in Phase 2, as proposed, but require substantially greater improvements in fuel efficiency. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]
- Adjust the criteria pollutant emissions program for engines as needed to ensure that both these emissions and GHG emissions decline in tandem. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

Engine standards for tractor trucks

Revised weighting of SET cycle test points; baseline engine efficiency [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

The agencies propose to change the weighting of the SET cycle test points in the Phase 2. The re-weighting would result in a higher percent (33% higher) of time spent at low engine speed points (A and B speeds) than is reflected in the current SET (p. 40192). This increase in the weights of A and B speeds means greater weight to points of low brake-specific fuel consumption and consequently show lower

overall cycle fuel consumption than results from current SET weightings. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

ACEEE supports this revised weighting for SET, because it better represents the real-world operation of today's long-haul trucks. In a presentation in 2014, the Daimler Truck North America (DTNA) shared data on the operating points of a 2010 model year DD15 heavy-duty diesel engine in on-road testing. The majority of the data points for that truck were clustered around A and B speeds and rarely reached C speeds in its operation. Volvo Group, in another presentation, presented the on-road engine operation of about 600 line-haul trucks covering 82 million miles, where these trucks spent most of their time under 1500 rpm engine speed. Note that most of these trucks are rated at 1800 rpm or more.<sup>2</sup> Therefore, increasing the weighting of A and B points of the SET cycle and reducing the weighting of C points in the Phase 2 certification protocol is appropriate. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

The engines that operate at lower speeds in the real world typically will be more efficient as a result. To the extent that these engines become prevalent prior to the start of Phase 2, however, these are gains achieved in Phase 1 or before, and they should be reflected in the Phase 2 baseline. With this baseline adjustment, it will be clear that the proposed Phase 2 tractor engine standard would achieve even less than the stated 4% fuel consumption reduction, clearly not an adequate improvement for the decade from 2017 to 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

*Recommendation: Revision of tractor engine baseline* [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

- Adjust the 2017 tractor engine baselines to reflect the reweighting of SET points. [EPA-HQ-OAR-2014-0827-1280-A1 p.9]

Stringency of the tractor engine standard

The Phase 2 proposal calls for only 4.2% efficiency gains for tractor truck engines by 2027 (p. 40197). In fact, given that the Phase 2 baseline efficiency level does not reflect the engine cycle test points' new weighting, as discussed above, the actual improvement the proposal represents is even less than 4%. In terms both of the importance of greater engine efficiency and the technologies available to increase that efficiency, the proposal is far too timid. [EPA-HQ-OAR-2014-0827-1280-A1 p.9-10]

Both the overall and the annual rate of improvement for medium and heavy heavy-duty engines in Phase 2 are lower than those in Phase 1, as shown in table 1. Phase 1 is being implemented in six years, from 2011-2017, while Phase 2 would be implemented over ten years, from 2017-2027. The Phase 1 rule, adopted in 2011, mandates some improvement from its pre-Phase 1 baseline in 2014, the first year of compliance. The Phase 2 rule also mandates some improvement in 2021, the first year of compliance, from the 2017 baseline. [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

[Table 1 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

Improved combustion, engine airflow improvement, friction and parasitic loss reduction, and waste heat recovery are the major technologies in the agencies' Phase 2 package. The agencies understate the benefits of these technologies in three ways: [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

1. the effectiveness numbers for some of the technologies are low; [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

2. the penetration levels for some technologies, especially waste heat recovery, are low; [EPA-HQ-OAR-2014-0827-1280-A1 p.10]
3. the agencies apply an unexplained discounting of the benefits of engine technologies when they are combined, which lowers the effectiveness of the package. [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

Consequently, the increase in tractor engine efficiency called for in the proposal is much too small. These issues will be discussed in the following paragraphs, leading to our recommendations regarding the stringency of Phase 2 standards for heavy-duty diesel engines used in tractor trucks. [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

*Recommendation: Stringency of engine standard for tractor trucks* [EPA-HQ-OAR-2014-0827-1280-A1 p.12]

- Any discounting of the benefits of technology packages to account for overlapping benefits should be based on the specifics of the technologies in the packages. [EPA-HQ-OAR-2014-0827-1280-A1 p.12]
- The standards for tractor track engines should require reductions of at least 9% in 2024 and 10% in 2027, rather than the much lower levels called for in the proposal. [EPA-HQ-OAR-2014-0827-1280-A1 p.12]

*Recommendations: Standards for vocational vehicle engines* [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

- Require at least 6% reduction in fuel consumption for gasoline engines in vocational applications in 2027 to reflect the availability of further friction reduction, turbo downsizing, and variable valve lift/actuation. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]
- Strengthen the proposed standards for diesel engines used in vocational vehicles by 3% in 2024 and 4% in 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

#### **Response:**

This comment contains constructive suggestions. However, as detailed in the RIA, we believe a 10% increase in 2027 is beyond what will be feasible in this time frame industry-wide. Data cited by the commenter mainly relies on the literature, including DOE Supertruck programs, which are not directly applicable. The values from the literature are single optimal operating points, not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we must consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point. Technology effectiveness is also not additive. Chapter 2.7.5 of the RIA details justifications of the dis-synergy factor used in the rule. These justifications were also supported by many industry comments, such as the reports made by four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar). The technology effectiveness of WHR in Rankine cycle, which we project to be less effective than what this (and other) commenters recommended, were directly obtained from credible, but CBI information, and also reflect the recommendation from a leading engine manufacturer. It is critical to derive the standards based on the agencies' weighting factors over 13 modes, vehicle weight, and three vehicle certification cycles. Thus, the adjusted values for stringency are typically much smaller than the values seen in the literature. Having said that, we have made changes to increase the stringency of the standards from those proposed. In the final rule, we also readjusted the

baseline of the tractor engine standards to reflect the reweighting impact. See Response 3.3.3 below. Chapter 2.7.4 of the RIA discusses the change in the baseline. We made a few other key changes to engine standard analysis. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the 2027 tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. We also readjusted the baseline for the vocational engine standards, and strengthened the vocational engine standards to reflect certain differences in estimated technology effectiveness and projection rates from proposal. See RIA Chapter 2.7.9 for projected compliance pathway for the final standard.

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## 2 2013 Diesel Truck Index

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

### *Vocational engine certification*

Since the public comment closed on the proposal, certification data for a number of new heavy-duty engines have been made public. Conventional diesel engines from Cummins,<sup>18</sup> Detroit Diesel,<sup>19</sup> Hino,<sup>20</sup> and PACCAR<sup>21</sup> in medium- and heavy-duty vocational applications could all be certified in 2016 to the proposed 2027 standard. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

### Impact on proposal

That an assortment of engine families certified for the 2016 model year from a breadth of manufacturers already achieve the 2027 fleet-average standard in their respective classes indicates that the agencies have set far too weak a standard for vocational engines. This, in turn, leads to weakened vocational vehicle standards, since these engines are incorporated into GEM for compliance. We expect based on careful examination of recent engine certification data that the agencies will adjust greenhouse gas emission and fuel consumption targets downward in 2027 to more appropriately account for where the technology is today and what it can achieve more than a decade hence. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

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18 Cummins 2016 8.9L MHDD diesel engine (GCEXH05040LAV): FCL = 553 g/bhp-hr, compared to a proposed 2027 MHDD standard of 553 g/bhp-hr. Certified to vocational applications (ISL9).

19 Detroit Diesel 2016 14.8L HHDD diesel engine (GDDXH14.8EAD): FCL = 517 g/bhp-hr, compared to a 2027 HHDD standard of 533 g/bhp-hr. Certified to vocational and tractor applications (DD15).

20 Hino 2016 7.7L MHDD diesel engine (GHMXH07.7JWU): FCL = 538 g/bhp-hr, compared to a proposed 2027 standard of 553 g/bhp-hr. Certified to vocational applications (J08E-WU).

21 PACCAR 2016 10.8L HHDD diesel engine (GPCRH10.8M01): FCL = 509 g/bhp-hr, compared to a proposed 2027 standard of 533 g/bhp-hr. Certified to vocational and tractor applications (MX-11).

**Response:**

We have significantly adjusted the FTP baseline CO<sub>2</sub> emission levels taking into account the new certification data. Chapter 2.7.4 of the RIA details the methodology of how these baseline changes reflect the certification data referenced by the commenter. See also Response 3.3.3 below.

**Organization:** American Gas Association (AGA) et al.

**We Strongly Support Preserving the Compliance Pathway Flexibility**

In the HD Phase 1 Rule,<sup>2</sup> the agencies adopted provisions that allowed original equipment manufacturers (OEMs) to offset any nitrous oxide (N<sub>2</sub>O) and methane emissions above the standard with carbon dioxide (CO<sub>2</sub>) emissions below the standard. Under this approach, an OEM would convert measured N<sub>2</sub>O and methane emissions levels generated on the engine certification test cycle into a CO<sub>2</sub>-equivalent credit.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

We strongly support the maintenance of this provision in the Phase 2 Proposal. Doing so preserves the valuable compliance pathway flexibility for cross-pollutant trading of methane, N<sub>2</sub>O, and CO<sub>2</sub>. We further note that this flexibility is not only beneficial to the OEMs in the natural gas sector that use it to offset methane emissions with CO<sub>2</sub>-equivalent credits, but it is also a necessity for some diesel engine OEMs who use the provision to offset high N<sub>2</sub>O emissions with CO<sub>2</sub>-equivalent credits. [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

**We Support the Maintenance of a Common Regulatory Structure for all Fuel Types**

We support the common regulatory structure for all fuel types and support the continuation of separate standards for spark-ignition and compression-ignition engines, as was established in the HD Phase 1 Rule.<sup>23</sup> We raise concerns with any proposal to modify the regulatory structure to distinguish among the fuels used in those categories, and commend the agencies on not doing so in the Phase 2 Proposal. With respect to the proposed changes to the certification of natural gas engines, we agree with agencies in their assessment that these changes are merely clarifications that ratify the status quo. [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

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2 “Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rule.” Federal Register, September 15, 2011. <http://www.gpo.gov/fdsys/pkg/FR-2011-09-15/pdf/2011-20740.pdf>. (Hereafter cited as the “HD Phase 1 Rule”)

3 Phase 2 Proposal, page 40341.

23 Phase 2 Proposal, page 40193.

**Response:**

We appreciate your support on the compliance pathway flexibility and the maintenance of a common regulatory structure for all fuel types.

**Organization:** American Power Group Inc. (APG)

As the proposed CO2 standards Heavy-Heavy Duty-Tractor/Vocational reflect Fuel Economy (FE) increases manifested through both engine efficiency and vehicle efficiency improvements (tires, aero, etc.), and as the CO2 exhaust emission values are determined by engine dynamometer tests (RMC13: HHD-line haul Tractor or FTP-HDT: HHD-Vocational), how is the EPA proposing to reflect the vehicle efficiency improvements within the respective M.Y. engine dyna test procedures? Will there be a modification to the test parameters and/or a correction factor applied ? The previous answer (6 Aug, 2015) was 'EPA did not propose to reflect vehicle efficiency improvements in the engine dynamometer test procedures'. Although we understand the given answer, the question remains, if vehicle efficiency improvements are to be employed to increase FE and reduce CO2 emissions, how can this be accounted for in the results of a dynamometer emission test? To not correct for vehicle efficiency affects effectively places the burden of all F.E. increase on the engine alone. [EPA-HQ-OAR-2014-0827-1197-A1 p.4]

**Response:**

We did not propose to reflect vehicle efficiency improvements in the engine dynamometer test procedures or adopt any such provisions in the final rule. Any vehicle related technologies that can have an impact on the vehicle will be recognized and accounted for exclusively by the vehicle standards.

**Organization:** American Trucking Association (ATA)

The actual stringency in the proposed rule is much greater than what EPA has indicated due to errors in EPA's baselines and testing protocols, such as: [EPA-HQ-OAR-2014-0827-1243-A1 p.13]

- Compliance margins are not provided for engine fuel map audits requiring OEMs to over-design (if plausible) beyond their certification levels to ensure passing routine audits. [EPA-HQ-OAR-2014-0827-1243-A1 p.13]

In summary, these issues create impossible hurdles that could not be met within the framework of the rule and the agencies must work with OEMs to rectify these matters. [EPA-HQ-OAR-2014-0827-1243-A1 p.13]

**Response:**

As described elsewhere in the final rule, each of these factors been considered in the final analysis. First, although the agencies revised both the SET and FTP baselines, these changes had no impact on standard stringency. The changes reflect only the baseline from which stringency is calculated. See Response 3.3.3. Second, the final standards do account for a compliance margin. See Section 1.4.3 of this RTC.

**Organization:** Bay Area Air Quality Management District (BAAQMD)

The proposed EPA/DOT Phase 2 rule-making can help us pursue both our air quality and GHG emission reduction goals. To ensure the maximum benefits are achieved from this joint-rule-making effort, we would like to offer the following suggestions.

Consider more stringent engine emissions standards that reflect the technologies currently available in the mass market and those that are now being developed and tested. The current proposal improves engine

GHG emissions by 4% compared to the final Phase 1 standards, but we believe more stringent standards are technically feasible. [EPA-HQ-OAR-2014-0827-1136-A1 p.2]

**Response:**

In the final rule, we readjusted the baseline of the tractor engine standards to reflect the reweighting impact of the SET. Chapter 2.7.4 of the RIA and Response 3.3.3 detail the change in the SET baseline. We made a few key changes on engine standards. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the 2027 tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. We also strengthened the vocational engine standards.

**Organization:** Bendix Commercial Vehicle Systems, LLC

**II. Vehicle Simulation, Engine Standards and Test Procedures, B. Phase 2 Proposed Regulatory Structure** [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

We request comment on whether or not a chassis dynamometer test procedure should be required in lieu of the vehicle simulation approach we are proposing. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

Bendix does not believe that the agencies should require chassis dynamometer testing in lieu of the vehicle simulation approach being proposed. At the time of this rule making, there simply aren't enough chassis dynamometers available to make it a requirement and it is our belief that the associated costs of making it a requirement are not understood well enough to assess the financial impact. However, we do believe that the use of chassis dynamometer testing will increase to assess the vehicle benefits of many new technologies and the resulting data should be able to be used as input to GEM. [EPA-HQ-OAR-2014-0827-1241-A1 p.2]

**Response:**

We are not requiring chassis dynamometer certification.

**Organization:** Center for Biological Diversity

*Engine Standards*

There is clearly large potential for greater engine improvements than those currently proposed. Engine standards are particularly important because these are the most verifiable reductions and central to achieving overall vehicle efficiency. Diesel engines are more efficient than gas engines, and currently separate standards are applied to gas and diesel engines. [EPA-HQ-OAR-2014-0827-1460-A1 p.7]

**Response:**

In the final rule, we readjusted the baseline of the engine standards to reflect the SET reweighting impact. Chapter 2.7.4 of the RIA details the change in the tractor engine baseline. We made a few key changes to the final engine standards. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in



2027, and include down speed benefits for engines. As a result of this, the tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. We also strengthened the vocational engine standards from proposal.

**Organization:** Cummins, Inc.

There is a discrepancy between the proposed engine standards and the Agencies' projection of engine capability as implemented in the engine maps used in GEM. Figure 2 shows results of an analysis of the HD tractor engine maps. When these maps are used with the Agencies' expected class 8 high roof sleeper cab vehicle technology packages for 2021, 2024 and 2027, the engine map performance on the GEM cycles is better than the engine standard. This result is an implied engine stringency where engine CO<sub>2</sub> reduction is driven by the vehicle program with no accompanying NO<sub>x</sub> control. The Agencies should set the engine standard at the expected performance of the engine as represented by the engine maps which define the engine capability. [EPA-HQ-OAR-2014-0827-1298-A1 p.9]

[Figure 2 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

Also, the Agencies have assumed engine downspeeding in the vehicle program technology packages. However, no downspeeding has been assumed in the engine program. An engine optimized for downspeeding usually has a lower rated speed, plus the peak torque is higher and occurs at a lower speed. These changes have not been considered by the Agencies. Figures 3-6 from the Draft RIA show that the torque curves have not been changed for any of the future expected engines. The RMCSET points therefore have not changed, so no expectation of downspeeding performance is considered in the engine standard setting. As stated in our oral comments: [EPA-HQ-OAR-2014-0827-1298-A1 p.10]

[Figures 3-6, 4, 5 and 6 can be found on p.10-12 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

*Cummins supports the proposed alternative fuel source categorization* [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

The Agencies are proposing that all engines, that are not gasoline-fueled and are intended for MHD or HHD service classes, must meet the compression-ignition ("diesel") emission standards. This designation applies regardless of whether an engine is normally considered a spark-ignited engine. Cummins supports this provision as it provides a fuel neutral assessment and consistent certification requirements relative to emission standards, including NTE, and certification cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

The Preamble (80 FR 40158, 40207) further indicates that this new designation for alternative-fueled MHD and HHD engines also applies for criteria emissions. Cummins agrees with this clarification as it maintains alignment between criteria emission and GHG certification for engines. The Agencies should clearly define this within the standard setting parts for criteria emissions. [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

*Cummins opposes IRAF requirements for CO<sub>2</sub> emissions* [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

For reasons outlined in EMA's comments, Cummins opposes IRAF requirements for CO<sub>2</sub> emissions. [EPA-HQ-OAR-2014-0827-1298-A1 p.27]

*Cummins requests that the Agencies more clearly explain the methodology for setting the engine standards* [EPA-HQ-OAR-2014-0827-1298-A1 p.35]

Additional clarification from the Agencies is needed for the following: [EPA-HQ-OAR-2014-0827-1298-A1 p.35]

(a) It appears the reweighted RMCSET was not correctly accounted for in determining the engine standard levels. Table 4 shows results from an analysis of the engine maps created by the Agencies to represent future engine technology. The new RMCSET weightings reduce CO<sub>2</sub> by 1.8%. This impact is not accounted for in the standard values which appear to assume the Phase 1 RMCSET weightings. Cummins asks for clarification on this discrepancy. [EPA-HQ-OAR-2014-0827-1298-A1 p.35]

[Table 4 can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

**Response:**

At proposal, there was indeed an incorrect discrepancy between the proposed engine standards and the agencies' projection of engine capability as used in the GEM. This was an error that has been corrected. The final engine standards for MY 2021 and 2024 use estimates of technology efficiency which are identical to those used in GEM, and which reflect downspeeding of engines. As the commenter suggests, the engine standard is set at the expected performance of the engine as represented by the engine maps which define the engine capability. See Chapter 2.8.4.1 of the RIA. However, as discussed in Section II.D.(2)(e) of the Preamble, vehicle manufacturers can use a broader mix of engine designs to achieve an average engine performance significantly better than what is required by the engine standards, and the MY 2027 vehicle standards reflect engine platform improvements (which are amenable to measurement in GEM), without forcing each manufacturer to achieve these additional reductions for the engine standards.

We appreciate Cummins' support for the proposed alternative fuel source categorization.

With regard to Cummins' comment endorsing the EMA position that inclusion of CO<sub>2</sub> in IRAFs changes standard stringency, we do not believe this will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the frequency and impact of regeneration emissions since 2007. Rather, the agencies are including IRAF CO<sub>2</sub> emissions for Phase 2 to prevent these emissions from increasing in the future to the point where they would otherwise become significant. In their comments on the NPRM, manufacturers qualitatively acknowledged the likely already small and decreasing magnitude of IRAF CO<sub>2</sub> emissions in their comments. For example, EMA stated, "the rates of infrequent regenerations have been going down since the adoption of the Phase 1 standards" and that IRAF "contributions are minor." Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting criteria emissions compliance strategies that could reverse this trend. Manufacturers expressed concern about the additional test burden, but the only additional requirement would be to measure and report CO<sub>2</sub> emissions for the same tests they are already performing to determine IRAFs for other pollutants.

At the time of the proposal, we did not specifically adjust baseline levels to include additional IRAF emissions because we believed them to be negligible and decreasing. Commenters opposing this proposed provision provided no data to dispute this belief. We continue to believe that regeneration strategies can be engineered to maintain these negligible rates. Note, however, the agencies did consider potential IRAF impacts when establishing the final FTP and SET baselines. Highway operation includes enough high temperature operation to make active regenerations unnecessary. Furthermore, recent improvements in exhaust after-treatment catalyst formulations and exhaust temperature thermal management strategies, such as intake air throttling, minimize CO<sub>2</sub> IRAF impacts during non-highway operation, where active regeneration might be required. Finally, as is discussed in Section II.D(2), recent

significant efficiency improvements over the FTP cycle suggest that FTP emissions may actually be even lower than we have estimated in our updated FTP baselines, which would provide additional margin for manufacturers to manage any minor CO<sub>2</sub> IRAF impacts that may occur. See also Response 3.3.4.

We have considerably expand the explanation on the methodology for setting engine standards described in Chapter 2.7 of the RIA. This commenter, as well as commenters from the NGO community, noted the error in not accounting for the Phase 2 reweighted of SET modes in the baseline. Consequently, we adjusted the baseline engine standards based on the new weighting factors of 13 SET modes. See Response 3.3.3.

**Organization:** Daimler Trucks North America and Detroit Diesel Company

- And two additional documents posted to the docket, Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines, by Michael P. Walsh and Stephen J. Charlton, plus its Addendum:

Daimler would like to reiterate that engine standards are unnecessary, given the stringent full vehicle standards. But if there are going to be standards, then 1) the agencies are correct to reweight the RMC test conditions as proposed in the NPRM and 2) the agencies' proposed stringencies (in the NPRM) are essentially at the limit of what is achievable on an engine test. In particular, the paper by Messrs. Walsh and Charlton dramatically mischaracterizes what is possible and errs in important details about the current state of technology. Moreover, in the Addendum, when Walsh and Charlton state 1) that Super Truck is "an important source of data [from which] a technology assessment could be made" and 2) that the SwRI report "was found to be overly conservative in its assessment of the available technologies," the authors are stating as fact what are really opinions not consistent with the actual state of technology. We tested DTNA's Super Truck on the road, on test tracks, and in simulation enough to know this: Walsh and Charlton inaccurately conclude that Super Truck demonstrates a suite of technologies ready for series production. Rather, through our extensive expertise in demonstrating the most efficient truck on the road, we learned that many of the technologies simply are not feasible for series production; they are suited to a lab and no more. For more details, we refer the agencies to our detailed comments about this paper, jointly submitted through an additional memo to the docket by Daimler, Navistar, Paccar, and Volvo. [EPA-HQ-OAR-2014-0827-1918-A2 p.9]

As previously stated, DTNA has invested heavily in its engine, transmission, aftertreatment and controls technologies to maintain a fuel efficiency leadership position in the marketplace while at the same time meeting or exceeding mandated CO<sub>2</sub> emissions reductions. It is important to note that many of the technology improvements included in EPA's analysis (in its preamble and regulatory impact analysis) of potential improvements beyond the 2017 model year have already been implemented in order to meet reductions required to meet 2017 requirements. EPA should not be projecting improvements for Phase 2 based on improvements that had already been implemented to meet Phase 1. The reason behind this flaw in EPA's analysis is brought to light in the regulatory impact analysis where EPA makes note on many occasions that its projected improvements (used to derive the improvements noted in the above tables) were based on improvements that manufacturers projected in its Super Truck programs. For example, improvements projected in DTNA's program were estimates based on a 2009 model year engine baseline. Multiple improvements to DTNA engine injection systems, turbochargers and aftertreatment have since been made in order to achieve CO<sub>2</sub> certification levels at or marginally below 2017 SET standards. [EPA-HQ-OAR-2014-0827-1164-A1 p.20]

[Large portion of below text is redacted]

**Fuel Maps Developed by EPA for Stringency Assessment** - EPA requested comment regarding the fuel maps it had developed using projections of fuel efficiency improvements from various technologies. DTNA has reviewed fuel maps EPA had developed for the 2021, 2024 and 2027 model years and formulated recommendations regarding modifications that EPA should consider when finalizing the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1164-A1 p.49]

As described elsewhere in DTNA's comments, EPA's projections of fuel efficiency improvements are very aggressive compared to levels that DTNA expects to be achievable in the Phase 2 timeframe. As DTNA has explained to the agency, the EPA had based its projected efficiency improvements from estimates that used a baseline case that preceded the 2017 model year baseline used for the Phase 2 fuel map analysis. Consequently, it appears that EPA has overestimated the how much improvement remains available since a portion of the improvements from the older baseline engine were already applied in order to reach 2017 required levels. DTNA recommends that EPA revisit its estimate improvements to make sure that they had not overestimated remaining improvements which would appear to be the case given the very low 174 g/kW-hr levels in the 1100 RPM / 1600 N-M region of the fuel map. [EPA-HQ-OAR-2014-0827-1164-A1 p.49]

[redacted]

This observation stresses the importance of allowing, as proposed in Phase 2, that as manufacturers design drivetrains to operate engines in their most efficient speed and torque regions, manufacturers be able to input to GEM their actual torque curves and actual fuel efficiency characteristics. [EPA-HQ-OAR-2014-0827-1164-A1 p.49-50]

**Response:**

Although we disagree with DTNA and DDC's comments on separate engine standards, we largely agree with many of their comments on the reports by Michael P. Walsh and Stephen J. Charlton, plus its Addendum further addressing the Walsh and Charlton reports. As noted in other responses, the SuperTruck program tests under a single mode, and under what Daimler properly characterizes as 'lab conditions' for many of these results.

While we appreciate DTNA's comments on various technologies EPA proposed as a basis for the engine standard, we believe that much of the data and emission values quoted by DTNA are overly conservative. Our values were based on many data sources, not just from public data sources, but also many CBI sources from OEMs. On the other hand, our technology effectiveness is still below what many other stakeholders have urged, including one major engine OEM that recommended a much higher reduction rate. The 174 g/kw-hr BSFC mentioned by DTNA is the peak efficiency and is only equivalent to 48% BTE, which is far lower than what DOE SuperTruck programs, which have already demonstrated 50-51% peak BTE under some conditions. (Although the agencies do not consider the SuperTruck program to be a sufficient basis for determining overall standard stringency due to its unrepresentativeness, the program is a valid basis for demonstrating peak technology efficiency.) We believe that the engine standards we are adopting represent the most achievable reductions for the given time frame on an industry-wide basis at reasonable cost.

**Organization:** Daimler Trucks North America LLC

2. Engine CO2 Test

- i. Establishing separate standards for child ratings or only for parents

- The agencies should not set Phase 2 CO<sub>2</sub> and fuel consumption standards for the other ratings (often called the child ratings) within an engine family. EPA requests comment from manufacturers regarding continuation of the Phase 1 approach to GHG certification of an engine family wherein the GHG certification of the parent and child ratings was based on emissions results from testing of the parent rating. 80 FR 40206. DTNA supports the continuation of this Phase 1 approach for certification of parent and child ratings and the Phase 1 requirement that a minimum percentage of the family actual sales volume be below certified levels. DTNA agrees that by including the actual fuel map and rating specific full load curve in the GEM simulation, the range of engine ratings are appropriately represented in the vehicle certification. [EPA-HQ-OAR-2014-0827-1164-A1 p.16]

#### ii. IRAF

- **IRAF** – The agencies propose to include CO<sub>2</sub> emissions and fuel consumption due to regeneration over the FTP and RMC as cycles as determined in the infrequently regenerating aftertreatment devices (IRAF) provisions in 40 CFR 1065.680. 80 FR 40193. EPA also requests comment regarding its proposed Phase 2 modification to include emissions contribution from infrequently regenerating aftertreatment devices (IRAF) in calculation of final CO<sub>2</sub> emissions over the SET and FTP test cycles. In Phase 1 EPA excluded IRAF contribution based on its correct understanding that (in the context of Phase 1 stringency) such contributions are minor, and that competitive pressures would drive manufacturers to continue to seek ways to minimize frequency of regeneration and its associated fuel efficiency penalty. DTNA believes that the rationale for excluding IRAF in Phase 1 is equally valid for Phase 2. DTNA does not foresee circumstances in which manufacturers would seek to increase IRAF associated fuel consumption penalties. In fact, the proposed fuel efficiency improvements are more than likely to pressure manufacturers towards developing engines at higher in cylinder NO<sub>x</sub> levels which are beneficial to passive regeneration of diesel particulate filters, and lower particulate emissions levels due to the natural tradeoff between NO<sub>x</sub> and particulates. [EPA-HQ-OAR-2014-0827-1164-A1 p.16]

Consequently the need for active regenerations and the associated IRAF impact on fuel consumption can be expected to decrease. DTNA recommends that for the above reasons and in light of both mitigating the vastly increased burden of Phase 2 regulations, that EPA maintains the Phase 1 approach of excluding IRAF effects in the testing and data processing for Phase 2. Should EPA choose to move forward on its proposed path of including IRAFs in its Phase 2 regulation, DTNA suggests that in light of the demanding stringency of Phase 2 regulations, the associated effective increase in stringency due to inclusion of IRAFs be accounted for and avoided by raising the 2017 baseline CO<sub>2</sub> levels and Phase 2 engine standards by an appropriate amount. [EPA-HQ-OAR-2014-0827-1164-A1 p.16-17]

#### iii. DF

- **DF** - EPA requests comments regarding the appropriateness of continuing the practice of engine manufacturers adopting assigned DFs for CO<sub>2</sub> emissions. 80 FR 40206. During Phase 1 discussions DTNA shared data from laboratory and field tests with EPA to demonstrate the in-use fuel efficiency performance of its products. These data illustrated that fuel efficiency remains stable over the course of high mileage testing and thereby support EPA's rationale of allowing manufacturers to adopt a 0.0 g/bhp-h additive deterioration factor for CO<sub>2</sub> emissions. DTNA agrees that it is prudent for EPA to consider, subject to good engineering judgement, allowing the same assigned DF for advance or off-cycle technologies. [EPA-HQ-OAR-2014-0827-1164-A1 p.17]

#### iv. Reweighting of RMC

- **RMC reweighting and engine stringency.** EPA requests comments regarding proposed changes to the test methodology for determining CO<sub>2</sub> emissions levels for engines certified to proposed tractor standards. 80 FR 40192. DTNA, as is stated elsewhere in these comments, strongly recommends elimination of both FTP and SET engine standards in the GHG Phase 2 program for many reasons, one of which is that fixed engine cycles currently and in the future will inadequately reflect actual engine operation across a range of applications, and over time as drivetrain designs evolve. Both of these shortfalls can be addressed by using a complete vehicle approach. That said, DTNA applauds EPA's effort to improve the alignment between the tractor certification SET test cycle and engine operating conditions so that the test cycle is more reflective of how engines operate in line haul tractor operation. DTNA has gone on record on numerous occasions, and has presented data to the regulators, informing that the weighting scheme currently applied in the SET protocol is inappropriate as a measure of CO<sub>2</sub> emissions for GHG regulations. A mismatch between operating points of the certification test cycle and the operating points in actual operation is problematic because it can cause engine manufacturers to develop technologies for the purpose of meeting regulatory requirements that do not provide the benefit in the real world that regulators intended and that end users will nonetheless end up paying for. Regulators must seek to correctly align regulatory requirements to actual operation so as to avoid such unintended consequences and the associated waste of manufacturers engineering efforts and cost to end users for technologies that provide little real world benefit. The example provided below illustrates that the operation at "C-speed" in the current SET protocol grossly overemphasizes the negligible operation that occurs in actual operation at high engine speeds. Over the past decade, vehicle and engine manufacturers, in their drive for improved efficiencies, have developed their products and educated end users to operate their products at lower engine speeds to improve fuel efficiency and reduce operating costs. This has resulted, as depicted in the example, in dominant operation in the A-speed and B-speed regions. Clearly, the proposed changes to increase weighting of the lower A-speed and B-speed points are appropriate and necessary for the GHG Phase 2 test cycle to better reflect actual operation of today's vehicles. Further, in shifting emphasis away from C-speed operation, EPA proposes to shift weighting to the lower A-speed of the SET. DTNA agrees that moving the weighting in this manner, as opposed for example to B-speed operation, is appropriate consideration of the likely continued trend towards more efficient drivetrain designs that encourage operation at lower engine speeds in its NAFTA line-haul applications. [EPA-HQ-OAR-2014-0827-1164-A1 p.18-19]

[The graphics, plots of the RMC and actual measured engine operation, showing very little C-speed operation, can be found on p.19 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

- **Reduced Parasitics - Variable Speed Coolant Pumps -** DTNA has realized parasitic load reduction through the development and introduction of variable speed coolant pumps on its production DD13 and DD15 engine families. The benefits of this technology are dependent on the application but are realized when cooling demands require less than full flow capacity of the coolant pump, which in most applications is a considerable percentage of operating time. High duty cycle applications, such as those for which the DD16 engine is targeted, do not benefit as much since cooling system demands are greater. Consequently the DD16 family does not include this feature. This technology is already implemented and cannot be included in projections for the future. [EPA-HQ-OAR-2014-0827-1164-A1 p.21]

- **Aftertreatment -** EPA estimates potential benefit of 0.5% due to future aftertreatment design improvements to reduce backpressure in conjunction with improved aftertreatment NO<sub>x</sub> reduction performance to handle higher engine out NO<sub>x</sub> levels that are a natural outcome of retuning for improved combustion. DTNA has completed a redesign of its aftertreatment system for its 2016 model year products with consideration for improved backpressure by introducing improved substrates. However, requirements for improved NO<sub>x</sub> reduction performance via improved DEF mixing directionally work against backpressure reduction resulting in negligible difference in final backpressure performance. As

development is pressed to further combustion improvements for CO<sub>2</sub> reduction it will be a challenge to maintain or avoid further increases in backpressure in the future. It may be anticipated that in order to achieve fuel efficiency improvements proposed by EPA, aftertreatment system redesign may be required to convert even higher NO<sub>x</sub> flux from engines that are tuned to higher NO<sub>x</sub> levels to achieve fuel efficiency goals while at the same time meeting packaging and weight design constraints driven by needs for improved vehicle efficiency. Substrate manufacturers continue to develop improved materials intended to improve pressure drop characteristics which may help to avoid additional backpressure increases. [redacted]. [EPA-HQ-OAR-2014-0827-1164-A1 p.21-22]

- **Downsizing** - DTNA offers heavy-heavy duty engine products that span a range of displacements from 12.8L to 15.6L and has considerable experience in developing these products for maximum efficiency across a range of applications. Our experience supports that within this product range, the optimum displacement for in-use fuel efficiency for fleet applications (which because of their high volume, account for a significant fraction of Class 8 fuel consumed) is the DD15 (14.8L displacement). DTNA expects that trends in current and future drivetrain designs will continue to highlight the DD15 displacement as the fuel economy leader. It is well known and discussed elsewhere that drivetrain design trends are evolving towards ever decreasing engine operating speeds. At higher engine speeds and moderate-light loads, there is a theoretical efficiency advantage of a smaller displacement engine since a smaller fraction of the fuel burned is lost to overcoming parasitic losses to smaller contact surfaces of rotating and sliding components. However, with downspeeding, as engine operating speeds are reduced, overall friction losses are reduced and the friction advantage of the smaller engine diminishes. In concert with reduced operating speeds, the engine torque capacity must increase to achieve required power levels demanded of the vehicle so as to avoid loss in gradeability and the operator's over the road performance (route time). As a result, since the smaller displacement engine has less capability to produce the necessary high torque levels it is less capable of downspeeding without compromising either durability or performance. Consequently DTNA suggests that downsized engines not be considered to provide a fuel efficiency benefit. [EPA-HQ-OAR-2014-0827-1164-A1 p.22]

- **Model Based Control (MBC)** – EPA projects a very significant 2% efficiency improvement due to implementation of MBC when operating over transient conditions. DTNA has expended considerable effort to successfully apply the principles of model based controls to multiple systems. MBC approaches are or have been used to control engine coolant temperature, turbocharger inlet temperature, peak firing pressure and EGR systems amongst others. Extensive research has also been applied to combustion and emissions control using MBC approaches, seeking improvements over transient operation to reach steady state efficiency levels. Extensive work to generate data has shown that controls system improvements can only compensate for a fraction of the negative efficiency impacts of hardware dependent turbo lag, gas transport delays and thermal inertias. We have found that small efficiency improvements during transients may be reached, once again, at the cost of increased NO<sub>x</sub> levels. DTNA has learned that implementation of Neural Network approaches and on-line optimization carries computational demands that far exceed existing and foreseeable system capacity. While fuel efficiency gains from MBC are anticipated to be [redacted] we believe that continued MBC refinement can lead to improved transient torque response, thermal protection and transient particulate control. [EPA-HQ-OAR-2014-0827-1164-A1 p.22-23]

- **General Engine Compliance Margins** - EPA requests comment from manufacturers regarding continued declaration of FCLs above the measured levels during certification of engines to future GHG standards as was the case for DTNA's Phase 1 heavy-heavy duty engines. 80 FR 40195. DTNA's FCLs included compliance margin for measurement variability to ensure compliance during possible EPA confirmatory testing. DTNA is likely to continue to include compliance margin in the future and recommends that EPA considers, in setting its future standards that manufacturers will need to set FCLs above measured levels for this reason. [EPA-HQ-OAR-2014-0827-1164-A1 p.23]

## 5. CO2 from Urea SCR Systems

**CO2 from Urea SCR Systems** – Comments are requested by (80 FR 40193) regarding its Phase 2 proposal to allow manufacturers to downward adjust its gaseous emission measurement based engine fuel map points by the amount of CO2 that is generated by the consumption of urea. The consumption of urea would be averaged during each sampling period to calculate the correction. EPA estimates that up to 1% of an engine's CO2 emissions may be derived from the consumption of urea. The agencies further explained that it would apply this correction with any engines for which the engine manufacturer applied the correction for its fuel maps during certification. DTNA supports that manufacturers should be allowed to downward correct its Carbon mass balance based fuel consumption measurements by the amount contributed by DEF consumption on the condition that EPA and manufacturers work together to define measurement procedures for urea consumption that reliably and repeatedly produce satisfactorily accurate results. It is appropriate that EPA would apply the same adjustments when assessing a manufacturers fuel maps in an audit or confirmatory test scenario. Although EPA states that it does not propose a urea contribution correction to engine CO2 emissions that are measured over the SET or FTP for certification purposes, it requests comment (80 FR 40193) regarding both doing so, and regarding the magnitude of such an adjustment. EPA suggests that commensurate with a downward adjustment of reported CO2 levels, the CO2 standards themselves should also be reduced by a fixed amount of 1 – 2 g/bhp-h. DTNA does not support either the offset of manufacturer's certified CO2 levels or the downward adjustment of standards for CO2 contribution related to urea consumption. Manufacturers will vary in their approaches to NOx control strategies and consequently the urea contributions to CO2 emissions will vary. It would be inappropriate for EPA to assume a given downward adjustment in standards when any given magnitude of adjustment would not be appropriate given that there is likely to be a range depending on manufacturers DEF based control strategies. DTNA recommends no change to the Phase 1 practice of including CO2 from all sources in the certified CO2 levels for an engine, thus making the manufacturer accountable for its design philosophy for NOx control, DEF injection and its consequences to CO2 emissions. [EPA-HQ-OAR-2014-0827-1164-A1 p.24]

## 7. NOx

**Forcing** decreased tailpipe NOx comes with the tradeoff of increased GHG emissions - Reduction in tailpipe brake specific NOx emissions has classically been achieved at the cost of degraded engine efficiency and higher CO2 emissions. Even with the addition of highly effective NOx aftertreatment, this tradeoff continues to exist as is evidenced by industry efforts to improve NOx aftertreatment performance in order to optimize combustion for higher efficiency at higher engine out NOx levels. A Continued push for reduced engine out NOx emissions should be avoided in consideration of basic fuel efficiency compromises. Since ultimately the emissions level of a vehicle travelling over the road is a function of both the brake specific emissions of the engine and the road load required of the vehicle, a highly effective approach to reducing emissions of both CO2 and NOx is to improve the efficiency of the vehicle so that less power is required of the engine. Improvements in tire rolling resistance, cab aerodynamics, trailer aerodynamics all contribute to reductions in required road load and should be carefully accounted for in evaluating GHG Phase 2 positive contribution to NOx emissions reductions. In summary, the EPA should work with us to understand the tradeoffs—and likely increase in GHG emissions—that would occur if the agency decided to seek lower engine-out NOx; and the EPA should recognize the decreased NOx benefit from improved vehicle drag. [EPA-HQ-OAR-2014-0827-1164-A1 p.28]

**Alternate CO2 Standards** - The agencies ask whether the alternate CO2 allowance, used for non-SCR engines in Phase 1, should be eliminated. We think that the standard is no longer needed, as it was primarily intended to help [redacted] prior to its adoption of SCR. Now, the agencies should eliminate the option. 80 FR 40206. [EPA-HQ-OAR-2014-0827-1164-A1 p.30]



**Response:**

We will use the same approach as Phase 1 for certification between parent and child ratings as the commenter suggests. We do not believe inclusion of CO<sub>2</sub> into IRAF will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the impact of regeneration emissions since 2007. Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting compliance strategies that could reverse this trend. See Response 3.3.4.

We appreciate DNTA's positive comments on DF and SET reweighting. While we also appreciate DTNA's comments on various technologies EPA proposed for the engine standard setting, we believe that much of the data and emission values quoted by DTNA are overly conservative. Our values were based on many data sources, not just from public data sources, but also many CBI sources from OEMs. On the other hand, our technology effectiveness is still below what many other stakeholders have proposed, including one major engine OEM that recommended a much higher reduction rate. We believe that the engine standards we are adopting represent the most achievable reductions for the given time frame on an industry-wide basis. For diesel engines utilizing urea SCR emission control systems for NO<sub>x</sub> reduction, the agencies will allow, but not require, correction of the final engine (and powertrain) fuel maps to account for the contribution of CO<sub>2</sub> from the urea injected into the exhaust. We understand DTNA's concerns on NO<sub>x</sub> trade-off with CO<sub>2</sub> and we will take into consideration any effect on CO<sub>2</sub> emissions when developing any future NO<sub>x</sub> standards.

**Organization:** Daimler Trucks North America, Navistar Inc., Paccar Inc., and the Volvo Group

**Reasons for Additional Comment Submission**

Since the close of the formal comment period on October 1, 2015, there continues to be important discussion and reaction to the proposed greenhouse gas emissions stringency for engines separate from the complete vehicle requirements. In particular, a paper by Steven Charlton and Michael Walsh<sup>1</sup> (the "Charlton/Walsh Paper") submitted to the docket calls for a sizable increase in engine stringency citing various sources to support its contentions. The arguments in that paper are highly speculative, unsubstantiated, misleading and/or inaccurate, and must not form the basis for increased stringency. [EPA-HQ-OAR-2014-0827-1894-A1 p.2]

The purpose of this document, submitted by the commercial vehicle OEMs, is to provide the Agencies with the best technical data and assessments as input to the GHG and Fuel Efficiency Phase 2 regulations. [EPA-HQ-OAR-2014-0827-1894-A1 p.2]

**Background Statement**

The major heavy-duty truck manufacturers have invested heavily in fuel efficiency for many years, driven by the competitive demand for lowest commercial vehicle operating cost. We are fully supportive of sensible heavy duty GHG and efficiency regulations that reduce fuel consumption in real-world operations while meeting market requirements including adequate payback, durability, and reliability. Furthermore, regulations should invite open competition to deliver maximum benefits to vehicle purchasers at least cost, thereby incentivizing purchase of the most efficient vehicles and maximizing benefits to society. Regulations should not favor one vehicle manufacturer or supplier over another, nor should they focus on one vehicle subsystem over another, recognizing that manufacturers and suppliers may have differing levels of focus and expertise. While one manufacturer may choose to focus on highly advanced engine technology, others may choose to focus on vehicle aerodynamics, powertrain

integration, advanced vehicle controls, or any combination of these and other technologies. EPA has consistently recognized the importance preserving competition and encouraging innovative efforts for meeting stringent emissions standards, rather than forcing all manufacturers into using the same technological path. Setting separate engine standards based on the upper limits of advanced research would force all manufacturers to dedicate their limited resources on this with no assurance of success. Conversely, allowing manufacturers to focus on a wider variety of technologies will drive broader innovation and ultimately identify new opportunities for efficiency. [EPA-HQ-OAR-2014-0827-1894-A1 p.2-3]

### **Recommendation**

EPA and NHTSA should not increase the engine efficiency targets proposed in the NPRM. As a fundamental principle, separate engine standards provide no environmental or energy efficiency benefit because the GHG reduction benefits are calculated only with the engine incorporated into the vehicle. Therefore increasing the stringency of a separate engine standard provides no direct environmental benefit. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

Consequently, the separate engine standards should be set at a level that avoids unintended consequences. EPA and NHTSA should recognize the importance of considering the engine as an integrated part of a complete vehicle. With this approach, the agencies can avoid forcing engine optimization on fixed test cycles that do not, and cannot, replicate how the engine operates in each vehicle. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

By driving engine efficiency as part of the complete vehicle, manufacturers must optimize the engine for the actual engine operation, dictated by the vehicle power demand, powertrain, and controls. At the same time, manufacturers will be able to consider the impact of engine size, weight, and cooling demand on the vehicle efficiency when making optimal design tradeoffs, while avoiding the negative consequences of far-reaching engine standards as proposed in the Charlton/Walsh Paper and that the Agencies identified in the NPRM. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

A vehicle has many different subsystems and components that a vehicle OEM can innovate, design and integrate to optimize overall vehicle fuel economy. Vehicle efficiency obtained through system integration is far more significant than any single subsystem or component efficiency. In fact, two components that each have lower efficiency than their baseline counterparts can be combined and integrated to produce higher overall system efficiency through vehicle integration. We can illustrate this by considering just two components from a vehicle as an example, the engine and the transmission. [EPA-HQ-OAR-2014-0827-1894-A1 p.3]

While continuously variable transmissions (CVT) have not been demonstrated as viable technology for the HD highway market, the concept can be helpful in this illustrative example. From a component perspective, a CVT has lower average mechanical efficiency than a traditional, discrete ratio, counter-rotating transmission. However the CVT eliminates the existing fixed relationship between vehicle and engine speed. This enables the engine to be operated at its peak efficiency point for a requested power demand. Combine this with an engine that is designed and tuned specifically to be integrated to the CVT, and the result is a more efficient vehicle. This same engine would be optimized for operation with a CVT rather than the standard FTP cycle. As such, this same engine would however have lower overall efficiency when measured over the standardized test cycles than a typical engine, when compared on a component basis. However, the integration of these two so-called “less-efficient” components yields a vehicle that is more efficient than the combination of the two standard, baseline components. Furthermore, in addition to fuel economy improvements, the CVT with a compatibly optimized engine

could potentially reduce criteria emissions through engine/aftertreatment performance improvements. The flexibility of decoupling engine speed from vehicle speed enables the vehicle to avoid areas of the engine speed-torque map that have poor aftertreatment efficiency during real-world operation. This improves overall aftertreatment performance, further reducing real-world vehicle emissions in addition to CO<sub>2</sub> reduction. [EPA-HQ-OAR-2014-0827-1894-A1 p.3-4]

EPA must allow manufacturers to innovate solutions that optimize vehicle efficiency for real-world situations rather than forcing manufacturers to optimize components under lab environments. Constraining vehicle design by mandating the use of certain components is extremely counter-productive for fuel efficiency. While such constraints may benefit a subset of component manufacturers, there would be an unintended detrimental cost in fuel economy and environmental impact. Furthermore vehicle purchasers would ultimately and unfairly bear the higher financial costs. There is no technical, environmental, or financial common sense in driving small improvements in engine efficiency standards when they will potentially limit the ability to achieve vehicle efficiency improvements. Vehicle manufacturers must be allowed broad choices of solutions in order to encourage innovation and thus produce the most efficient vehicles possible. [EPA-HQ-OAR-2014-0827-1894-A1 p.4]

As mentioned in the subject paper, the 21 CTP report on US Department of Energy commercial vehicle programs states, “The engine systems Goal 1 of a 50% BTE for an emissions compliant engine has been achieved. Two of the four SuperTruck teams have successfully demonstrated BTE greater than 50% in on-road tests using commercial, ultra-low-sulfur diesel fuel.” This statement is misleading for a number of reasons: [EPA-HQ-OAR-2014-0827-1894-A1 p.13-14]

- The 50% BTE is achieved at a single operating point, not on a test cycle that reflects the engine’s operating range. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]
- NO<sub>x</sub> emissions are demonstrated at 0.2 g/bhp-hr only on a new, single engine. No margin is provided for variability, deterioration, OBD, or in-use requirements. It is incorrect to characterize these engines as being emissions compliant. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]
- These engines are designed for optimum fuel efficiency with compromises made to life expectancy and reliability, and were intended only for short-term demonstration, and without commercially acceptable constraints on cost. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]

Note that in SuperTruck 2 (a follow-up initiative launched by DOE for manufacturers to further demonstrate efficiency technologies), DOE has proposed only lab demonstration of the target 55% BTE. DOE clearly recognizes that the proposed pathways are extremely tenuous, do not account for in-vehicle operation, and have never even been laboratory demonstrated with a complete engine (vs. a single cylinder approximation). The technologies discussed in this section of the paper are simply an overview of the menu of approaches, none of which are proven feasible. The only engines that have ever approached 55% BTE are huge ship engines running with unlimited cooling water, unlimited NO<sub>x</sub>, and controlled steady state duty cycles. These engines deploy multiple waste heat recovery systems to generate electricity that is counted into the BTE, even though not converted back to mechanical propulsion. It is not reasonable to expect a truck engine to achieve this level of efficiency, given the many constraints and requirements. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]

## **Conclusion:**

Furthermore, there is no efficiency or GHG contribution from a separate engine standard that is not already included in the complete vehicle standard. The logical and appropriate conclusion is that engine

improvements should be driven from the complete vehicle standard and any separate engine standard should represent a level that can be achieved without compromise in vehicle efficiency or lowest total cost of vehicle operation, not an aggressive limit that forces manufacturer to focus on the engine over other potential efficiencies. EPA and NHTSA have accomplished this in their phase 2 proposal. These engine targets should not be made more stringent. [EPA-HQ-OAR-2014-0827-1894-A1 p.20]

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1 <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-1237>

**Response:**

We understand the principle behind the comments made by these four major vehicle OEMs. While we believe that the separate engine standard is necessary, we agree they should not be set in way that would prevent optimization of the engines for the vehicles. However, we believe they overstated the significance of this issue. Certain technologies may perform better in the vehicle than over the engine test cycle, but these marginal differences do not equate to actually preventing manufacturers from optimizing either engine or vehicle efficiencies for in-use emissions. The commenters also ignore the role emission averaging can play in this process by allowing different degrees of optimization across engines.

In regard to the comments on component-by-component optimization, we also understand the principles behind these comments. Our vehicle standards promote total vehicle optimization, which is realized by our certification tool - GEM. GEM allows all individual components, such as advanced engine technologies that can be measured through the engine dynamometer, advanced aero-dynamic technology, tire rolling resistance, and efficient transmission and axle design into a seamless package that is modeled and certified in a systematic manner. The only component that is required to comply with an individual standard is the engine component, which is recognized by separate engine standards. Section II.B.2.b of Preamble details the justifications surrounding why we need the separate engine standards. As can be seen, we fully recognize the pros and cons of having separate engine standards, and we believe that this level of component optimization is appropriate and reasonable.

**Organization:** Environmental Defense Fund (EDF)

Engine standards must be strengthened

As stated above, engine standards provide proven, measureable and durable real-world emissions reductions. Engine technologies can also provide a significant portion of total vehicle fuel efficiency potential. And because combination tractors and vocational trucks account for about 85 percent of fuel use in the medium and heavy-duty sector, establishing a robust engine standard to drive technologies in those classes is critical. [EPA-HQ-OAR-2014-0827-1312-A1 p.27]

Unfortunately, the Agencies have proposed a 4.1 percent engine efficiency improvement over Phase 1 for diesel engines, which falls far short of what is technologically feasible. These proposed standards are not technology forcing considering the current state of advanced engine technology development, nor do they reflect the full potential of available technologies on the shelf today. It is clear that the proposed engine standards do not meet the Agencies' statutory requirements for appropriate and maximum feasible standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.27]

The administrative record does not support the Agencies conclusion in the Preamble that they have taken "a more technology-forcing approach than in Phase 1, predicated on use of both off-the-shelf technologies

and emerging technologies that are not yet in widespread use.” The proposed standards can be met with today’s technologies – manufacturers need not rely on any advanced technologies;<sup>130</sup> by definition, they are not technology forcing. The Agencies finalized a 9 percent engine improvement in the Phase 1 rule to be implemented between 2014 and 2018. In comparison, the proposed 4.1 percent improvement is less than half of the improvement required under Phase 1, and the Agencies are proposing to give manufacturers more than twice as long. And because the proposed standards will not be fully implemented until 2027, they preclude the opportunity to set more meaningful standards until 2030 under NHTSA’s statutory requirements for lead-time. [EPA-HQ-OAR-2014-0827-1312-A1 p.28]

A recent report by Walsh et. al. performed an exhaustive literature review, and critiqued the methodology and assumptions used by the Agencies in their determination of stringency.<sup>131</sup> The study found “the Agencies to be overly conservative in their assessment of technology effectiveness, cost/retail price and adoption rates, which is reflected in the relaxed HD tractor engine standards proposed.”<sup>132</sup> Based on the recommendations of the report, EDF requests that the Agencies set significantly more stringent Phase 2 engine standards that are consistent with the Clean Air Act’s 202(a) technology forcing authority. [EPA-HQ-OAR-2014-0827-1312-A1 p.28]

Proposed engine standards are weaker in the real--world than rulemaking documents claim

Although the proposed engine standards will nominally achieve a 4.1 percent emission and fuel consumption reduction, in reality they are equivalent to a 2.1 to 3.1 percent reduction because of the effects of the proposed test procedure changes.<sup>133</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.28]

The Supplemental Engine Test (SET) was adopted as the sole test cycle for GHG compliance determinations in EPA’s medium- and heavy-duty Phase 1 GHG rule finalized in September 2011. In Phase 2, the Agencies are proposing to revise the cycle weighting for CO<sub>2</sub> compliance testing purposes, based on the belief that the revised weighting would make the SET more representative. The proposed cycle re-weighting is shown in Figure 1 below.<sup>134</sup> The Agencies increased the weighting of the A speed from 23% to 45% and reduced the C speed from 23% to 5%. The B speed weighting remained essentially unchanged. [EPA-HQ-OAR-2014-0827-1312-A1 p.28]

[Figure 1 can be found on p.29 of docket number EPA-HQ-OAR-2014-0827-1312-A1]

The fuel consumption of a heavy-duty tractor engine would usually be lower at the A speed than the B or C speeds. Consequently, an engine tested on the re-weighted cycle would have approximately 1 to 2% lower CO<sub>2</sub> emissions as compared to levels measured on the existing cycle.<sup>136</sup> The proposed cycle re-weighting therefore relaxes the standards, and the Agencies should account for this effect in the setting of the engine standards. [EPA-HQ-OAR-2014-0827-1312-A1 P.29]

Proposed engine standards do not reflect the compliance potential of existing and emerging technologies

In summary, the Walsh et. al. study found that EPA and NHTSA’s proposed standards do not reflect the current state of existing and emerging engine technology development. The analysis found that significant progress in improving engine fuel efficiency has already been demonstrated by all manufacturers participating in the DOE SuperTruck Program. In fact, manufacturers have demonstrated with on-the-road trucks the potential to reduce CO<sub>2</sub> emissions from the engine by 15 to 20%.<sup>137</sup> A wide range of heavy-duty engine technologies have been improved upon or developed, and applied successfully to demonstration trucks in the SuperTruck Program. These technologies include combustion/closed cycle efficiency improvements, air handling/open cycle efficiency improvements, friction and parasitic loss reduction, downspeeding, and waste heat recovery. And both Volvo and Cummins have already

demonstrated at least 48% BTE on their demonstration vehicles without advanced technologies like waste heat recovery (“WHR”),<sup>138</sup> compared to the proposed standard of 44.6% BTE (441gCO<sub>2</sub>/bhp-hr). [EPA-HQ-OAR-2014-0827-1312-A1 p.29-30]

Furthermore, the most recent NAS report,<sup>139</sup> which conducted an in-depth progress assessment of the SuperTruck program, concluded “the engine systems Goal 1 of a 50% brake thermal efficiency (BTE) for an emissions compliant engine has been achieved.”<sup>140</sup> A 50% BTE level implies an engine CO<sub>2</sub> standard of 390 g/bhp-hr or a 15% emissions reduction compared to 2017 levels. NAS also concluded “a pathway to achieve 55% is being developed.”<sup>141</sup> Figure 2 below graphically shows the Phase 1 and proposed Phase 2 emission standards (expressed as BTE) and, for reference, the assessments of NAS, SwRI, and the results of the SuperTruck program.<sup>142</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.30]

[Figure 2 can be found on p.30 of docket number EPA-HQ-OAR-2014-0827-1312-A1]

As can be seen from Figure 1, the proposed engine standards fall significantly short of what is projected as possible by NAS and is already being demonstrated within the SuperTruck program. Data from the SuperTruck teams from Daimler, Navistar, Volvo, and Cummins/Peterbilt is highly relevant to the development of the engine standard and the Agencies must appropriately consider this information in developing final engine standards.<sup>144</sup> The DOE program has resulted in more than \$375 million dollars being invested in research, development, and demonstration vehicles, and was specifically designed to integrate emerging advanced technologies into over-the-road line-haul trucks, in order to demonstrate significant reductions in GHG and fuel consumption in real-world freight operations.<sup>145,146</sup> The freight efficiency results obtained to date over mixed drive cycles clearly indicate that a significantly stronger engine standard is feasible. [EPA-HQ-OAR-2014-0827-1312-A1 p.30-31]

Technology feasibility assessment is overly conservative

As discussed above, the proposed standards will not facilitate development of advanced technologies. The weak standards proposed by the Agencies are the result of an analysis that is overly conservative in its assessment of technology effectiveness, technology penetration rates, cost projections, and the application of a “dis-synergy” factor to discount technology effectiveness. [EPA-HQ-OAR-2014-0827-1312-A1 p.31]

Nearly all of the engine technology effectiveness values used by the Agencies were underestimated. In some cases, the Agencies used lower effectiveness estimates than SwRI’s research study projected. (The SwRI study was funded by NHTSA and was a key technical support reference for the proposal). In other cases, the effectiveness values assigned were lower than publically available industry estimates. For example, the Agencies estimated that friction and parasitic loss reductions would result in a 1.4% efficiency improvement. In contrast, the SwRI study estimates more than a 4% improvement and some industry estimates are even higher. As another example, the Agencies projected a 3.6% efficiency improvement for WHR, whereas the latest information reported by Cummins shows that an improvement of 5 to 6.5% is possible.<sup>147</sup> The Agencies fail to adequately justify the use of lower estimates in the rulemaking record. [EPA-HQ-OAR-2014-0827-1312-A1 p.31-32]

The Agencies also assumed constant effectiveness for all of the individual technologies between 2021 and 2030. This assumption means that no performance improvements are projected during the 9-year period over which the standards are being phased in. In contrast, real world experience would suggest that manufacturers and suppliers would continue developing and refining their engine technologies and therefore effectiveness would improve. We recommend that the Agencies properly account for these

expected real-world effectiveness improvements in their feasibility assessment. [EPA-HQ-OAR-2014-0827-1312-A1 p.32]

The Agencies' technology penetration assumptions are also problematic. As mentioned above and demonstrated in Table II-6 below from the Preamble, the Agencies are relying substantially on existing engine technologies. Because many of these technologies are already on the road and have proven to be cost effective, the Agencies should accelerate the penetration of existing technologies earlier than 2024. [EPA-HQ-OAR-2014-0827-1312-A1 p.32]

[Table II-6 can be found on p.32 of docket number EPA-HQ-OAR-2014-0827-1312-A1]

The last column in the table shows the very small penetration rates assigned for more advanced technologies, such as WHR and turbo compounding. These minimal penetration rates combined with weak standards do not drive the technologies. Moreover, other advanced combustion technologies are not included on the list. Between 2024 and 2027, the Agencies are only requiring an additional 5% penetration for existing technologies, no additional penetration for turbo compounding, and a 10% increase for WHR. As a consequence, a negligible increase of only 0.5% in stringency is added in 2027. It is critical that the Agencies assume a much more realistic deployment of advanced technologies to finalize a rule that is truly technology forcing. Beyond 2024, there is a tremendous opportunity for the Agencies to set transformational standards that will result in significant additional CO2 reductions compared to those projected for the proposal. [EPA-HQ-OAR-2014-0827-1312-A1 p.32]

Another example of the conservative nature of the Agencies' analysis is the derivation of cost for WHR systems. NHTSA hired Tetra Tech, Inc. ("TTI") to work with SwRI to study the cost of the key technologies for reducing CO2 and fuel consumption. TTI relied on existing literature for cost information: a 2009 NESCAFF/ICCT study<sup>148</sup> and a 2009 TIAX study.<sup>149</sup> Other secondary sources (NAS and NHTSA) were referenced. However, these sources also heavily relied on the NESCAFF/ICCT and TIAX studies. Not only are the data sources dated, the costs were created for a 2009 WHR system that has little in common with the state-of-the-art systems demonstrated today by the SuperTruck program. [EPA-HQ-OAR-2014-0827-1312-A1 p.33]

In addition, the Agencies assumed that WHR was on the flat portion of the cost learning curve, an inappropriate assumption for this emerging technology. The Agencies' explanation for this assumption is as follows: [EPA-HQ-OAR-2014-0827-1312-A1 p.33]

*"We consider this technology to be on the flat portion of the learning curve (curve 12) because although waste heat recovery is a new technology and in the 2015 to 2017 timeframe remains, perhaps, on the steeper portion of the learning curve, applying such rapid learning effects to the cost estimate we have would result in costs too low in the MY2024 to 2027 timeframe."*<sup>150</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.33]

The agencies have not provided a reasonable explanation for declining to apply the cost curve in the way that they themselves recognized was appropriate. As a consequence, EPA and NHTSA's technology cost estimates are biased on the high side, reducing the stringency of the standard. [EPA-HQ-OAR-2014-0827-1312-A1 p.33]

The agencies use of a "dis-synergy" factor is likewise not well supported. Theoretically, a dis-synergy factor is intended to account for the fact that some technologies may negatively impact the performance of other technologies. However, a positive – or synergistic – effect can also occur. And for some technologies such as friction reduction and turbo efficiency improvements, one would expect no effect.

Therefore, it is not appropriate to apply a dis-synergistic value across the board. [EPA-HQ-OAR-2014-0827-1312-A1 p.33]

When determining synergistic and dis-synergistic effects, it is important to account for the specific combination of technologies under consideration, and apply values for each situation. Instead, the Agencies applied a uniform 25% discount in 2021 and a 15% discount in 2024 and 2027 across all technologies. This fails to credit efficiency benefits of some technology combinations. Furthermore, the Agencies provide no explanation for the derivation or justification for the use of the dis-synergy factors in the rulemaking record. Nor do they provide any evidence to support their proposed approach, which EDF considers inappropriate given that many of the technologies on EPA's list may not even have dis-synergistic effects. [EPA-HQ-OAR-2014-0827-1312-A1 p.33-34]

In summary, EPA and NHTSA made overly conservative assumptions on almost every critical input that went into the derivation of the proposed engine standards. This results in standards that provide minor incremental improvement over 2017 engine designs despite cost-effective available technologies and more than 12 years of lead time. We respectfully urge the Agencies to correct these deficiencies in their analysis, which would more than double the stringency of the proposed standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.34]

#### *Recommended engine standards*

Based on the literature review and analysis performed by Walsh et. al., and the extensive technology analyses performed by ACEEE,<sup>151</sup> UCS<sup>152</sup> and ICCT,<sup>153</sup> we are strongly recommending that the Agencies consider the following performance-based standards for line-haul and heavy-haul applications, which consume the majority of the fuel in the medium- and heavy-duty truck category: [EPA-HQ-OAR-2014-0827-1312-A1 p.34]

#### **a) Engine standards**

- Model Year 2027 and beyond HD Tractor Engines 390 gCO<sub>2</sub>/bhp-hr (50.4% BTE)
- Model Year 2024-26 HD Tractor Engines 405 gCO<sub>2</sub>/bhp-hr (48.5% BTE)
- Model Year 2021-23 HD Tractor Engines 435 gCO<sub>2</sub>/bhp-hr (45.1% BTE) [EPA-HQ-OAR-2014-0827-1312-A1 p.34]

Robust engine standards are needed to drive emissions and fuel consumption reductions across the entire vehicle. The technology is clearly available to meet these standards in the time frames suggested. [EPA-HQ-OAR-2014-0827-1312-A1 p.34]

The 12-year lead-time the Agencies are providing for compliance is more than sufficient for manufacturers to develop and successfully deploy the advanced engine technologies needed to meet more stringent standards. In fact, the lead-time is extraordinarily long when compared to most past Agency actions over the last 40 years. At minimum, the Agencies could consider conducting a biennial review as was done for the 2007/2010 HD criteria pollutant rule.<sup>154</sup> These reviews were conducted biennially, and reviewed the development status of the advanced technologies that were in question, specifically diesel NO<sub>x</sub> adsorbers. At the end of each review cycle, EPA publically released a report that discussed the status of the technology development and any implications concerning rule implementation. [EPA-HQ-OAR-2014-0827-1312-A1 p.34-35]



130 See comments submitted to this docket by ACEEE and UCS; EPA-HQ-OAR-2014-0827-1280-A1 and EPA-HQ-OAR-2014-0827-1329-A2

131 Walsh and Charlton, *Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines*, Consultant Report, (September 2015).

132 Walsh and Charlton (2015) at 10.

133 *Id.*

134 *Id.*

135 *Id.*

136 *Id.*

137 *Id.*; Review of the 21<sup>st</sup> Century Truck Partnership: Third Report; The National Academies of Sciences, Engineering, and Medicine, (September 11, 2015).

138 Amar, P., “*Volvo SuperTruck - Powertrain Technologies for Efficiency Improvement*, 2015 Annual Merit Review, Washington, DC, (June 12, 2015); Koeberlein, D., *Cummins SuperTruck Program Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks*, DOE Merit Review, (May 16, 2013), Project ID: ACE057.

139 Review of the 21<sup>st</sup> Century Truck Partnership: Third Report; The National Academies of Sciences, Engineering, and Medicine, (September 11, 2015).

140 *Id.* at S-2.

141 *Id.* at S-2.

142 Walsh and Charlton, *Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines*, Consultant Report, (September 2015).

143 *Id.*

144 Koeberlein, D., *Cummins SuperTruck Program Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks*, DOE Merit Review, (16 May, 2013), Project ID: ACE057; Koeberlein, D., *Cummins SuperTruck Program Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks*, DOE Merit Review, (12 June, 2015), Project ID: ACE057; Rotz and Ziegler, *Daimler SuperTruck - Recovery Act –Class 8 Truck Freight Efficiency Improvement Project*, Super Truck Program: Vehicle Project Review, DOE Merit Review, (11 June, 2015), Project ID: ARRAVT080; Singh, S., *SuperTruck Program: Engine Project Review, Recovery Act – Class 8 Truck Freight Efficiency Improvement Project*, Detroit Diesel Corporation, Project: ACE 058, (June 12, 2015); Amar, P., *Volvo SuperTruck - Powertrain Technologies for Efficiency Improvement*, 2015 Annual Merit Review, Washington, DC, (June 12, 2015); Zukouski, R., *Navistar SuperTruck – Development and Demonstration of a Fuel-Efficient Class 8 Tractor & Trailer - Engine Systems*, DOE Merit Review, (12 June, 2015), Project ID: ACE05; Reinhart, T. E., *Commercial medium- and heavy-duty truck fuel efficiency technology study - Report #1*, (Report No. DOT HS 812

146), Washington, DC: National Highway Traffic Safety Administration, (June 2015); Reinhart, T., *Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2*, Washington, DC: National Highway Traffic Safety Administration, (June 2015).

145 “DOE SuperTruck Program Benefits Analysis,” Final Report, prepared for U.S. Department of Energy, Office of Vehicle Technologies and Argonne National Laboratory, (December 20, 2012).

146 Gravel, R., *SuperTruck: An opportunity to reduce GHG emissions while meeting service demands*, Asilomar Conference, (August, 2013), available at [www.its.ucdavis.edu/fies/general/pdf/2013-08-21\\_Asilomar-2013-Gravel.pdf](http://www.its.ucdavis.edu/fies/general/pdf/2013-08-21_Asilomar-2013-Gravel.pdf).

147 Koeberlein, D., *Cummins SuperTruck Program Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks*, DOE Merit Review, (June 12, 2015), Project ID: ACE057.

148 Northeast States Center for a Clean Air Future (NESCCAF), ICCT International Council on Clean Transportation, Southwest Research Institute, and TIAX, LLC, *Reducing Heavy-Duty Long Haul Combination Truck Fuel Consumption and CO2 Emissions*, Final Report (October, 2009).

149 TIAX, *Assessment of Fuel Economy Technologies for Medium- and Heavy Duty Vehicles - Final Report*, Case D0506, (November 19, 2009).

150 RIA at 2-221.

151 See ACEEE comments submitted to this docket; EPA-HQ-OAR-2014-0827-1280-A1

152 See UCS comments submitted to this docket; EPA-HQ-OAR-2014-0827-1329-A2

153 See ICCT comments submitted to this docket; EPA-HQ-OAR-2014-0827-1180-A4

154 66 Fed. Reg. “Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements,” (January 18, 2001).

### **1. Strong engine standards are critical to a meaningful program**

We reiterate our strong support for the Agencies’ proposed structure of the rule – separate engine standards are imperative to drive innovative engine technology and provide proven, measureable and durable real-world emissions reductions. However, these benefits can only be realized through robust engine standards. Weak standards, as proposed by the Agencies, do not drive advanced technologies and fall short of unlocking the full capabilities of existing technologies. Additionally, limited engine standards do not take advantage of the robust in-use enforcement provisions of the engine program. These provisions provide high confidence that GHG reductions demonstrated on new engines actually occur in the real world. In order to secure the significant benefits afforded by separate engine standards, the Agencies’ must finalize far more meaningful standards that drive technology and allow for robust enforcement. [EPA-HQ-OAR-2014-0827-1886-A1 p.3]

a. Proposed engine standards are clearly not technology forcing and should be significantly strengthened in the final rule

The NODA states that the proposal “intended to” base standards “not only on currently available technologies but also on utilization of technologies now under development or not yet widely deployed.”<sup>7</sup> However, this is clearly not the case. The Agencies proposed a meager 4.1 percent engine efficiency improvement over Phase 1 for Class 8 diesel engines. (In-use they are equivalent to only a 2.1 to 3.1 percent reduction because of proposed updates to the test procedure.<sup>8</sup>) The proposed standards are not technology forcing because they do not reflect the full potential of available technologies on the shelf today, nor do they fully consider the current state of advanced engine technology development, as shown below. [EPA-HQ-OAR-2014-0827-1886-A1 p.3]

*i. Numerous model year 2016 medium-heavy-duty and heavy-heavy-duty vocational truck engines are already in compliance with EPA’s proposed 2027 CO2 standards*

Recent heavy-duty certification data posted by the California Air Resources Board (CARB)<sup>9</sup> on their website show that at least four medium-heavy-duty and heavy-heavy-duty vocational truck engines from four different manufacturers (Detroit Diesel, PACCAR, Hino, and Cummins) already meet the proposed 2027 engine standards. The data made publically available by CARB are certificates of compliance (Executive Orders) for the 2016 model year. Table 1 below compares the certified levels of these engines to the proposed 2027 CO2 standards for vocational truck engines. [EPA-HQ-OAR-2014-0827-1886-A1 p.3-4]

[Table 1 can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1886-A1]

The table clearly shows that these 2016 engines are already in compliance with the 2027 standards – more than a decade before they are required. And several of the current engines are significantly cleaner than the proposed levels. This is compelling evidence that the agencies have proposed extraordinarily weak standards for vocational engines, and the standards are not consistent with the CAA’s technology-forcing mandate. In fact, the 2016 certification data demonstrates that the 2027 standards will not require technologies beyond those already being applied to today’s production engines. It is critical that the Agencies more accurately reflect the true capabilities of today’s engines into their analysis and set meaningful 2027 engine standards that drive the adoption of more advanced technologies. Given that more than a decade lead-time is being provided, the standards must go well beyond what were proposed in order to be reconciled with EPA’s technology-forcing authority and NHTSA’s maximum feasible mandate. [EPA-HQ-OAR-2014-0827-1886-A1 p.4]

*ii. More recent assessments of Waste Heat Recovery should be considered by the Agencies*

In our comments, submitted to the docket on October 1, 2015, we highlighted our concerns with the Agencies’ conservative analysis of the potential of waste heat recovery (WHR) - an engine technology that can provide a step-change reduction in CO2 emissions. The data sources that the Agencies relied upon to project WHR costs were dated, the system design assumed had little in common with the latest designs planned for production,<sup>10</sup> and cost learning curve assumptions were flawed. Taken together, these factors bias WHR cost on the high side, which in turn resulted in very low proposed penetration rates of the technology and therefore reduced stringency of the program. A recent white paper analysis performed by John Wall, recently retired Chief Technology Officer for Cummins Engine Company, reinforces this view<sup>11</sup> (attached as Appendix A). [Appendix A can be found in docket number EPA-HQ-OAR-2014-0827-1886-A2][EPA-HQ-OAR-2014-0827-1886-A1 p.4-5]

Wall’s paper describes WHR as “a significant enabling technology to drive CO2 reductions.” His analysis found that “new WHR architectures reduce the projected cost of WHR to less than half the cost numbers presented in the Phase 2 NPRM.” This result was achieved even without applying a learning curve to the

cost projections. The white paper further concludes, “this substantially lower cost estimate should allow EPA to consider a more significant penetration of WHR technology with acceptable cost effectiveness.”<sup>12</sup> It is critically important that the Agencies’ final rule stringency determinations take into account the latest and most relevant data and analysis related to WHR and other technologies, and in doing so, significantly increase the stringency of the tractor engine standard. [EPA-HQ-OAR-2014-0827-1886-A1 p.5]

*iii. Additional data provided in NODA does not change need for more robust engine standards*

In a 2015 report, (submitted to the docket during the initial comment period) leading engine experts Walsh and Charlton performed an exhaustive literature review of engine technology, and critiqued the methodology and assumptions used by the Agencies in their determination of stringency.<sup>13</sup> The study concluded that the “agencies have underestimated the potential of key technologies when setting the GHG emission and fuel consumption standard for HD tractor engines,” and therefore “the standards set for HD tractor engines fall well short of being “technology advancing.” Walsh et. al. made specific recommendations for stronger and more appropriate standards, which EDF cited in our 2015 comments to the docket.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1886-A1 p.5]

As part of the NODA, the agencies are seeking comment on a Southwest Research Institute (SwRI) Report titled “Commercial Medium- and Heavy-Duty Fuel Efficiency Technology Study – Report #2.” According to the agencies, an independent peer review of the initial report identified errors that were corrected and a final report was released as part of the NODA. After reviewing the final SwRI peer-reviewed report, Walsh and Charlton found that 1) the report was “overly conservative in its assessment of the available technologies, especially waste heat recovery (WHR),” 2) the report contained “non-data based speculation and opinion for technologies in question that have been demonstrated in both the test cell and in over-the-road trucks,” and 3) “the final report from SWRI, containing only minor corrections, does not alter the recommendations made by [us].” Based on their review and the above conclusions, the authors “continue to recommend the adoption of more challenging limit standards for CO<sub>2</sub> in the Phase 2 rule: [EPA-HQ-OAR-2014-0827-1886-A1 p.5-6]

MY 2027 and beyond HD Tractor Engines 390 gCO<sub>2</sub>/HP-hr (50.4% BTE)

MY 2024-2026 HD Tractor Engines 405 gCO<sub>2</sub>/HP-hr (48.5% BTE)

MY 2021-2023 HD Tractor Engines 435 gCO<sub>2</sub>/HP-hr (45.1% BTE)”<sup>15</sup>

Again, EDF supports the conclusions and recommendations made by Walsh and Charlton – two of the nation’s leading experts on heavy-duty truck engine technology. [EPA-HQ-OAR-2014-0827-1886-A1 p.6]

**b. Robust final engine standards are needed to provide enforcement**

As recently exemplified by Volkswagen, in-use testing requirements and enforcement are critical to achieving real-world emissions reductions. One of the most cost-effective ways to safeguard emissions reductions is through the use of robust engine standards. The existing heavy-duty engine testing and in-use compliance requirements have evolved over decades, making them very rigorous and providing verifiable proof that in-use engine emission reductions are real. Despite the assurances afforded by engine standards, the Agencies have instead allocated most of the Phase 2 stringency to model-based vehicle standards that do not currently include in-use compliance and enforcement requirements. The agencies should instead finalize far stronger engine standards to capitalize on the existing strong engine compliance and enforcement provisions, which will provide high assurance that emission reductions

required by the standards are achieved in-use. Since the real world benefits of engine fuel economy improvements can readily be monitored and enforced, those improvements should be of the highest priority. [EPA-HQ-OAR-2014-0827-1886-A1 p.6]

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7 81 Fed. Reg. at 10825 (March 2, 2016).

8 Walsh and Charlton, Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines, Consultant Report, (September 2015).

9 See CARB certification data for each manufacturer at:

[http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/hino\\_mhdd\\_a0310085\\_7d684\\_0d20-0d01.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/hino_mhdd_a0310085_7d684_0d20-0d01.pdf);

[http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins\\_mhdd\\_a0210637r1\\_8d9\\_0d20-0d01.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins_mhdd_a0210637r1_8d9_0d20-0d01.pdf);

[http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/paccar\\_hhdd\\_a3840022\\_10d8\\_0d20-0d01.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/paccar_hhdd_a3840022_10d8_0d20-0d01.pdf);

[http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/detroitdiesel\\_hhdd\\_a2900156\\_14d8\\_0d20-0d01.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/detroitdiesel_hhdd_a2900156_14d8_0d20-0d01.pdf) (last accessed March 30, 2016)

10 Comments submitted to docket by Cummins on October 1, 2014, Docket ID# EPA-HQ-OAR-2014-0827-1298; Page 15.

11 John Wall, “A Perspective on Waste Heat Recovery for Consideration for the Phase 2 GHG Rule,” (February 11, 2016).

12 John Wall, “A Perspective on Waste Heat Recovery for Consideration for the Phase 2 GHG Rule,” (February 11, 2016) at 4.

13 Walsh and Charlton, Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines, Consultant Report, (September 2015).

14 Comments of EDF, Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Proposed Rule, (October 1, 2015). Docket ID No. EPA-HQ-OAR-2014-0827-1312.

15 Walsh, Michael P. and Charlton, Stephen J., “Addendum: Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines,” (March 28, 2016).

**Response:**

We appreciate EDF’s constructive comments. The commenter is correct that the SET baseline at proposal failed to account for the reweighted SET modes in Phase 2 (One OEM pointed out this same error). The agencies have corrected this error in developing the SET baseline for the final rule. See Response 3.3.3. We also made a significant adjustment to the FTP vocational baseline engine emission values based on the latest certification data (initially brought to the agencies’ attention by this commenter). We also have reassessed the costs of WHR and have revised the cost downward from that estimated at proposal. These reductions largely reflect the agencies’ judgment that the WHR system considered at proposal had

certain components and aspects not actually needed. This judgment is consistent with CBI information from one of the engine manufacturers as well as information from other credible sources. The detailed process of the adjustment of the baseline values can be found in Chapter 2.7.4 of the RIA and RTC Response 3.3.3, and the cost related to WHR is in Chapters 2.7.6, 2.7.8, 2.7.10, and 2.11.2.15 of the RIA. We have made certain other changes from proposal which have the effect of increasing the stringency of the engine standards including: increasing the dis-synergy factor from 0.85 to 0.9 in 2027, increasing the market penetration for WHR Rankine cycle technology from 15% to 25% for a tractor engine in 2027, and including down speed benefits as part of the projected compliance pathway. This resulted in an increase from 4.2% to 5.1% for the tractor engine standards in 2027 compared to the proposed rule. . Chapters 2.3 and 2.7 of the RIA detail the justification for these changes.

We respectfully disagree with many of EDF's arguments for even more aggressive engine stringency standards for the final rule. Their argument is largely based on the report from Walsh/Charlton. We have reviewed the responsive report from four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar). In these reports, they rebut all points made by EDF, specifically as they pertain to the Walsh/Charlton report. When taking the vehicle OEMs' comments into consideration:

- We disagree with EDF's comments that our standards are not technology forcing. We believe that implying that the standards we were proposing were too low and stating that a 9 percent reduction from Phase 1 is achievable, is simply misleading. The driving forces behind this is that improvements in technology effectiveness cannot be extrapolated in a linear way as it is constrained by the law of thermodynamics. A good summary report that highlights the limitation of engine efficiency improvement can be found at: [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/deer\\_2011/wednesday/presentations/deer11\\_edwards.pdf](http://www1.eere.energy.gov/vehiclesandfuels/pdfs/deer_2011/wednesday/presentations/deer11_edwards.pdf). Any further incremental improvements will require tremendous engineering efforts with high cost and unreliability. Furthermore, NOx emissions always act as one of major constraints for further improvement in engine efficiency. In our final rule, the peak thermal efficiency of the tractor engine is approaching 50%, which is in the range of the DOE SuperTruck program. DOE acknowledged (Roland Gravel, 2016 SAE Government/Industry Meeting, January 21, 2016) that there were significant differences between the technologies developed by DOE through the SuperTruck program and technologies used to comply with regulations, and many of technologies developed under the SuperTruck program still have a long way to reach production level. Despite these challenges, we have significantly adjusted our standards for both tractor and vocational engines to make this rule even more stringent compared to the NPRM, as explained in the initial part of this response.
- We disagree with the approach taken by EDF regarding the technology effectiveness derived from DOE's Supertruck program and NAS's report. It appears that EDF took a single value out of the literature, which was primarily based on peak values. In contrast, we considered the stringency over 13 composite modes (i.e. accounted for actual in-use driving patterns), where the reduction achievable is (not surprisingly) much lower than from the single most efficient point.
- We believe that the technology effectiveness used in our rule is consistent with the SwRI report, specifically with respect to friction when making an apples-to-apples comparison. In order to make such a comparison, the certification cycle weighting and certification vehicle weight must be used for this evaluation.

- We do not believe that the effectiveness we set for WHR is conservative. As a matter of fact, the effectiveness used in our rulemaking was directly from the same engine manufacturer that EDF and Walsh/Charlton quoted, and is consistent with this engine manufacturer's expectations in terms of reductions. In addition, we did consider recent technology information obtained from one of the engine manufacturers. Consequently, we increased the estimated market penetration from 15% to 25% in 2027, thus increasing the estimated contribution from WHR used to set standard stringency in the final rule.
- We do not think that there is any positive synergy effect when putting all technologies into one package, while the dis-synergy effect is always present. Please see the detailed explanation and justifications regarding this matter in Chapter 2.7.5 of the RIA. We have significantly expanded the explanation of the dis-synergy effect in this final rule and we did increase the dis-synergy factor from 0.85 to 0.9 in 2027.
- We do not believe that the SwRI reports are too conservative, specifically as they pertain to their estimate on WHR effectiveness. The projections from these reports is in line with what EDF mentioned in their comments, which is about 4%. Although SwRI's evaluation of the technology is not entirely based on test data, the methodology used is defensible because it incorporates the use of a state-of-the-art simulation tool box to model the technology effectiveness. This modeling approach is even more important as it is not possible for the agencies to evaluate all possible technologies under test cell or real-world driving conditions. Therefore, the assumptions used in running simulations must be largely based on literature values in conjunction with limited testing data.

**Organization:** Honeywell Transportation System (HTS)

Technology Available for Greater GHG Reduction with Strong Payback

While the new SET cycle weighting factors introduced in the proposal more accurately reflect real-world use of heavy duty long haul truck engines, they also result in a "calculated" fuel consumption reduction of between one half and one percent. This "baseline shift" is not reflected in the current proposal, which means that the "actual" required engine efficiency improvement from 2017 to 2027 (a period marked by no planned changes in NOx or particulate matter (PM) emissions) is between 3.2 percent and 3.7 percent, resulting in an annualized reduction rate of only 0.35 percent per year. According to industry sources<sup>2</sup> in the period between 1980 and 1999 (a period with relatively few new NOx and PM rules), heavy duty engine OEMs were reducing fuel consumption at an annualized rate of 0.8 percent. This rate of development was not driven by regulatory pressures, but rather was motivated by the desire of engine OEMs to offer reduced operating costs to their customers in a highly competitive truck sales environment. Based on this precedent, and discussions with our OEM customers, HTS believes that in a stable NOx and PM regulatory environment, competitive pressure will drive engine OEMs to reduce fuel consumption at a rate that is higher than is reflected in the current engine-level proposal and more in line with historical performance. We therefore believe that a more stringent regulation could be met without being overly burdensome on engine manufacturers, the trucking industry and consumers. [EPA-HQ-OAR-2014-0827-1230-A1 p.2-3]

Therefore, HTS recommends that the engine-level standard be moved to Alternative 4, with a 4.2 percent improvement over the 2017 baseline effective in 2024, and a 7 to 10 percent improvement over the 2017 baseline by 2027. [EPA-HQ-OAR-2014-0827-1230-A1 p.3]

[The following comments were submitted as testimony at the Long Beach, California public hearing August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp 2547-258.]

We appreciate that revised weighting factors for the SET cycle CO<sub>2</sub> emissions for the heavy-duty tractor engine standards have been included in the proposal. These revised weighting factors better represent real-world operating conditions of long-haul trucks with minimal additional complexity. However, the new weighting factors effectively represent a regulatory downspeeding of engines, and we estimate this will result in a cycle-weighted fuel consumption improvement of approximately 1 percent, with no changes made to the actual engine. This essentially means that 2021 model year engines only need to be .5 percent more efficient than the 2017 baseline, a .12 percent per year improvement over a 4-year time period. This is well below the industry's historical continuous improvement rate of change in efficiency. The new weighting factors have a similar impact on subsequent emissions reduction levels.

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For this reason, we believe there is room to make the engine-level CO<sub>2</sub> reduction larger than is reflected in the current proposal, without the need for widespread adoption of advanced technologies like Rankine Cycle waste heat recovery. Honeywell can help provide data and work with the EPA to refine the inputs to models to better reflect the improvements that air systems technology can provide in order to enable this.

2 Greszler, Anthony. Heavy Duty Diesel Engine and Powertrains for 2010 and Beyond. Presentation to SAE <http://www.sae.org/events/gim/presentations/2009/anthonygreszler.pdf>

**Response:**

The agencies have corrected the tractor engine baseline for the final rule to reflect the reweighting of the 13 modes of the SET. The agencies have also increased the stringency of the engine standard over that proposed. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. The agencies have calculated stringency from revised baselines which (particularly for the FTP baseline) reflect historic improvements in engine performance consistent with the commenter's suggestion.

**Organization:** National Association of Clean Air Agencies (NACAA)

Toward this end, we believe the proposed engine standards must be strengthened. Others –including the California Air Resources Board (CARB),<sup>3</sup> engine makers<sup>4</sup> and independent non-governmental organizations<sup>5</sup> – have suggested engine efficiency can be improved significantly more than the modest 4.2 percent proposed by EPA. Recent work by the Southwest Research Institute, West Virginia University, the U.S. Department of Energy's SuperTruck teams and Cummins, the largest manufacturer of heavy-duty truck engines, all indicates the feasibility of engine GHG reductions in the Phase 2 timeframe at levels more than twice that included in the proposal. Further, these analyses, as well as those of EPA, indicate that technologies to achieve this degree of improvement are currently available and highly cost effective. In conjunction with increasing engine standards, we also recommend that EPA increase the corresponding whole-vehicle standards to capitalize on the full emission reduction potential of efficiency-improving technologies. We believe it is imperative that EPA strengthen the engine and vehicle standards in the final rule to reflect this. [EPA-HQ-OAR-2014-0827-1157-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.53.]

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3 California Air Resources Board, Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency (June 2015), [http://www.arb.ca.gov/msprog/tech/techreport/epdo\\_ve\\_tech\\_report.pdf](http://www.arb.ca.gov/msprog/tech/techreport/epdo_ve_tech_report.pdf).

4 Cummins, Engine Technologies for GHG and Low NOx (April 2015), [http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2\\_7\\_wayne\\_e\\_cummins.pdf](http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2_7_wayne_e_cummins.pdf).

5 International Council on Clean Transportation, Advanced Tractor-Trailer Efficiency Technology Potential in the 2020-2030 Timeframe (April 2015), [http://www.theicct.org/sites/default/files/publications/ICCT\\_ATTEST\\_20150420.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_ATTEST_20150420.pdf).

**Response:**

We have made the standards more stringent from those proposed. See earlier comment responses and Chapters 2.3 and 2.7 of the RIA, which detail the justification for this increase.

**Organization:** Natural Resources Defense Council (NRDC)

Setting strong, long-term national limits on motor vehicle global warming pollution and fuel efficiency standards is a necessary and important action for the U.S. to meet nation targets for reducing greenhouse gas (GHG) emissions.<sup>1</sup> It is appropriate and necessary that President Obama has made medium- and heavy-duty vehicle GHG and fuel consumption standards an integral part of his Climate Action Plan.<sup>2</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.3]

Medium- and heavy-duty vehicle performance standards are an essential component of a comprehensive strategy to cut U.S. global warming pollution and oil consumption. The transportation sector is responsible for approximately a third of the nation's greenhouse gas emissions and 70 percent of total oil demand. Highway medium- and heavy-duty vehicles are second only to light-duty vehicles in total fuel consumption and global warming pollution within the transportation sector. According to the agencies, medium and heavy trucks consume 20 percent of the oil used in the transportation sector and emit about 20 percent of transportation sector global warming pollution.<sup>3</sup> Yet these trucks represent only about 5 percent of the vehicles on the roads.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.3]

The process of setting the Phase 2 medium- and heavy-duty vehicle standards extends a record of success that started with the model year 2012-2016 light-duty vehicle GHG and fuel economy standards. The Phase 2 truck standards address both the need for the National Highway Traffic Safety Administration to set fuel efficiency standards under the Energy Independence and Security Act of 2007 and the requirement for U.S. Environmental Protection Agency to regulate emissions of greenhouse gases under the Clean Air Act. [EPA-HQ-OAR-2014-0827-1220-A1 p.3]

The Phase 2 proposed rule is a very important step forward but it should be strengthened to maximize the environmental, security and economic benefits. Below, we recommend actions the agencies should take to improve the proposal to better meet the Administration's overall energy and climate security goals and address the imperative that we dramatically reduce carbon pollution. [EPA-HQ-OAR-2014-0827-1220-A1 p.3]

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1 On March 31, 2015, the U.S. submitted its target to the United Nations Framework Convention on Climate Change to reduce GHG emissions by 26-28% below 2005 levels by 2025.

<sup>2</sup> Climate Action Plan available at <https://www.whitehouse.gov/sites/default/files/image/president27climateactionplan.pdf>.

<sup>3</sup> EPA and NHTSA, “EPA and NHTSA Greenhouse Gas Emissions and Fuel Efficiency Standards for of Medium- and Heavy-Duty Vehicles: By the Numbers,” EPA-420-F-15-903, June 2015. Available at <http://www.epa.gov/otaq/climate/regs-heavy-duty.htm>.

<sup>4</sup> Ibid.

**Response:**

We appreciate your comments, and we believe that our final rule will indeed meet the Administration’s overall energy and climate security goals and address the imperative that we dramatically reduce carbon pollution.

**Organization:** Navistar, Inc.

We believe the inclusion of CO2 emissions from IRAF’s as part of the existing certification test procedure would be both non representative of the in-service activity and increase the aggregate certification burden. In addition the inclusion of CO2 IRAFs may actually increase CO2 emissions in service as manufacturers balance the certification penalties against reduced DPF backpressure between regenerations. [EPA-HQ-OAR-2014-0827-1199-A1 p.22]

The agencies’ acknowledged that “*manufacturers have already made great progress in reducing the impact of regeneration emissions since 2007.*” Since the onset of use of regenerative DPFs emission increases have been practically nil. Currently regeneration rates are driven more by timer based algorithms for soot removal and desulfurization rather than demand based DPF loading. Many in-service line haul fleets have reported intervals of thousands of miles between regenerations due in large part to passive regeneration. By including the fuel consumed during regeneration there will be a natural tendency for manufacturers to reduce the frequency and duration of regenerations to avoid the implications of regeneration fuel penalty. However this approach can have the unintended consequence of increasing DPF backpressure and pumping losses absent increased passive regeneration, which can have a direct and negative impact on fuel economy. [EPA-HQ-OAR-2014-0827-1199-A1 p.22]

As engine out NOx levels increase in order to improve base engine fuel economy there will be an associated increase in passive regeneration, which will only further reduce regeneration frequency. As aftertreatment systems improve with each generation, they become more operationally efficient. Manufacturers need the flexibility to size and operate their systems to maximize the aggregate fuel economy without increasing the regulatory burden, not to mention the risks to component durability or to customer fuel economy. We would therefore recommend that Phase 1 requirements be extended to Phase 2. [EPA-HQ-OAR-2014-0827-1199-A1 p.22-23]

**VI. Response to Comments on Engine Standards**

In light of discussions with EPA for a realistic rule, Navistar feels that it must comment additionally on comments by other commenters as well as other documents recently placed in the docket, specifically a document by a Mr. Walsh and Mr. Charlton.<sup>11</sup> While EPA chose not to seek further comment as part of the NODA, Navistar feels that the issues raised in those materials are important enough to highlight in these additional comments. Primarily, we feel it is important to respond to comments that we find are technically inaccurate and misleading. Walsh and Charlton based their recommendations of increased

engine stringency on the achievements of participants of the Department of Energy (“DOE”) - funded SuperTruck program, of which Navistar is an awardee. [EPA-HQ-OAR-2014-0827-1919-A2 p.8-9]

The basic premise of the SuperTruck initiative was to demonstrate 50% freight efficiency improvement at 65 mph and to demonstrate 50% engine BTE at the vehicle’s cruise point. The participants demonstrated a wide range of technologies in order to achieve these objectives. However, it is a technology development program and by definition limited to a specific operating condition or cycle. Furthermore, the technologies are highly experimental, have not been vetted for commercialization, and thus, are not all likely to be ready for production in the foreseeable future. Therefore, we want to give the EPA as much information as possible to develop a realistic and successful implementation of the Phase 2 regulations. [EPA-HQ-OAR-2014-0827-1919-A2 p.9]

Walsh and Charlton’s claims and recommendations were summarized as 11 major findings and are focused on tractor engines. In the proposed Phase 2 regulations, these engines are certified in the ramp modal cycle (RMC) for CO<sub>2</sub> and the FTP for the other GHG constituents. The NPRM also proposed a reweighing of the modes in this cycle that departs from that used for criteria pollutants, but that aim to align the engine standard to the real world or in-vehicle usage of these engines. In the following, Navistar highlights the major concerns with the authors’ findings. [EPA-HQ-OAR-2014-0827-1919-A2 p.9]

Finding 1 & 2 & 7: The authors erroneously attempt to use the achievement of SuperTruck as evidence for further stringency on the engine standard. SuperTruck achievement of 50% or greater BTE for the engine is a single point demonstration, as opposed to the cycle demonstration (RMC) required for GHG certification of an engine. This is very clearly shown in Figure 5 of their paper, where the authors highlight the region that is used in the SuperTruck demonstration overlaid with the RMC modes: this is a very small subset of the test cycles used in the regulatory framework. Furthermore, systems on the demonstrator engines are not all production feasible. These SuperTruck programs are unconstrained to the limitations of production feasible solutions. SuperTruck programs are not required to deliver production requirements of full tailpipe compliance (deterioration factors, NTE), On-Board Diagnostics as well as all other regulatory requirements of other constituents (NO<sub>x</sub>, N<sub>2</sub>O, and CH<sub>4</sub>) or with the level of robustness necessary for production feasible systems. [EPA-HQ-OAR-2014-0827-1919-A2 p.9]

Figure 1 shows a typical tractor engine map. This is the 2018MY representative tractor map available in the EPA Phase II GEM model that is used to set the baseline for the GHG Phase 2 regulations. The modes for the RMC are overlaid and show the weighting (by size) as proposed in the NPRM. From this figure it is clear that the authors have extrapolated the achievements of SuperTruck in their recommendation of 50% BTE in the RMC cycle. At the A-speed, which is the highest weighted speed, the BTE of a typical engine that meets 2017MY GHG will range from 39% at the lower torque to a maximum of 46% at the 75% load point. In order for such an engine to meet a composite number of 50% with the assumption of a flat map, the part load points would need to improve over 11% efficiency points and this is without the appropriate engineering margins. Furthermore, the assumption of a flat map is counter to the physics and the optimization of the systems that support the function of the engine as is demonstrated by what EPA considers state-of-the-art today. Within the space of the RMC cycle, excluding the idle point, BTE ranges from 34% to the maximum already stated of 46%. Hence, in the event that a manufacturer had to design for the 50% BTE, the engine would have to significantly exceed the achievements of the SuperTruck program by having the cruise point be well above 50% BTE and even exceeding the secondary objective of a pathway to 55% BTE as shown in Figure 2. Figure 2 is a hypothetical map using the realistic shape of the engine map that mathematically results in 50.5% BTE for the RMC with GHG Phase 2 weighting. Production margins, hence, would dictate a peak efficiency of 60% to achieve Charlton and Walsh proposed stringency. In Navistar’s opinion, the recommendation by Charlton and Walsh is based on misleading premises and not physically possible.<sup>12</sup> [EPA-HQ-OAR-2014-0827-1919-A2 p.9-10]

[Figure 1 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1919-A2]

[Figure 2 can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1919-A2]

Finding 3: Unlike the claim by Charlton and Walsh, significant improvements in both engine and aftertreatment technologies will have to be implemented in order to achieve the currently proposed engine targets included in the GHG Phase 2 NPRM. The authors only focus on the stringency of CO<sub>2</sub> in this claim, and throughout the paper, and treat the engine standard as a standalone requirement in the rule. They fail to account for the implications of the rule as a whole: consideration of the implication of the other regulated GHG constituents, known future pressures to reduce NO<sub>x</sub> for which the NPRM protects (inclusion of IRAF, etc) and the engine in the context of the vehicle regulation. Per our comments submitted to the NPRM docket, the rule in its full context represents 10% efficiency improvement over the MY2017 engines, which have yet to make it to the marketplace and themselves represent over 3% improvement over the MY2014 engines. [EPA-HQ-OAR-2014-0827-1919-A2 p.11]

The addition of the manufacturer specified fuel maps to the vehicle standards in Phase 2 and expanded selective enforcement audit (SEA) programs will drive additional stringency on the engine to account for compliance and production margin (shown in Figure 3 as a dotted green line). The reweighting of the RMC cycle is critical and without it the engine, as a standalone component, and its technologies would not align with the vehicle standard (or GEM). Again, as shown in the author's Figure 5, the reweighting is closer to real world operation (NESCAUM cycle) and will drive technologies that will have significant impact on the real world CO<sub>2</sub> as opposed to just meeting a generic standard on a dynamometer. [EPA-HQ-OAR-2014-0827-1919-A2 p.11]

The combined Phase 1 and Phase 2 rules in essence result in over 10% improvement in engine efficiency in the span of 13 years. However, when other components of the GHG Phase 2 regulation are taken into account, the full impact of this rule is about 17% improvement in that span even with the reweighting of the RMC. [EPA-HQ-OAR-2014-0827-1919-A2 p.12]

Slide 16 from the authors' presentation to the EPA represents their perception of a typical engine development program. We believe it is flawed. The first issue is that it fails to acknowledge the gap between engine and vehicle model years. An engine is not a standalone component and needs to be finalized well in advance of a vehicle program to ensure that it meets the requirements for the vehicle, such as GHG, and further to ensure that all of the many interactions between the vehicle components and the engine are appropriately designed and validated. The second issue is that they assume a 3-year development program. Modern engines have requirements beyond the basic dyno certification cycles-- FTP and RMC. As of 2013, all heavy duty engines are required to also meet OBD requirements. In essence this requires the base engine and aftertreatment design and calibration to be finalized before starting the work and preparation for certification. A heavy-duty tractor engine with significant redesign needs a longer development cycle. [EPA-HQ-OAR-2014-0827-1919-A2 p.12]

Finding 10: Charlton and Walsh argue against the reweighting of the RMC because it breaks the linkage with criteria pollutant cycles. They contradict themselves with such an argument. The intent of the rule is to address climate change and they recommend increased stringency without the reweighting of the RMC cycle to achieve this change. However, numerous studies and databases exist that document the usage of engines in the tractor applications in the line-haul sector, and these were the basis of the reweight. Though heavy-duty vehicles only represent 4% of the vehicles on the road, they consume about 18% of the fuel in the US and the line-haul sector represents over 60% of that. Therefore, in order to enact the necessary climate change the improvements need to be realized in real-world representative cycles. [EPA-HQ-OAR-2014-0827-1919-A2 p.14]

The authors site the unintended consequences to criteria pollutants as a counter argument, not acknowledging that current regulations already tightly control the engines emission of criteria pollutants. Beyond the dynamometer cycle demonstration, there are Not-To-Exceed requirements. The NTE requirement, added in 2007, regulates the pollutant output of an engine at a maximum of, for example, 1.5 times the standard for 2010, for a wide range of ambient conditions and altitude. There are also the On-Board Diagnostic (OBD) requirements introduced for all HD diesel engine in 2013. This requires that the engine's control systems detect malfunctioning components of the emission control systems (EGR valves, injectors, etc.) throughout the useful life for the engine. In addition, the CO2 regulatory impact for the Phase 2 regulation is only captured from the Vehicle standards which operate closer to real world with the GEM cycles. [EPA-HQ-OAR-2014-0827-1919-A2 p.14]

In conclusion, Navistar supports the implementation of a realistic, impactful and commercially feasible rule. The Proposed Rule is of such complexity, and carries such widespread ramifications for the industry that commenting on the inaccuracies represented in the paper by Charlton and Walsh is critical. They fail to acknowledge and explain that the achievements of the SuperTruck program are limited to a very small subset of an engine map and are not representative of the certification RMC cycle. The stringency that they recommend is not physically possible and requires engine peak efficiencies > 58% BTE, something that was not demonstrated in the SuperTruck program or in the pathways. Downsampling is correctly accounted for in the vehicle portion of the standard as it requires the full powertrain definition in order to achieve the gains. WHR systems are in the infancy of development with no commercially feasible implementation at the current time and has dis-synergy with the rule itself. The agencies have adequately account for its penetration in the lifetime of this rule. [EPA-HQ-OAR-2014-0827-1919-A2 p.15]

To create the hypothetical engine that forms the baseline for the vocational engine in GEM, the agencies constructed a hypothetical engine map. This was not derived from an actual in-use engine. Our current analysis of this hypothetical map shows a shift in the baseline from actual, real-world engines. That is, the theoretical starting point, the MY17 standards, has changed. The baseline engine maps within GEM for the vocational vehicle are not aligned with current 2017MY compliant engines and hence, set up an unrealistic baseline for the vocational vehicle standard. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

Navistar took one of its MY2017 CO2 compliant engine families and created an engine map for use in the Phase 2 version of GEM. Comparing the tested engine map to the 2018MY baseline maps the tested engines showed differences ranging between 1 to 5% in the cruise part of the map and around 10% in the "acceleration" part of the map for the 345hp engine map to 10% to 15% differences for the 350hp engine map. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

The problematic areas of the hypothetical vocation baseline engine include the following: [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

- The EPA 345 hp HD generic engine map has an uncharacteristic shape where the minimum BSFC points is at 9% of maximum power. Other hypothetical engines show 80% of maximum power. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]
- The 270 hp MD hypothetical engine is flawed as well. Comparison with actual compliant MY2017 engines show that the hypothetical engines were 10% higher in fuel consumption than the real-world engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

Ultimately, this discrepancy must be corrected. Navistar will separately provide proprietary information to EPA showing this concern in greater detail. All manufacturers should begin from the same starting line, the actual MY2017 emission performance of the engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

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11 EPA-HQ-OAR-2014-0827-1237. EPA also placed a powerpoint presentation delivered to EPA by the same authors in the docket.

<sup>12</sup> Participants at the Transportation Combustion Engine Efficiency Colloquium found that, **with money as no object**, 60% BTE is the maximum efficiency possible for current engine configurations. See K. Edwards, et al., *Defining Engine Efficiency Limits*, presentation at 17th DEER Conference 3-6 October 2011. Available at [http://energy.gov/sites/prod/files/2014/03/f8/deer11\\_edwards.pdf](http://energy.gov/sites/prod/files/2014/03/f8/deer11_edwards.pdf)

**Response:**

We do not believe inclusion of CO<sub>2</sub> into IRAF will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the impact of regeneration emissions since 2007. Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting compliance strategies that could reverse this trend. See Response 3.3.4.

We appreciate Navistar's comments on a document by Mr. Walsh and Mr. Charlton. We largely agree with these arguments. Specifically, we agree that the peak thermal efficiency deduced by the Walsh/Charlton reports would not be realistic. We agree that use of the SuperTruck program data can be misleading because data sources are limited to a very small subset of the engine map and are not representative of the certification RMC cycle. The technology path for downspeeding proposed by the Walsh/Charlton report is not practical, because while the peak torque of the engine moves down to an engine speed of around 800 rpm, the required high boost pressure cannot be maintained due to the engine's low speed. We agree that there may be a trade-off between some of the technologies used for NOx reduction and those used for fuel economy improvements (although we do not believe the NOx control and fuel consumption improvements are mutually exclusive (see, e.g. RTC Section 15.8.1)).

All the agencies' baseline engines are developed based on real life in-use engines. In the final rule, we have combined a 345hp engine with a 350hp engine as one engine, which will be applied to both tractor and vocational vehicles. In combining these two engines the minimum brake specific fuel consumption point is now in line with the other baseline engines and is located at approximately 70% of peak engine power. We also made changes to the 270hp baseline engine fuel map. However, it should be pointed out that the engine for the baseline 270hp rating engine was 7 liter based, and is much smaller than the Navistar 9 liter engine. As a result, the engine sweet spot and the rated speed are also appreciably different. On the other hand, the 350hp engine used by the agencies is 11 liter based, and is bigger than Navistar's N10 engine. Depending on the vehicle configurations, such as transmission, and axle ratio, the engine operating points in terms of engine speed and load can be so different between two different engines, resulting in different values of CO<sub>2</sub> g/hp-hr. Although we did not provide the baseline values, we made the best efforts to supply those vocational vehicle baseline values in the later power user release version provided for comment.

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

The engine standard should be stronger.

The proposal would reduce fuel consumption from engines by 4.2 percent, which is far short of what is achievable over the coming decade. We note that at least one engine manufacturer has indicated potential engine efficiency improvements of 15 percent or more even with advanced NOx controls. Moreover,

EPA's estimates for both the effectiveness and likely market penetration of engine efficiency technology improvements are far too conservative, according to analyses performed by CARB<sup>3</sup> and ICCT.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1221-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.138.]]

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3 California Air Resources Board, Engine/Powerplant and Drivetrain Optimization: Vehicle/Trailer Efficiency Technology Assessment, presented at the Air Resources Board Symposium on California's Development of its Phase 2 Greenhouse Gas Emission Standards for On-Road Heavy-Duty Vehicles (April 22, 2015). Available at: [http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2\\_1\\_alex\\_s\\_arb.pdf](http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2_1_alex_s_arb.pdf).

4 International Council on Clean Transportation, United States Efficiency and Greenhouse Gas Emission Regulations for Model Year 2018-2027 Heavy-Duty Vehicles, Engines, and Trailers (July 2015). Available at: [http://www.theicct.org/sites/default/files/publications/ICCT-update\\_US-HDV-Ph2-NPRM\\_jun2015\\_v2.pdf](http://www.theicct.org/sites/default/files/publications/ICCT-update_US-HDV-Ph2-NPRM_jun2015_v2.pdf).

**Response:**

See response to EDF above noting both the increased stringency in the final engine standards from those proposed, and explanation of why more stringent standards are either not feasible or unreasonable.

**Organization:** Shahed, SM

The proposed Phase 2 standards only require a 4% reduction in fuel consumption and CO<sub>2</sub> emissions of engines, compared to Phase 1, through 2027, a requirement that may well be met with already demonstrated technology. If the standard is set too low, it presents a risk that the agencies' goal of spurring development and deployment of advanced technology may not be met, and it may render the separate engine requirement largely meaningless. [NHTSA-2014-0132-0033-A1 p.2]

The EPA has a long and successful history of setting technology forcing standards. I respectfully suggest the Phase 2 engine standard can require a larger reduction in fuel consumption to become at least "technology encouraging" if not "technology forcing." Enough promising technologies and time exist to provide compliance at a cost increase that meets the payback scenarios outlined in the proposed standard. Based on my experience and judgment, I support anywhere between 10% and 15% fuel consumption reduction for Phase 2 heavy engine standards, depending on how ambitious the regulators want to be. [NHTSA-2014-0132-0033-A1 p.2]

**Response:**

We made a few key changes on engine standards. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the projected market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase.

It should be pointed out that while the literature, specifically from the DOE SuperTruck program, demonstrates more reduction on the engine side, the technology demonstrations only focus on a single

operating point. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point.

**Organization:** Sierra Club

### **Strengthen the engine standard**

The engine standards finalized in this rule will influence the engine technologies adopted over the next 15 years. Unfortunately, the proposed standards only require roughly a 4 percent improvement in engine efficiency, far short of what can be achieved. Organizations such as the American Council for an Energy-Efficient Economy have noted that a 10 percent increase in engine efficiency is possible over the timeframe of the rule. We urge you to strengthen the engine standard to ensure continued gains in engine efficiency in the years to come. [EPA-HQ-OAR-2014-0827-1277-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.189]]

### **Response:**

As detailed in the RIA, we believe the 10% increase in 2027 is beyond what is feasible in this time frame industry-wide. Data cited by the commenter mainly relies on the literature, including DOE SuperTruck programs, which are not directly applicable. The values from the literature are single optimal operating points and not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we must consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point. Technology effectiveness is also not additive. Chapter 2.7.5 of the RIA details justifications of dis-synergy used in the rule. These justifications were also supported by many industry comments, such as the reports made by four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar). The technology effectiveness of WHR in Rankine cycle used by the agencies, which we project to be less effective than what commenters recommended, were directly obtained from credible, but CBI information, based on the recommendation from a leading engine manufacturer. It is critical to derive the standards based on the agencies' weighting factors over 13 modes, vehicle weight, and three vehicle certification cycles. Thus, the adjusted values for stringency are typically much smaller than the values seen in the literature. Having said that, we have made changes to strengthen the standards from those proposed. In the final rule, we did readjust the baseline of the tractor engine standards to reflect the SET reweighting impact. Chapter 2.7.4 of the RIA and Response 3.3.3 discuss the change in the baseline. We made a few other key changes to engine standard analysis. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the 2027 tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. We also strengthened the vocational engine standards after readjustment of the baseline values of the engines.

**Organization:** Truck & Engine Manufacturers Association (EMA)

### Accounting for IRAFs

The Agencies are proposing to require the inclusion of the emissions from any infrequent regeneration events into the various Phase 2 test cycles. (See Proposed sections 1065.680, 1036.501(d) and 1036.530(a)). There is no basis for this change from Phase 1. The rates of infrequent regenerations have



been going down since the adoption of the Phase 1 standards, not up. Thus, there is no factual predicate for the proposed change from the Phase 1 program. [EPA-HQ-OAR-2014-0827-1269-A1 p.39]

In Phase 1, the Agencies excluded IRAF contributions based on their correct understanding that such contributions are minor, and that competitive pressures drive manufacturers to continue to seek ways to minimize the frequency of regeneration and its associated fuel efficiency penalty. The rationale for excluding IRAF in Phase 1 is equally valid for Phase 2. There are no reasonably anticipated circumstances under which manufacturers would seek to increase IRAF-associated fuel consumption penalties. In fact, the proposed fuel efficiency improvements are more than likely to pressure manufacturers towards developing engines at higher in-cylinder NO<sub>x</sub> levels, which are beneficial to passive regeneration of diesel particulate filters, and lower particulate emissions levels due to the natural tradeoff between NO<sub>x</sub> and particulates. Consequently, the need for active regenerations and the associated IRAF impact on fuel consumption can be expected to decrease. For these reasons, and in recognition of the vastly increased burden of the Phase 2 regulations, EPA should maintain the Phase 1 approach of excluding IRAF effects in the testing and data processing for Phase 2. [EPA-HQ-OAR-2014-0827-1269-A1 p.39]

**Response:**

We do not believe that the inclusion of CO<sub>2</sub> into IRAF will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the impact of regeneration emissions since 2007. Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting compliance strategies that could reverse this trend. See Response 3.3.4.

**Organization:** Union of Concerned Scientists (UCS)

**TRACTOR ENGINE STANDARDS**

The largest single area of verifiable fuel consumption reduction over the lifetime of the vehicle comes from improvements to the engine. Therefore, it is critical that the regulations measure these improvements and push manufacturers to invest in technologies that will reduce fuel consumption from the engine without compromising further reductions in criteria pollution. [EPA-HQ-OAR-2014-0827-1329-A2 p.5]

**Adjustment to the engine test cycle.** Based on data from manufacturers, the agencies revised the SET engine test cycle. This revision for greenhouse gas emissions shifts much of the weighting of the highest test speed (C) to the lowest speed (A), reflecting the industry move towards downspeeding. We support the agencies' revision and believe that this helps ensure that the standards reflect on-road behavior as much as possible and encourage investment in technologies that will provide real world benefits. [EPA-HQ-OAR-2014-0827-1329-A2 p.8]

Future regulation of criteria pollutants should correct the disparity the Phase 2 regulation has created between the SET test weightings for fuel consumption regulations and those for criteria pollutants. This correction is necessary both to better assess the real world pollution from these engines and to ensure that manufacturers cannot try to game the system by reducing NO<sub>x</sub> emissions more in the zone more heavily weighted in the criteria test while increasing NO<sub>x</sub> and reducing fuel consumption at the lower speeds where the vehicle is more likely to run. [EPA-HQ-OAR-2014-0827-1329-A2 p.8]

In assessing the impact of this procedural adjustment, however, the agencies did not seem to appropriately consider how this revision would affect the baseline for improvement. The agencies have presented two

engine maps that are compliant with 2017 model year standards: the 2017 map from Phase 1 and the 2018 baseline map for Phase 2. In the Draft RIA (p. 2-82), the agencies note that the 2018 baseline reflects two changes: 1) the “sweet spot” has been broadened, and 2) the engine is designed to be increasingly downsized. However, the resultant 2018 map shows an increase in fuel consumption at lower engine speeds, which is the exact opposite of what one would expect (Table 1). In fact, while the two engines would have similar scores under the Phase 1 SET weightings, our analysis shows that the agency’s revised engine results in a 0.6-percent increase in emissions from the 2018 engine on the Phase 2 weighting compared to the 2017 engine. This change effectively lowers the bar for manufacturers for Phase 2 without making any changes to their 2018 engines. [EPA-HQ-OAR-2014-0827-1329-A2 p.8]

[Table 1, 'Comparison of Calculated Engine Performance and Regulatory Values', can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

The fact that both engines showed a reduction in fuel usage on the SET(2) weighting compared to SET(1) the same value as the 2017 HHD tractor engine standard, which is based the SET(1). We thus further calculated the SET(1) and SET(2) results of all the engine maps that the agencies have used to set the stringency of the heavy duty engine regulations. Our analysis indicates that while the calculated values well-replicate the SET(1) values, the stringency in Phase 2 set according to the SET(2) weighting does not accurately reflect the engine maps provided. In fact, according to our analysis, the agencies’ engine maps significantly outperform the Phase 2 engine standard, by as much as 1.6 percent in 2027. It is difficult to assess the reason for this disparity—one possibility is that the agencies did not adjust the engine standard to reflect the new SET(2) weighting, since our calculated values for each engine’s performance on the SET(1) more closely mirror the standard. What is clear, however, is that the agency’s own engine maps achieve a 434 g CO<sub>2</sub>/bhp-hr level on the reweighted test cycle is an improvement of 5.7 percent over the agencies’ baseline value of 460 g CO<sub>2</sub>/bhp -hr, not 4.2 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.8-9]

The agencies' proposal must be 'technology-forcing' and achieve the 'maximum feasible' reductions in the timeframe of the rule. To do this, the agencies must strengthen Alternative 4 by: [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

- Increasing the stringency of the engine standard in 2024 to at least 9 percent from the current baseline to ensure real-world reductions over the lifetime of the vehicles; [EPA-HQ-OAR-2014-0827-1329-A2 p.27][This comment can also be found in section 1.5 and 1.7 of this comment summary]

Diesel engines. While most of the technologies assessed by SwRI on the diesel engine were considered by the agencies in setting the vocational engine standard, SwRI noted much greater potential in friction reduction than the agencies, achieving 1.9-percent improvement at 65-mph and 6.2 percent on the transient cycle compared to the baseline engine. After factoring in the improvements already captured by the agencies in Phase 1 and 2, this led to additional improvements to diesel-powered vocational vehicles of between 1.7 and 2.9 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

#### **Response:**

We have made all necessary changes on the baseline tractor standards to reflect the new SET weighting factors. We also made a few key changes to the engine standards. See earlier responses and Chapters 2.3 and 2.7 of the RIA.

It should be pointed out that while the literature, specifically from the DOE SuperTurck program, demonstrates more reduction on the engine side, the technology demonstrations only focus on a single operating point. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point.

Using the same principle as in the SwRI final report together with the agencies' vehicle certification weights and certification cycle weighting factors over 55mph, 65mph, and ARB cycles; SwRI's findings largely support the agencies' final standards, including friction reduction.

**Organization:** Volvo Group

Fortunately, technologies aimed at reducing vehicle power demand, such as improving aerodynamics and reducing rolling resistance, result in less total work needed from the engine to complete the mission of moving cargo from point A to point B, and therefore proportionately less total NOx is emitted. This is not the case, however, when it comes to technologies focused on improving engine efficiency. Here, the NOx/efficiency trade-off typically results in precisely the opposite effect. The most logical thing EPA and NHTSA could do to avoid forcing this trade-off is to eliminate the separate engine standards in the proposal. At minimum, they should maintain the proposed engine stringency levels to mitigate undue risk of unintended consequences. This would permit manufacturers to focus their development efforts on efficiency technologies that capitalize on synergistic GHG-NOx reduction opportunities, rather than those engine technologies that complicate and frustrate future NOx reductions. [EPA-HQ-OAR-2014-0827-1290-A1 p.60]

While not referenced in the NODA, a paper had been submitted to the docket (EPA-HQ-OAR-2014-0827-1237) which presented arguments encouraging the Agencies to increase the stringency of the engine standards proposed in the NPRM. The Volvo Group joined with Daimler Trucks North America, Navistar, Inc., and PACCAR Inc. to prepare comments refuting many of the arguments posed in the paper. These joint comments, which stress the importance that the Agencies avoid unintended consequences by maintaining the standards as proposed, were submitted to the docket. [EPA-HQ-OAR-2014-0827-1928-A1 p.3]

**Response:**

We understand Volvo's concerns on engine NOx trade-off with CO<sub>2</sub>. We will work with Volvo closely on this matter of and when the time comes. We also appreciate Volvo's comments submitted to the docket (EPA-HQ-OAR-2014-0827-1237).

**Organization:** Walsh, Michael and Charlton, Stephen

The literature related to control of GHGs from medium- and heavy-duty commercial vehicles is extensive. Every attempt has been made to include the most relevant, high quality and influential reports, presentations and reviews on the subject. [NHTSA-2014-0132-0102-A1 p.16]

### *5.1 NAS GHG Phase 1, Final Report [37]*

Section 108 of EISA required that NHTSA contract with NAS to undertake a study and develop a report that evaluated medium- and heavy-duty truck fuel economy. This study was carried out between 2008 and 2010 and resulted in the publication of a 250 page report outlining possible regulatory structures, metrics, certification methods and available vehicle and engine technologies that could be applied to reduce GHG emissions and improve fuel efficiency. [NHTSA-2014-0132-0102-A1 p.16]

In addition to seeking input from a broad range of stakeholders, NAS contracted with TIAX [36] to carry out an in-depth analysis of available technologies and the related unit and capital costs. The TIAX study informed NAS significantly on the state of existing and emerging technologies across all vehicle classes from Class 2b through Class 8. [NHTSA-2014-0132-0102-A1 p.16]

Key findings included:

- The major enabling technologies necessary to achieve significant reductions in fuel consumption are hybridization, advanced diesel engines, and aerodynamics.
- Diesel engine advancements are helpful in all applications and will include continuing improvements to fuel injection systems, emissions control, and air handling systems, in addition to commercialization of waste heat recovery systems.
- Diesel engines have the potential for 15-21% reduction of fuel consumption in the 2015-2020 time frame, relative to a 2008 baseline. This was by far the most significant area of improvement for Class 8 tractor-trailers identified in the study. [NHTSA-2014-0132-0102-A1 p.16]

By this estimate, the NAS committee indicated a potential for diesel engine BTE to reach somewhere between 47.2% and 50.8%, (416 – 387 gCO<sub>2</sub>/HP-hr) given a 2008 baseline of 40.1%, which became the baseline for the Phase 1 regulation. [NHTSA-2014-0132-0102-A1 p.16]

A summary of the results from this study are included in Appendix D [see p.39] for reference. [NHTSA-2014-0132-0102-A1 p.16]

## 5.2 NAS GHG Phase 2, First Report, 2014 [38]

NAS published a further report to inform EPA and NHTSA as they prepared the proposed Phase 2 GHG rule [38]. This report is in effect an interim report, to be followed by a final report expected in 2016. The EISA anticipates that the NAS will update its report at 5-year intervals through 2025. The committee was formed in January 2013 and published their interim report in early 2014 by agreement with NHTSA. At the time of publishing the interim report the committee was unable to complete their assessment of available technologies to support the Phase 2 rule: [NHTSA-2014-0132-0102-A1 p.16]

*“Owing to time constraints for preparation of this report, the committee has not been able to conduct a comprehensive analysis of new technologies that would supplement those identified in the National Research Council (NRC) Phase One Report.” [NHTSA-2014-0132-0102-A1 p.16]*

The committee observed that the Phase I Rule was informed by off-the-shelf technologies included in the NAS Phase One Report, and that the Phase 2 regulations would be informed by the NAS Phase Two Report on future and advanced technologies. To this end, NHTSA contracted with the Southwest Research Institute (SwRI) to conduct a multiyear study of fuel-efficiency technologies for medium- and heavy-duty vehicles (Classes 2b-8) in the years before and during the Phase 2 regulations’ time frame. The SWRI reports are reviewed in this study [42, 43]. [NHTSA-2014-0132-0102-A1 p.16]

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36 “Assessment of Fuel Economy Technologies for Medium- and HeavyDuty Vehicles - Final Report,” TIAX Case D0506, November 19, 2009.

37 “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles – Phase 1,” Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles; National Research Council; Transportation Research Board, March 31, 2010

38 “Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two: First Report,” Committee on Assessment of Technologies and Approaches for Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, Phase Two, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences, Transportation Research Board, National Research Council, 2014

42 Reinhart, T. E., “Commercial medium- and heavy-duty truck fuel efficiency technology study - Report #1. (Report No. DOT HS 812 146). Washington, DC: National Highway Traffic Safety Administration. June 2015.

43 Reinhart, T., “Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2.” (Report No. DOT HS xxx xxx). Washington, DC: National Highway Traffic Safety Administration, June 2015.

The focus here is on the stringency of GHG emission and fuel consumption standards for HD tractor engines used in line-haul and heavy-haul applications, since these trucks have the highest vehicle miles travelled, burn the most fuel and emit the most CO<sub>2</sub>. [NHTSA-2014-0132-0102-A1 p.5]

### **Finding 1**

The most recent NAS report published September 11, 2015 [41], which followed an in-depth study carried out over several months with multiple on-site visits, for the DOE SuperTruck program found that:

“The engine systems Goal 1 of a 50% BTE for an emissions compliant engine has been achieved. Two of the four SuperTruck teams have successfully demonstrated BTE greater than 50% in on-road tests using commercial, ultra-low-sulfur diesel fuel” NAS [41].

This significant milestone should be compared with the proposed limit standard for HD tractor engines contained in the NPRM of 441 gCO<sub>2</sub>/HP-hr, which is equivalent to a BTE of only 44.6%. [NHTSA-2014-0132-0102-A1 p.6]

### **Finding 2**

Having validated that the SuperTruck program had met Goal 1 (50% BTE in highway cruise operations) the NAS committee has shifted their focus to defining the pathways to a HD engine attaining 55% BTE. The NAS committee observed that all of the programs are pursuing improved friction and pumping, more effective air boosting systems, smaller auxiliary and accessory loads, and improvements in WHR, and that all teams are investigating advanced low-temperature combustion (LTC) approaches.

While industry has its sights set on delivering commercially viable HD tractor engines capable of 55% BTE, this should be compared with the proposed limit standard for HD tractor engines contained in the NPRM of 441 gCO<sub>2</sub>/HP-hr, which is equivalent to a BTE of only 44.6%. [NHTSA-2014-0132-0102-A1 p.6]

### **Finding 3**

The proposed rule contains very modest standards for HD tractor engines equivalent to a 2.1% to 3.1% reduction in GHG emissions and fuel consumption for 2027 and beyond. [NHTSA-2014-0132-0102-A1 p.6]

**2027 Standard 441 gCO<sub>2</sub>/HP-hr is a 4.13% reduction from the 2017 Phase 1 standard of 460 gCO<sub>2</sub>/HP-hr. Relaxation of 1-2% by re-weighting the SET test cycle.**

**Net reduction of CO<sub>2</sub> is only 2.13% to 3.13%.**

Given the 12 year lead time to 2027 and the weak engine standards contained in the NPRM; if this rule moves forward in its current form it will stall investment in the advanced engine technologies already demonstrated in the SuperTruck Program as providing a 15-20% reduction in GHG emissions and fuel consumption. R&D funds are a scarce resource that will be withdrawn or reallocated to other priorities. [NHTSA-2014-0132-0102-A1 p.6]

The agencies have recognized the emergence of downspeeding by their proposed changes to the SET engine test cycle, as discussed in section 3.2.1 of this paper. [NHTSA-2014-0132-0102-A1 p.7]

*“One of the key technology trends is to down speed, moving the predominant engine speed from the range of 1300-1400 rpm to the range of 1150-1200 rpm at vehicle speed of 65mph.” Draft RIA section 2.7.3 [15]*

*“It can be argued that, if the current SET weighting factors were retained in Phase 2, the test would even more poorly reflect real-world driving operations.” Draft RIA section 2.7.3 [15]. [NHTSA-2014-0132-0102-A1 p.7]*

While the agencies have acknowledged that engine downspeeding is a key technology trend and have modified the engine test cycle to reflect this trend, they have failed to include the CO<sub>2</sub> and fuel consumption savings in the stringency of the engine limit standards. In fact quite the opposite – by changing the test cycle the agencies have relaxed the stringency by 1-2% (section 3.2.1). By not including downspeeding in setting limit standards for engines, they have in effect further relaxed the standards – by as much as 2-4% per SWRI report #1 [42]. The combined relaxation is 3%-6%, which exceeds the overall reduction proposed in the NPRM [14]. Even by the agencies estimate of 1.8% reduction due to downspeeding, the combined relaxation is 2.8%-3.8%. [NHTSA-2014-0132-0102-A1 p.7-8]

The agencies having wrongly included downspeeding as a vehicle technology and allocated the CO<sub>2</sub> reduction to the vehicle via the GEM simulation. By so doing they have relaxed the stringency of the engine limit standards, which is a significant oversight by the agencies. This issue can be corrected by including downspeeding in the derivation of the proposed engine standards, Draft RIA section 2.7.4, Table 2-8 [15]. [NHTSA-2014-0132-0102-A1 p.8]

### **Finding 7**

Even with effective exclusion of WHR, advanced combustion and downspeeding, the agencies failed to set aggressive technology forcing standards for the technologies it did include in its preferred package: [NHTSA-2014-0132-0102-A1 p.8]

- Combustion / fuel injection optimization
- Exhaust aftertreatment (Lower DP)
- Engine friction and other parasitic losses
- Engine breathing system

- Turbocharging system
- Engine downsizing

For example, Volvo demonstrated 48% BTE without WHR [34] compared with the proposed standard for HD tractor engines of 44.6% BTE (441 g/CO<sub>2</sub>/HP-hr). Cummins demonstrated 48.3% BTE without WHR [30]. [NHTSA-2014-0132-0102-A1 p.8]

The standards proposed assume only very minor incremental improvements to current engine designs, and fall short of being technology-advancing. [NHTSA-2014-0132-0102-A1 p.8]

### **Finding 9**

It is evident that only scant attention was paid to the progress being made by the SuperTruck teams from Cummins / Peterbilt, Daimler, Navistar and Volvo to improve HD tractor engine GHG emissions and fuel consumption. There is little evidence in the published reports from SWRI and the agencies of seeking data from the SuperTruck program – beyond citing the annual merit reviews as references. SWRI chose instead to rely on a cycle simulation model based on a 2011 engine and an Excel spreadsheet model of WHR. [NHTSA-2014-0132-0102-A1 p.9]

SuperTruck achievements were largely dismissed by both SWRI and the agencies: [NHTSA-2014-0132-0102-A1 p.9]

*“All of these results shown in this paragraph are demonstrated through the DOE SuperTruck program at single operating point on the engine map, and therefore the overall expected reduction of these technologies is less than the single point result.” [14] NPRM page 186.[NHTSA-2014-0132-0102-A1 p.9]*

*“Note that the SuperTruck program engine goal focuses on achieving 50% brake thermal efficiency (BTE) at a single operating point, and that many of the technologies used in this program may not be commercially viable in the 2015 timeframe.” [43] SWRI Report #2, June 2015 [NHTSA-2014-0132-0102-A1 p.9]*

*“This package borders on that of a SuperTruck, and it provides benefits approaching what are being reported in the SuperTruck program. This package would demand a large increase in cost and complexity. Fuel savings benefits for this package range from 16% on the GARB urban cycle at 100% payload, to 35% at 65 MPH.” [42] SWRI Report #1, June 2015 [NHTSA-2014-0132-0102-A1 p.9]*

The SuperTruck program was specifically designed to integrate emerging advanced technologies into over-the-road line-haul trucks, in order to demonstrate significant reductions in GHG and fuel consumption in real-world freight operations [21,24,26]. The freight efficiency results obtained over mixed drive cycles are compelling: [NHTSA-2014-0132-0102-A1 p.10]

*“One truck has achieved a freight efficiency of over 175 ton-miles per gallon, compared to a 2009 model baseline efficiency of 99 ton-miles per gallon. In terms of fuel economy, the truck achieved 10.7 miles per gallon (mpg), compared to the baseline truck at 6.45 mpg” [41] NAS 21CTP Report #3, September 11, 2015. [NHTSA-2014-0132-0102-A1 p.10]*

*“A second truck has doubled fuel economy from a 2009 baseline of 6.1 mpg to 12.2 mpg over one long-haul route, with a 120 percent increase in freight efficiency in ton-miles per gallon from a 2009 baseline*

of 94 ton-miles per gallon to 206 ton-miles per gallon.” [41] NAS 21CTP Report #3, September 11, 2015. [NHTSA-2014-0132-0102-A1 p.10]

This performance was achieved through both vehicle power demand reductions and engine BTE improvements: [NHTSA-2014-0132-0102-A1 p.10]

“The SuperTruck projects incorporated a number of vehicle power demand technologies that accounted for about 56 to 74 percent of the total fuel consumption reductions, with 26 to 44 percent coming from engine efficiency improvements.” [41] NAS 21CTP Report #3, September 11, 2015. [NHTSA-2014-0132-0102-A1 p.10]

NAS [41] found that the engines developed for the SuperTruck program contributed significantly to the in-use real-world freight efficiency improvements demonstrated. These engines, which demonstrated 50% or greater BTE at a highway cruise condition, were operated over complete duty cycles in-vehicle, which included idle operation, and transient operations such as: acceleration, highway cruise and deceleration. [NHTSA-2014-0132-0102-A1 p.10]

No attempt is reported by SWRI or the agencies to seek data, present data, or evaluate in any other way, the true performance of a SuperTruck engine. This is a significant miss by the agencies. [NHTSA-2014-0132-0102-A1 p.10]

### **Finding 10**

By modifying the HD engine SET test cycle for GHG emissions and fuel consumption certification, the direct linkage between criteria pollutants and GHGs has been broken, since NOx and PM would continue to be measured on the current cycle. This loss of linkage between criteria pollutants and GHG emissions could lead to unintended consequences, for example with regard to in-use emissions. [NHTSA-2014-0132-0102-A1 p.10]

### **Recommendations**

Figure 2 shows both Phase 1 and proposed Phase 2 GHG emission and fuel consumption standards, expressed as HD tractor engine BTE%. Also shown for reference are the assessments of NAS, SWRI and the results of the SuperTruck program. The determination of BTE% from brake specific CO2 emission is described in Appendix B. [NHTSA-2014-0132-0102-A1 p.10]

[Figure 2 can be found on p.10 of docket number NHTSA-2014-0132-0102-A1]

1. The agencies should revise and strengthen the standards for HD tractor engines used in line-haul and heavy-haul applications. These engines have the highest annual mileage, consume the most fuel and emit the most CO2. The following limit standards and schedule were found to be feasible in the time scale under discussion, and are recommended for consideration:

**MY 2027 and beyond HD Tractor Engines            390 gCO2/HP-hr            (50.4% BTE)**  
[NHTSA-2014-0132-0102-A1 p.10]

The proposed change of weighting factors illustrated in Figure 4, reduces the stringency of the HD tractor engine GHG and fuel consumption standards. Increasing the weighting of the A speed from 23% to 45%, and reducing the C speed weighting from 23% to 5% has more or less the same effect as downspeeding.



The fuel consumption of a HD tractor engine is typically lower at the A speed than the B or C speeds. If the same engine were tested on both cycles, the new proposed cycle would deliver approximately 1-2% lower CO<sub>2</sub>. The proposed weighting factors relax the stringency of the HD engine standards significantly and should be taken into account when setting limit standards for CO<sub>2</sub>. [NHTSA-2014-0132-0102-A1 p.12]

|   |                            |
|---|----------------------------|
| <b>Proposed reduction of CO<sub>2</sub> and fuel consumption, 2027 and beyond</b> | <b>4.13%</b>               |
| <b>Relaxation of SET Test Cycle</b>   | <b>1-2%</b>                |
| <b>Net reduction of CO<sub>2</sub> and fuel consumption, 2027 and beyond</b>      | <b><u>2.13 – 3.13%</u></b> |

[Figure 4 can be found on p.12 of docket number NHTSA-2014-0132-0102-A1]

### 5.5.1 Derivation of the Proposed Engine Standards

As described in Section II.D(a) of the HD Phase 2 NPRM [15], the agencies derived the proposed engine standards based on their projections of the effectiveness of various technologies over the proposed engine test cycles (i.e., percent reduction) and the extent to which such technologies could be adopted by industry by 2021, 2024, and 2027. [NHTSA-2014-0132-0102-A1 p.20]

Figure 9 shows the agencies derivation of the 2027 GHG emission standard with 4.2% reduction versus the 2017 Phase 1 baseline. According to the agencies, the maximum available GHG reduction relative to the 2017 Phase 1 base line is 8.1%, or equivalent to a BTE of 46.4%. However, this reduction is discounted by the agencies assessment of technology effectiveness (Dis-Synergy Factor) and market penetration. [NHTSA-2014-0132-0102-A1 p.20]

[Figure 9 can be found on p.20 of docket number NHTSA-2014-0132-0102-A1]

The data supporting this determination of HD engine stringency is clouded by at least three factors: [NHTSA-2014-0132-0102-A1 p.20]

- “The agencies would not be able to release the more detailed numbers along each mode of 13 SET modes to justify the stringency proposal due to the nature of CBI.” [15]
- No explanation is given for the Dis-Synergy Factors (75% and 85%) used to discount the SET weighted reductions.
- The market penetration percentages are the result of a confusion by the agencies between the forces of regulation and the forces of the free market. The market penetration should be limited only by the exclusion of vehicle applications for which the technology is not applicable – i.e. it would not produce the desired reductions or would prevent safe operation of the vehicle. [NHTSA-2014-0132-0102-A1 p.20]

Figure 16 tabulates the Phase 1 and proposed Phase 2 standards for HD tractor engines in terms of BTE%. Also shown in Figure 16 are the recommendations of NAS [37] and SWRI [42, 43] and the results of the SuperTruck Program [31-35]. Figure 2 shows the same data as Figure 16 in graphical form. [NHTSA-2014-0132-0102-A1 p.24]

The Phase 2 2027 limit standard for HD tractor engines is 441 gCO<sub>2</sub>/HP-hr, equivalent to a BTE of 44.6%, and a reduction from the Phase 1 2017 HD tractor engine standard of 460 gCO<sub>2</sub>/HP-hr, of only 4.13%. In fact, the relaxation of stringency of the SET test cycle for HD tractor engines proposed in the

Phase 2 rule, described earlier (section 3.2.1), reduces the stringency further by between 1% and 2%. [NHTSA-2014-0132-0102-A1 p.24]

The proposed rule is therefore equivalent to only a 2.1% to 3.1% reduction in GHG emissions and fuel consumption, commencing in 2027. [NHTSA-2014-0132-0102-A1 p.24]

When considering the lead time available through 2027, and the progress demonstrated by the SuperTruck projects in both engine testing and vehicle testing, there is a compelling case for more stringent HD tractor engine standards than contained in the NPRM. This study finds that the following standards are technologically and commercially feasible and meet the president's expectation for utilizing advanced technology: [NHTSA-2014-0132-0102-A1 p.25]

**MV 2027 and beyond HD Tractor Engines 390 gCO<sub>2</sub>/HP-hr (50.4% BTE)** [NHTSA-2014-0132-0102-A1 p.25]

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**2 Based on analysis of fuel maps used in HD Phase 2 version** of GEM to set 2021, 2024 and 2027MY Standards. Draft RIA – Figures 2-12, 2-13 and 2-14 [15].

5 The loss of alignment between criteria pollutant emissions with GHG emissions caused by proposed changes to the weighting factors for GHG emissions, should be remedied by either reverting back to the SET test cycle used for NO<sub>x</sub> and PM for GHG certification, or by adopting the new test cycle for NO<sub>x</sub> and PM certification. [NHTSA-2014-0132-0102-A1 p.11]

15 Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium - and Heavy – Duty Engines and Vehicles–Phase 2. Draft Regulatory Impact Analysis. Assessment and Standards Division, Office of Transportation and Air Quality U.S. Environmental Protection Agency and Office of International Policy, Fuel Economy, and Consumer Programs, National Highway Traffic Safety Administration, U.S. Department of Transportation - EPA-420-D-15-900, June 2015

21 “DOE SuperTruck Program Benefits Analysis,” Final Report,– prepared for U.S, Department of Energy, Office of Vehicle Technologies and Argonne National Laboratory, December 20, 2012

24 “Roadmap and Technical White Papers,” 21st Century Truck Program, U.S. Department of Energy, 21CTP-0003, Final - February 27, 2013. [http://energy.gov/sites/prod/files/2014/02/f8/21ctp\\_roadmap\\_white\\_papers\\_2013.pdf](http://energy.gov/sites/prod/files/2014/02/f8/21ctp_roadmap_white_papers_2013.pdf)

26 Gravel, R., “SuperTruck: An opportunity to reduce GHG emissions while meeting service demands.” Asilomar Conference, August, 2013 [www.its.ucdavis.edu/files/general/pdf/2013-08-21\\_Asilomar-2013-Gravel.pdf](http://www.its.ucdavis.edu/files/general/pdf/2013-08-21_Asilomar-2013-Gravel.pdf).

30 Koeberlein, D., “Cummins SuperTruck Program Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks,” DOE Merit Review, 16 May, 2013, Project ID: ACE057

34 Amar, P., “Volvo SuperTruck - Powertrain Technologies for Efficiency Improvement,” 2015 Annual Merit Review, Washington, DC, June 12, 2015

41 “Review Of The 21<sup>st</sup> Century Truck Partnership: Third Report,” Committee to Review the 21st Century Truck Partnership, Phase 3; Board on Energy and Environmental Systems; Division on Engineering and Physical Sciences; The National Academies of Sciences, Engineering, and Medicine, September 11, 2015.

42 Reinhart, T. E., “Commercial medium- and heavy-duty truck fuel efficiency technology study - Report #1. (Report No. DOT HS 812 146). Washington, DC: National Highway Traffic Safety Administration. June 2015.

43 Reinhart, T., “Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2.” (Report No. DOT HS xxx xxx). Washington, DC: National Highway Traffic Safety Administration, June 2015.

**Response:**

We appreciate the commenter’s constructive comments. In the final rule, we do readjust the baseline of the tractor engine standards to reflect the SET reweighting impact. Chapter 2.7.4 of the RIA and Response 3.3.3 detail the reasons for the change in the baseline. We respectfully disagree with many of arguments that pertain to a more aggressive engine standard. See Response to EDF in this section above. We have reviewed the reports from four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar), which rebut the points made by the commenter. Specifically, we disagree with the approach taken by the commenter regarding the technology effectiveness from DOE’s Supertruck program and NAS’s report. It appears that the commenter took single values out of the literature, primarily reflecting peak values, such as their findings 1 and 2 related to 50% and 55% BTE. The values from the literature are single optimal operating points and not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is (necessarily) not as great as the reduction over the single, most efficient, operating point. The technology path for downspeeding proposed by the commenter is not practical, because while the peak torque of the engine moves down to an engine speed of around 800 rpm, the required high boost pressure cannot be maintained due to the engine’s low speed. While we disagree with many of the comments, we agree with some. We have made the standards more stringent than proposed. We increase the dis-synergy factor from 0.85 to 0.9, and increase the projected market penetration for WHR Rankine cycle technology from 15% to 25% in 2027, and included down speed benefits on engines. As a result of that, the tractor engine 2027 MY standards increased from 4.2% (proposal) to 5.1% in the final rule. Chapters 2.3 and 2.7 of the RIA detail the justification for this increase. For vocational engines, we have adjusted the vocational engine baseline CO<sub>2</sub> emission level based on the new certification data, strengthening the standards relative to the NPRM. Chapters 2.3 and 2.7 of the RIA detail the justification for this increase.

**3.3.1 Diesel (Compression-Ignition) Engine Standards**

**Organization:** American Automotive Policy Council

**§ 1065.680 Adjusting emission levels to Account for Infrequently Regenerating Aftertreatment Devices**

Proposed changes to 1065.680 require that manufacturers develop regeneration emission rate and frequency factors to account for GHGs emitted during a regeneration event. Furthermore, EPA opines that these changes would not significantly impact the stringency of the proposed standards without providing

supporting data. AAPC testing, the results of which are presented below, indicates that the proposed changes increase the stringency by 4 - 5 %. Additionally the technology and associated costs needed to recover the proposed IRAF application towards GHGs does not appear to be incorporated into the draft RIA nor any of the supporting cost benefit analysis. AAPC recommends that the Agencies withdraw the proposed IRAF requirement relative to GHG emissions. [EPA-HQ-OAR-2014-0827-1238-A1 p.29]

[Table of medium duty diesel emissions can be found on p.29 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

**Response:**

We do not believe inclusion of CO<sub>2</sub> into IRAF will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the impact of regeneration emissions since 2007. Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting compliance strategies that could reverse this trend. See Response 3.3.4.

Specifically, the data given by AAPC in their comments is for one diesel engine model that appears to be poorly optimized. It does not represent all of the diesel engine makes and models manufactured, and more importantly does represent what can be achieved with proper design and calibration. IRAF is already required for criteria pollutants for engines that utilize aftertreatment that requires infrequent regeneration. Therefore there should be no cost associated with adding a requirement to measure CO<sub>2</sub> to the IRAF provisions, as most test cell typically have CO<sub>2</sub> measurement capability.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Standards for vocational vehicle engines

Diesel engines

The agencies' Phase 2 technology package for diesel engines used in vocational applications is similar to that of diesel engines used in tractor trucks, except that the WHR technologies are not included. This is appropriate, considering that these technologies are suitable for steady-state operation, whereas vocational vehicles mostly operate in a transient duty cycle. However, the agencies' estimates of effectiveness and penetration of other technologies are conservative in our estimation. SwRI estimates that friction reduction can provide almost 4% fuel savings while combustion improvements can provide at least 2% fuel savings, as we have discussed in the previous section. Model-based control is a promising technology, especially for the transient engine operation typical in vocational vehicles. Improvements in computing power and speed would make it possible to use much more sophisticated algorithms that are more predictive than today's controls (p. 40195). We used the agencies' penetration in our estimate, even though their estimate was very low. This technology has a cost of less than \$100 but provides at least 2% fuel saving benefits, so its penetration would be expected to exceed the agencies' estimate of 40% in 2027 timeframe. [EPA-HQ-OAR-2014-0827-1280-A1 p.13]

The agencies also appear to assume an overlapping of benefits for vocational engine technologies, without providing a justification. We did not include such a factor. In our calculation, diesel engines for vocational vehicles can attain 7% and 8% fuel savings beyond Phase 1 levels in 2024 and 2027, respectively. Table 3 outlines the agency package and our estimate for vocational vehicles in 2024 and 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.13]

[Table 3 can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

The revised benefit from friction reduction in the final SwRI report ranges from 1% to 2.9% for highway cruising, dependent upon vehicle loading and speed. The SET-weighted average of these friction reduction estimates is 2.1%, which is 50 percent higher than the agencies' estimate of friction reduction potential in the proposal (Appendix 1), indicating that friction reduction can contribute more efficiency benefit than the proposal indicates. [Appendix 1 can be found on p.8 of this docket][EPA-HQ-OAR-2014-0827-1896-A1 p.2]

Furthermore, the final SwRI report<sup>4</sup> confirms the significant benefit of downspeeding on the engine side, even taking into account the accompanying loss in friction reduction potential. Downspeeding benefits are not reflected in the proposed engine standards, despite the fact that manufacturers have repeatedly acknowledged moving engine operation to even lower speeds.<sup>5</sup> The agencies also have noted the benefits of downspeeding when combined with downsizing, which they did refer to in setting the standard: "engine downsizing could be more effective if it is combined with downspeeding" (NPRM p. 40217). The SwRI report estimates savings ranging from 3% to 8% after lowering the engine speed from 1368 to 1051 rpm. This estimate includes the 50 percent discounting of friction reduction potential for the downsped engine. An SET-weighted average of downspeeding combined with friction reduction results in 3.3 percent improvement in 2027. As noted in other comments to the docket, the agencies should consider downspeeding improvements on the tractor engine test because of how it affects engine design.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1896-A1 p.2]

The agencies also should further consider their assessment of the penetration of advanced technologies like waste heat recovery (WHR). The SwRI report clearly illustrates the benefits of WHR, and a consultant report recently uploaded to the docket outlines how it is making its way into the fleet ahead of the rate of penetration that underlies the agencies' proposed targets.<sup>7</sup> The report also makes clear that current research into even more efficient engines indicates the potential for a durable, reliable 50-percent brake thermal efficiency engine in the timeframe of this rule. Further evidence of the significant penetration possible for WHR can be found in a recent white paper that illustrates that the agencies have significantly overestimated the costs of WHR and therefore underestimated its cost-effectiveness and potential rate of penetration in the market.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1896-A1 p.2]

The finalized report from the Southwest Research Institute indicates that tractor engines are capable of achieving an 8 to 10 percent reduction in fuel consumption from the 2018 baseline when considering the agencies' technology penetration rates; further analysis shows that a 15 percent reduction is possible (Appendix 1). [Appendix 1 can be found on p.8 of this docket][EPA-HQ-OAR-2014-0827-1896-A1 p.2]

#### Impact on proposal

The tractor truck engine stringency should be significantly strengthened in the final rule to reflect the most up-to-date data, which indicates that tractor engines can easily exceed the proposed 2027 target of 4.2 percent improvement. [EPA-HQ-OAR-2014-0827-1896-A1 p.2]

#### Southwest Research Institute Report<sup>24</sup>

##### SET-weighted improvement

Improvements in efficiency measured on the drive cycles simulated in the SwRI report do not directly correspond to the improvements these technologies would achieve on the engine cycle. To estimate the improvements that would be achieved on the SET cycle, we have utilized specific drive cycles to represent the A, B, C, and idle points, weighting the improvements achieved on these cycles in accordance with the SET regulatory weighting (Table 1). [EPA-HQ-OAR-2014-0827-1896-A1 p.8]  
[Table 1 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

The A speed and B speed are most similar to 55 mph and 65 mph, respectively. This can be confirmed with the drive ratio assumed in the SwRI report. However, the C speed represents an engine speed that is not easily represented by any of the drive cycles measured. Because we are primarily concerned with friction reduction, which we know will show diminished improvement at high speed, we have chosen to halve the improvement of the 65 mph cycle to represent a stand-in. The idle cycle is represented by the unloaded ARB transient cycle. Because the engine test is run at 25, 50, 75, and 100 percent loading, we have averaged the 0 and 50 percent loaded cycles to represent 25 percent loading, and the 50 and 100 percent loading to represent 75. [EPA-HQ-OAR-2014-0827-1896-A1 p.8]

Comparison of SwRI report and the NPRM: engine friction reduction

After assessing how to model the engine technologies in the SwRI report, we can compare these results to those of the NPRM (Table 2). Here, the fuel consumption reduction of each individual technology is shown as well as the agencies' assumed penetration of this technology in 2027, yielding a weighted reduction. [EPA-HQ-OAR-2014-0827-1896-A1 p.8]

The revised effectiveness represents the SwRI SET-weighted value. In combining the technologies, the final value reflects some assumption about how the technologies interact, which we refer to as dissynergy. Such interaction should be based on considerations specific to the technologies being combined—for example, the effectiveness of a waste heat recovery will be lower in combination with technologies that reduce the amount of waste heat available. However, we are unaware of other overlapping benefits among the particular technologies in the agency engine package. Therefore, while the agencies used a representative value of 15 percent for the dissynergy factor, we have reduced this value to 4 percent to reflect only the 25 percent of the fleet for which this the agencies applied this technology. [EPA-HQ-OAR-2014-0827-1896-A1 p.8]

[Table 2 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

Comparison of SwRI report and the NPRM: downspeeding

Downspeeding offers additional gains that are not included in Table 2. Higher brake mean effective pressure that results from downspeeding does interact with engine friction reduction; however, the SwRI report clearly showed that benefits from downspeeding were achieved beyond the levels outlined in Table 2. Table 3 outlines the additional benefits that are achievable when including downspeeding on the engine standard, based upon the SwRI report. [EPA-HQ-OAR-2014-0827-1896-A1 p.9]

[Table 3 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

*Feasibility Assessment of Future Efficiency Improvement for Class 8 Diesel Tractor Engines*<sup>25</sup>

In addition to the SwRI report, a presentation was uploaded to the docket from Dr. Stephen J. Charlton that outlines a path forward for the heavy-duty truck industry over the timeframe of the rule, taking into account ongoing research, product development cycles, and the breadth of technologies that could be available in the timeframe of this rule. [EPA-HQ-OAR-2014-0827-1896-A1 p.10]

Table 4 summarizes the findings of this report, illustrating a path to an engine standard in 2027 that would achieve a 15 percent reduction from the current 2018 baseline engine on the SET test. Notable differences between the agencies' proposed targets are: 1) greater penetration of WHR; 2) recognition that downspeeding will lead to efficiency improvements on the SET cycle as well as on the vehicle; 3) greater potential improvements from model-based controls; and 4) increased stringency of the 2018 baseline itself to reflect the updated SET weighting. [EPA-HQ-OAR-2014-0827-1896-A1 p.10]

[Table 4 can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

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24 EPA-HQ-OAR-2014-0827-1623/NHTSA-2014-0132-0185.

25 EPA-HQ-OAR-2014-0827-1472.

**Response:**

The findings from SwRI's report on friction are consistent with the agencies' estimate if exactly the same certification cycle weighting factors for tractors and the certification vehicle weights are used. Using the same principle for overall technology effectiveness reported by SwRI, specifically from their revised report, their findings again support the agencies' findings. We appreciated many of the constructive comments related to down speeding, and dis-synergy effect. Accordingly, we have made many changes on engine standards. On the vocational side, we changed the baseline engine to reflect the most recent certification data. The detailed vocational engine stringency and its baseline engine standards explanation can be found in Chapter 2.7 of the RIA. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the 2027 MY tractor engine standards' projected stringency over the baseline increased from 4.2% (proposed) to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase.

**Organization:** California Air Resources Board (CARB)

**Oppose/Requested Change Comment****Comment – Stringency of the engine standards for heavy-duty tractors**

The NPRM requests comment on the proposal to increase the stringency of the compression ignition tractor engine standards. CARB staff strongly supports U.S. EPA and NHTSA's decision to increase the stringency of the compression ignition engine standards. The Phase 1 regulation established engine standards that were easily achieved using "off-the-shelf" technologies. With the Phase 2 regulation, U.S. EPA and NHTSA committed to establish more stringent engine standards that force the introduction of new and advanced cost-effective engine technologies. CARB staff supports that effort, and in fact believes the engine standards should be made more stringent than either the preferred Alternative 3 standards or the Alternative 4 standards. As discussed further below, CARB staff recommends that when fully implemented, the tractor engine standard stringency should be increased from 4.2 percent to 7.1 percent, and that full implementation should happen by MY 2024. [EPA-HQ-OAR-2014-0827-1265-A1 p.30-31]

As shown in Table II-6 of the NPRM (included below), U.S. EPA and NHTSA's preferred Alternative 3 would result in standards for MY 2027 diesel engines that require a 4.2 percent reduction in CO2 emissions versus a 2017 baseline engine. Also proposed are interim standards for MY 2021 and MY 2024, requiring reductions in CO2 emissions of 1.5 to 3.7 percent better than a 2017 baseline. The proposed standards were determined by taking the SET weighted reduction for each technology, weighting it by the estimated market penetration, calculating a weighted average for the entire suite of technologies, and then applying a "dis-synergy factor" to the weighted average. Dis-synergy factors were used to make adjustments accounting for the potential that some combinations of technologies may result in CO2 reductions less than that indicated by the calculated weighted average. The dis-synergy factor applied to the 2021 weighted average was 0.75. The dis-synergy factor applied to the 2024 and 2027 weighted averages was 0.85. [EPA-HQ-OAR-2014-0827-1265-A1 p.31]

[The table, Table II-6 from the proposed rulemaking, can be found on p.31 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

CARB staff urges U.S. EPA and NHTSA to increase the stringency of the standards in consideration of the following concerns:

The estimated emission reductions used as the basis of Alternative 3 are overly conservative. A number of sources lead CARB to conclude that the SET weighted reductions that serve as the basis of the preferred Alternative 3 standards should be made more stringent, as listed below:[EPA-HQ-OAR-2014-0827-1265-A1 p.31]

- The estimated emission benefits of the Phase 2 engine standards from a 2010 baseline engine are significantly less than the potential cited in a number of published technical assessments. There are a number of published studies that estimated the potential reduction from the application of engine technologies on 2010 and pre-2010 engine technologies, and the estimated emission benefits of the Phase 2 engine standards from a 2010 baseline engine are significantly less than the potential cited in these assessments. The GHG emission rate of a 2010 baseline engine, 490 g/bhp-hr, was defined by U.S. EPA and NHTSA when developing the Phase 1 tractor engine standard. The proposed Phase 2 tractor engine standard for 2027 is 441 g/bhp-hr and represents a 10 percent reduction from a 2010 baseline engine, which is much less than what has been estimated as technically feasible in the following reports. [EPA-HQ-OAR-2014-0827-1265-A1 p.31-32]
- CARB's recently released technology assessment for engine and vehicle efficiency estimates that tractor engines can achieve up to 34 percent reduction in fuel use/GHG emissions from a 2010 baseline through the application of fuel saving technologies within the Phase 2 timeframe.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.32]
- U.S. Department of Energy's Supertruck Program demonstrated engine efficiency improvements up to 22 percent from a 2009 baseline engine. Technologies demonstrated included waste heat recovery (WHR) systems using the Rankine cycle.<sup>15</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.32]
- At the 2013 Society of Automotive Engineers (SAE) Commercial Vehicle Engineering Congress, Donald W. Stanton, Cummins Inc., presented a lecture entitled, "Systematic Development of Highly Efficient and Clean Engines to Meet Future Commercial Vehicle Greenhouse Gas Regulations." Dr. Stanton estimated that over 20 percent reduction in GHG emissions is possible through the application of engine technologies in the Phase 2 timeframe.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.32]
- The International Council on Clean Transportation (ICCT) research study on advanced tractor-trailer efficiency technologies estimated that up to 21.5 percent fuel consumption reduction from a 2010 baseline engine is possible in the 2020 to 2030 timeframe with the application of advanced engine technologies and WHR (Rankine).<sup>17</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.32]
- The SET weighted reductions are overly conservative. Cummins and SwRI, have conducted independent technical analyses assessing the potential reductions resulting from the application of engine technologies. Both analyses assumed the baseline engine was a Phase 1 compliant engine. The Cummins analysis was over the SET certification cycle; the SwRI analysis was over the drive cycles used by GEM.
  - Cummins has indicated that tractor engines can achieve a 9 to 15 percent fuel savings from a 2017 baseline engine in the 2020 to 2030 timeframe.
  - Southwest Research Institute (SwRI) completed a study for NHTSA to inform the development of the Phase 2 standards that concluded that tractor engine fuel consumption



could be reduced 4 to 10 percent from a baseline 2019 engine compliant with the Phase 1 standards.<sup>18</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.33]

Two of the above referenced sources, Cummins and SwRI, provided specific information relating the potential reductions from a Phase 1 compliant engine over either the SET certification cycle or the drive cycles used by GEM. The information they provided and how it compares to the proposed tractor engine standard is discussed in further detail below. [EPA-HQ-OAR-2014-0827-1265-A1 p.33]

### Cummins

At the April 22, 2015, CARB Symposium on Phase 2 GHG Emission Standards for Heavy-Duty Vehicles, Dr. Wayne Eckerle, Vice President of Corporate Research and Technology for Cummins Inc., presented Cummins' perspective on the potential for reduction of CO<sub>2</sub> from tractor engines in the 2020 to 2030 timeframe. Dr. Eckerle stated that CO<sub>2</sub> emission reductions of 9 to 15 percent from a 2017 baseline engine are achievable through improvements in combustion and air handling, friction and parasitics, heat transfer management, and WHR (Rankine cycle). These reductions were estimated over the SET certification cycle using the current mode weightings. The SET weighted reductions from Table II-6 for a tractor engine that employs WHR in the 2020 to 2027 timeframe are presented in Table 1. The total reduction of CO<sub>2</sub> emissions from the application of the suite of technologies is 6.7 percent. This includes the application of a dis-synergy factor of 0.85. WHR (Rankine cycle) was included since the Cummins engine employs that technology. Turbo compounding was not included since it is unlikely that a manufacturer would install two WHR technologies on the same engine. [EPA-HQ-OAR-2014-0827-1265-A1 p.33-34]

[Table 1 can be found on p.34 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

The 6.7 percent reduction represents the projected emission reduction from a single tractor engine that uses WHR (Rankine cycle) and not turbo compounding. The 4.2 percent reduction for MY 2027 (Table II-6 in the NPRM) represents the percent emission reduction from a fleet of tractor engines taking into account the projected market penetration of each technology. CARB staff believes comparing the 6.7 percent reduction to the 9 to 15 percent reduction represents an "apples-to-apples" comparison of what U.S. EPA and NHTSA, and Cummins believe is achievable in the 2020 to 2030 timeframe. So it is clear that U.S. EPA and NHTSA's 6.7 percent is much lower than what Cummins has publicly stated is achievable in the Phase 2 timeframe. [EPA-HQ-OAR-2014-0827-1265-A1 p.22]

Outside of WHR (Rankine cycle), Cummins has not published any information regarding the percent reduction potential associated with the individual engine technologies that contribute to the total 9 to 15 percent reduction estimate. Regarding WHR (Rankine cycle), Cummins estimates that a 4 to 5 percent emission reduction is achievable in the 2020 timeframe. Cummins is currently in its fourth generation WHR (Rankine cycle) system design and plans to implement end-user testing by late 2015, and has stated that production of a WHR (Rankine cycle) is possible by 2020. [EPA-HQ-OAR-2014-0827-1265-A1 p.34]

Given the information provided by Cummins regarding the potential for CO<sub>2</sub> emission reductions, CARB staff strongly urges U.S. EPA and NHTSA to reevaluate the projected SET weighted reductions it used to determine the proposed tractor engine standards. Comparing the 3.6 percent reduction U.S. EPA and NHTSA projected for WHR (Rankine cycle) to the Cummins estimate of 4 to 5 percent, and U.S. EPA's overall percent reduction of 6.7 percent to the Cummins estimate of 9 to 15 percent, suggests that the proposed SET weighted reductions in the 2020-2027 timeframe are overly conservative and should be made more stringent. [EPA-HQ-OAR-2014-0827-1265-A1 p.35]

### SwRI Report

To inform the development of the Phase 2 standard, the SwRI conducted research assessing the effectiveness of potential GHG emission reducing technologies for the Phase 2 timeframe. Engine models were created and calibrated using available experimental data. Each engine model was exercised over five cycles that included the three Phase 1 GEM cycles, i.e., 55 miles per hour (mph) steady-state cruise, 65 mph steady-state cruise, and the CARB urban cycle. [EPA-HQ-OAR-2014-0827-1265-A1 p.35]

Based on the technologies studied, SwRI concluded that there is the potential to improve long-haul truck engine fuel consumption and GHG emissions by 8 to 10 percent over the Phase 1 baseline. This would require the use of WHR (Rankine cycle). The study also indicated that fuel savings and GHG emissions using friction reduction and down speeding could result in reductions in the 4 to 7 percent range. [EPA-HQ-OAR-2014-0827-1265-A1 p.35]

To more directly compare the results of the SwRI study to the proposed Phase 2 engine standards, staff compared the SET weighted reductions assumed by U.S. EPA and NHTSA in setting the engine standard (as shown in Table 1), to the SwRI simulation results from the drive cycles used in GEM. Staff believes directly comparing the percent reduction from the SET to the percent reduction from the weighted GEM cycles is appropriate since U.S. EPA and NHTSA concluded that tractor engine technologies will improve engines and tractors proportionally, even though the separate engine and vehicle certification test procedures have different duty cycles (page 40199 of the NPRM). Table 2 shows the simulation results for two technology packages modeled in the SwRI study. Technology package 1 (referred to as “DD15 Technology Package 2” in the SwRI report) includes aggressive friction reduction and downspeeding, but does not include WHR (Rankine cycle). Technology package 2 (referred to as DD15 Technology Package 3f in the SwRI report) includes technology package 1 with WHR (Rankine cycle). These simulation results were estimated using the same three test cycles used in GEM. Staff then weighted the results in accordance with the GEM drive cycle weightings for sleeper-cab tractor trailers and day-cab tractor-trailers, as shown in Table 3. The percent reductions represent the reductions from a Phase 1 compliant baseline engine at 100 percent payload (46,040 lbs). [EPA-HQ-OAR-2014-0827-1265-A1 p.35-36]

[Table 2 can be found on p.36 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

[Table 3 can be found on p.36 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

As shown in Table 3, based on the SwRI study, the percent reduction in GHG emissions is estimated to range from 10.0 to 10.7 percent with WHR (Rankine cycle) and 4.9 to 5.1 percent without it. Comparing this to U.S. EPA and NHTSA’s overall percent reduction of 6.7 percent with WHR (Rankine cycle) and 3.8 percent without WHR (Rankine cycle) suggests that the proposed SET weighted reductions in the 2020-2027 timeframe are overly conservative and should be made more stringent. [EPA-HQ-OAR-2014-0827-1265-A1 p.36]

The dis-synergy factors used to establish the final standards are unnecessary given the conservative nature of the proposed standards.

U.S. EPA and NHTSA applied dis-synergy factors of 0.75 for MY 2021 and 0.85 for MYs judgment and are meant to account for the potential dis-synergy of engine technologies. For example, friction reduction technologies reduce waste heat produced by the engine. This, in turn, could reduce the effectiveness of WHR (Rankine cycle) to some degree. The dis-synergy factor is intended account for this loss of effectiveness. CARB staff understands the rationale behind the application of dis-synergy factors, but believes they are unnecessary given 1) the conservativeness of the SET weighted reductions that serve as

the basis for preferred Alternative 3 standards and 2) the equation<sup>19</sup> used to calculate the benefit of multiple combined technologies does not simply add the percent effectiveness of each technology, but accounts for the interaction between technologies and potential loss of effectiveness as technologies are combined. As noted previously, Cummins stated that CO<sub>2</sub> emission reductions of 9 to 15 percent from a 2017 baseline engine are achievable. The 9 to 15 percent estimate incorporates the anticipated dis-synergy when combining engine technologies. Removing the application 0.85 dis-synergy factor from U.S. EPA and NHTSA's calculation of the 2027 standard would raise the percent reduction of the standard from 4.2 percent to 4.8 percent. This is much less than what CARB believes is achievable, but would be a step in the right direction. [EPA-HQ-OAR-2014-0827-1265-A1 p.36-37]

### Suggested Tractor Engine Stringency

In consideration of the information presented above and additional information as noted below, CARB recommends U.S. EPA and NHTSA reevaluate the stringency of the tractor engine standards for preferred Alternative 3. Specifically, CARB suggests U.S. EPA and NHTSA make the following changes to the assumptions used in setting the standards: [EPA-HQ-OAR-2014-0827-1265-A1 p.37]

- Increase the percent reduction associated with “Parasitic/friction, lubrication” from 1.4 percent to 3.3 percent. Parasitic/friction, lubrication improvements were included in the technology package 1 discussed above. The SwRI study also evaluated the benefit of these improvements separately (referred to as DD15 Technology Package 1 in the SwRI report). The GEM drive cycle weighted average of the SwRI results ranged from 3.2 percent benefit for sleeper-cab tractor trailers to 3.4 for day-cab tractor-trailers. [EPA-HQ-OAR-2014-0827-1265-A1 p.37]
- Remove the dis-synergy factor from standard setting calculation. [EPA-HQ-OAR-2014-0827-1265-A1 p.37]
- Increase the 2024 penetration rate assumptions to those proposed in 2027. This more aggressive implementation schedule is consistent with our recommendation to adopt the Alternative 4 implementation schedule for all engine and vehicle categories. [EPA-HQ-OAR-2014-0827-1265-A1 p.37-38]
- Combine the WHR turbo compounding and Rankine cycle categories into one WHR category and increase the percent reduction associated with WHR to 4.5 percent. CARB staff is suggesting that for standard setting purposes the WHR SET reduction should reflect the percent reduction potential from the most effective technology, which would be 4.5 percent from WHR (Rankine cycle). The market penetration values used to set the standard would be the combined existing Alternative 3 percentages for turbo compounding and Rankine cycle technologies. Thus the market penetration for the engines that are projected to utilize WHR systems (either turbo compounding or Rankine cycle) remains unchanged from the original U.S. EPA proposal. But, the higher SET reduction associated with WHR would drive more to install WHR Rankine cycle systems. CARB is confident that manufacturers will have WHR Rankine cycle systems tested and production-ready to meet the MY 2024 standard. WHR Rankine cycle technology was developed and implemented as part of the Supertruck program. A fourth generation design of this technology is currently being developed for tractor applications by Cummins. End-user testing of this system is planned for late 2015. Production is possible as early as 2020. This should be sufficient leadtime to develop reliable and compliant engines for MY 2024. [EPA-HQ-OAR-2014-0827-1265-A1 p.38]

Table 4 below illustrates the impact the suggested changes would have on the stringency of the proposed tractor engine standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.38]

[Table 4 can be found on p. 38-39 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

To summarize, as shown in Table 4, CARB recommends that when fully implemented, the tractor engine standard stringency should be increased from 4.2 percent to 7.1 percent, and that full implementation should happen three years earlier than indicated in the preferred Alternative 3, moved from 2027 to 2024. This more aggressive implementation schedule is consistent with our recommendation to adopt the Alternative 4 implementation schedule for all engine and vehicle categories. [EPA-HQ-OAR-2014-0827-1265-A1 p.39]

#### Impact of More Stringent Tractor Engine Standards on Alternative 4 Tractor Vehicle Standards

If U.S. EPA and NHTSA adopt more stringent tractor engine standards, the corresponding tractor vehicle standards should also be made more stringent. Table 5 shows the fuel consumption reductions for the tractor engine and vehicle standards fully implemented by MY 2024. As discussed above we are suggesting that U.S. EPA and NHTSA adopt the Alternative 4 implementation schedule for tractor engine standards; the same holds true for tractor vehicle standards. Therefore, full implementation is shown as occurring by MY 2024 and not 2027 as prescribed by U.S. EPA and NHTSA's preferred Alternative 3. [EPA-HQ-OAR-2014-0827-1265-A1 p.39]

[Table 5 can be found on p.39 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

As shown, CARB is suggesting that U.S. EPA and NHTSA adopt more stringent tractor engine standards that would result in an additional 3 percent reduction when fully implemented by MY 2024. This would result in a corresponding additional 3 percent reduction in the tractor vehicle standard. [EPA-HQ-OAR-2014-0827-1265-A1 p.40]

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<sup>14</sup> (CARB, 2015c) California Air Resources Board, "Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency," June 2015, <<http://www.arb.ca.gov/msprog/tech/techreport/epdo ve tech report.pdf>>.

<sup>15</sup> (Delgado and Lutsey, 2014) Delgado, O., Lutsey, N., The U.S. SuperTruck Program: Expediting the development of advanced heavy-duty efficiency technologies, June 2014, <<http://www.theicct.org/us-supertruck-program-expediting-development-advanced-hdv-efficiency-technologies>>.

<sup>16</sup> (Stanton, 2013) Donald W. Stanton, "Systematic Development of Highly Efficient and Clean Engines to Meet Future Commercial Vehicle Greenhouse Gas Regulations," Cummins Inc., 2013 Society Automotive Engineers Commercial Vehicle Engineering Congress, 2013.

<sup>17</sup> (Delgado and Lutsey, 2015) Delgado, O., Lutsey, N., Advanced Tractor-Trailer Efficiency Technology Potential in the 2020 2030 Timeframe, April 2015, <<http://www.theicct.org/us-tractor-trailer-efficiency-technology>>

<sup>18</sup> (Reinhart, 2015) Reinhart, T., Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2. Draft, <<http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/Draft-SwRI-MDHD-FE-TechReport2 DocketVersion.pdf>>.

<sup>19</sup> %GHG reduction<sub>package</sub>=100[1-(1-({%GHG tech 1 /100}))(1-({%GHG tech 2 /100}))...(1-({%GHG tech N /100}))]

### **Comment - Feasibility of vocational vehicle engine standards**

CARB staff strongly recommends strengthening the proposed vocational engine standard from the proposed 4.0 percent reduction in CO<sub>2</sub> emissions beyond Phase 1 to 4.3 percent. For compression ignition engines fitted into vocational vehicles, the NPRM proposes an engine standard that achieves 4.0 percent reduction in CO<sub>2</sub> emissions beyond the Phase 1 standard. This proposed engine standard was derived assuming certain SET weighted reductions for applicable technologies, along with a certain penetration for each technology. Table 6 shows the projected emission reductions from the SET weighted reductions for vocational engine technologies listed in the NPRM. Without accounting for penetration, the vocational engine reductions amount to a 6.0 percent improvement for MY 2027 (in other words, 6.0 percent reduction could be achieved if the described technologies had penetration of 100 percent; with the technology penetrations assumed, the technologies' 6.0 percent potential improvement achieves an overall 4.0 percent reduction for vocational compression-ignition engines in total). Cummins, the largest manufacturer of heavy-duty truck engines, has publically stated a vocational engine emission improvement of 5 to 11 percent in the Phase 2 timeframe is feasible. U.S. EPA and NHTSA are currently proposing a vocational engine standard consistent with the lowest end of Cummins' projections. [EPA-HQ-OAR-2014-0827-1265-A1 p.40]

In addition, in deriving the proposed standard, U.S. EPA and NHTSA applied a dis-synergy factor of 0.85. CARB staff does not believe that the dis-synergy factor adjustment is necessary for two reasons. One, manufacturers already account for dis-synergistic effects between various technologies when predicting future engine improvements. Therefore, U.S. EPA is, in essence, double discounting when applying in their own dis-synergy factor. Two, the proposed vocational engine standard for vocational engines is already conservative; therefore, CARB staff believes the application of a dis-synergy factor is unnecessary. CARB staff strongly urges U.S. EPA and NHTSA to improve the vocational engine standard. Overall, CARB staff believes that the proposed Phase 2 emission standard for vocational vehicles under both Alternative 3 and Alternative 4 is overly conservative and leaves emission benefits "on the table." [EPA-HQ-OAR-2014-0827-1265-A1 p.40-41]

[Table 6 can be found on p.41 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

### **Response:**

We appreciate many of constructive comments made by CARB. We recognized that CARB's comments are largely based on the DOE SuperTruck programs, SwRI reports, and some of Cummins's public reports. The values from the DOE SuperTruck program are single optimal operating points and not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point. The findings from SwRI's report on friction is consistent with the agencies estimate if exactly the same certification cycle weighting factors for tractors and the certification vehicle weights are used. Using the same principle for overall technology effectiveness reported by SwRI, specifically from their revised report, their findings again support the agencies' findings. We noticed that Cummins's proposal on engine efficiency reduction is more aggressive than the agencies'. It should be clear that their proposed timing is out to 2030 and not 2027. Many technology adoption rates, such as WHR and other emerging technologies, would follow the S-shape curve as explained in Chapter 2.3.8 of the RIA, meaning that it will be adopted more slowly at the beginning, and then rapidly after a certain period of time. It can be expected that their reduction plan

should potentially include a new engine platform, which can significantly increase the chance to meet more aggressive reduction goals. On the other hand, we don't believe that developing a new engine platform is possible for all OEMs in the given timeframe. Consequently, we can't develop more stringent standards predicated on all OEMs developing a new engine platform in the timeframe of Phase 2.

We disagree with CARB's comments with respect to dis-synergy. The full justification regarding this matter can be found in Chapter 2.7.5 of the RIA. We also disagree with CARB's recommendation on friction reduction, where their conclusion was mainly based on SwRI reports. The finding from SwRI's report on friction is consistent with the agencies' estimates if exactly the same certification cycle weighting factors for tractors and the certification vehicle weights are used. In addition, SwRI revised their finding due to errors found in the baseline modeling. The modified engine standards for the final rule are based on many comments received and our further investigation into emerging engine technologies. We do not believe that a WHR effectiveness of 4.5% is feasible. Furthermore, WHR with Rankine cycle and turbo-compound conflict with each other, and they would not be combined as a single technology package because they compete for the same energy source. Our WHR effectiveness is directly obtained from and consistent with data from one of the engine manufacturers.

After taking all constructive comments, including CARB's, into consideration, we have made many changes to the proposed engine standards. These changes are described in previous responses.

**Organization:** Center for Biological Diversity

The Proposed Rule would require a 4.2 percent increase in diesel-engine efficiency between 2017 and 2027, yet efficiency gains of at least double this amount have been demonstrated. Furthermore, most diesel engines will improve efficiency at a much higher rate in the near future (about 6 percent between 2010 and 2017 alone).<sup>24</sup> It is unfathomable that a smaller total improvement in engine efficiency is proposed for decades from now than is currently required under Phase 1 standards. A variety of studies<sup>25</sup> indicates that diesel engine improvements of at least 10 percent below 2017 emission levels – and often more – are achievable within the timeframe of the Proposed Rule. In this instance, there is no reasoned basis that the NHTSA and EPA could find that an efficiency standard set at less than half of what is technologically feasible fulfills the technology-forcing requirements of the EISA and the Clean Air Act, rendering the rulemaking subject to legal challenge. [EPA-HQ-OAR-2014-0827-1460-A1 p.7]

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<sup>24</sup> International Council on Clean Transportation (“ICCT”), POLICY UPDATE: UNITED STATES EFFICIENCY AND GREENHOUSE GAS EMISSIONS REGULATIONS FOR MODEL YEAR 2018-2027 HEAVY-DUTY VEHICLES, ENGINES AND TRAILERS 3 (June 2015) (“ICCT Phase 2 Policy Analysis”), available at <http://theicct.org/us-phase2-hdv-efficiency-ghg-regulations-policy-update>.

<sup>25</sup> Nic Lutsey, *The ever-improving efficiency of the diesel engine*, International Council on Clean Transportation, Aug. 14, 2015, <http://theicct.org/blogs/staff/ever-improving-efficiency-diesel-engine>; ICCT Phase 2 Policy Analysis, *supra* note 24 at 3 (see collected references therein).

**Response:**

On the vocational side, we changed the baseline engine to reflect the most recent certification data. The detailed vocational engine stringency and its baseline engine standards can be found in Chapter 2.7 of the RIA. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this

increase. It should be pointed out that while the literature, including the DOE SuperTruck program, demonstrate more reduction on the engine side, the technology demonstration only focused on a single operating point. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point.

**Organization:** Engine Research Center

To be effective in achieving these benefits, however, the separate engine standard must not only be commercially acceptable and reasonable, but also meaningful. The new MDV and HDV standards are designed to 'spur innovation, encouraging the development of and deployment of existing and advanced cost-effective technologies for a new generation of cleaner, more fuel efficient commercial trucks .... ' The standard are meant to be set 'not only on currently available technologies but also on utilization of technologies now under development or not yet widely deployed while providing significant lead time to assure adequate time to develop, test, and phase in these [technologies]. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]

'The proposed Phase 2 standards only require a 4% reduction in fuel consumption and CO2 emissions of engines, compared to Phase 1, through 2027, a requirement that may well be met with already demonstrated technology. If the standard is set too low, it presents a risk that the agencies' goal of spurring development and deployment of advanced technology may not be met, and it may render the separate engine requirement largely meaningless. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]

I respectfully suggest the Phase 2 engine standard can require a larger reduction in fuel consumption. Enough promising technologies and time exist to provide compliance at a cost increase that meets the payback scenarios outlined in the proposed standard. Based on my experience and judgment, I support a 10% fuel consumption reduction for Phase 2 heavy engine standards. [EPA-HQ-OAR-2014-0827-1141-A1 p.2]

**Response:**

We have made many changes on engine standards as detailed in previous responses and in RIA Chapters 2.3 and 2.7.

**Organization:** Environmental Law and Policy Center

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 217.]

Analysis from EPA, California, and manufacturers demonstrate that cost-effective technologies are currently available to achieve at least a 15 percent improvement in engine efficiency, more than three times greater than that which is reflected in EPA's current proposal. Similarly, the proposal -- the proposed regulation ignores fuel efficiencies that could be achieved through aerodynamic improvements to trailers.

**Response:**

We have made many changes on engine standards. See previous responses and RIA Chapters 2.3 and 2.7.

**Organization:** International Council on Clean Transportation (ICCT)

- *Diesel engines* – The engine standards are based on modest incremental improvements including engine friction, air handling, and combustion/controls, which are part of every engine/vehicle manufacturers existing technology portfolio and therefore allow for accelerated deployment before 2024. For context, the agencies proposed standards require less than half of the known technology potential for diesel tractor engines (e.g., see Eckerle, 2015; Thiruvengadam et al, 2014; Reinhart, 2015). The proposed standards (Phase 1 and 2 together from a 2010 baseline) also fall well short of SuperTrucks’ engine technologies (i.e., 10% versus SuperTrucks’ 15%, over the SET cycle) that have already been physically demonstrated in Peterbilt and Daimler tractors (Lutsey, 2015a). [EPA-HQ-OAR-2014-0827-1180-A4 p.4]

*Overall diesel tractor engine efficiency:* Based on the above data and rationale, including the more up-to-date data would result in technology potential for new diesel tractor engines that would achieve fuel use reductions of up to 8% in 2024, and 10% in 2027, from a 2017 baseline. This is based on penetration of just 15% WHR technology by model year 2027, as assumed by the agencies. Based on the above studies, we believe this is still a conservative interpretation of the data and is significantly short of the technologies being demonstrated in the SuperTruck program. [EPA-HQ-OAR-2014-0827-1180-A4 p.9]

*SET Reweighting.* We support the agencies proposed decision to re-weight the SET test points more toward lower speeds to better reflect real-world driving characteristics. However, we note that while the engine stringency was developed based on the new proposed re-weighting (new SET), the baseline used as a starting point to develop such stringency levels was based on the original SET weighing (old SET). We recommend that the agencies reflect the average shift that this re-weighting causes by re-setting the baseline Phase 2 (i.e., model year 2017) engine fuel consumption. Based on ICCT analysis of multiple engine maps (including GEM Phase 1 2010, GEM Phase 1 2017, GEM Phase 2 2017, a 2010 compliant engine tested by Thiruvengadam et al, 2014, and a projected 2017 engine by Thiruvengadam et al, 2014), it appears as though by not re-setting the baseline that the agencies give, on average, 1.5% (with a range of 0.4% up to 2.9%). Our analysis of the specific Phase 2 GEM engine maps shows that the Phase 2 baseline engine CO2 emission levels over the new SET is reduced by 1.5% when compared to the old SET. By providing a 1.5% fuel consumption benefit for the re-weighting, the agencies effectively “give away” more than one third of the proposed Phase 2 engine benefit for no new shift in technology. Stated another way, the actual stringency of the agencies proposed tractor engine standard is 2.5% rather than 4.0%. Moreover, the Phase 1 compliant engines in 2017 would be already compliant with the Phase 2 2021 engine standard. To appropriately adjust for this, the reference 2017 engine and the Phase 2 tractor engine standards would be reduced downward by approximately 1.5%. For example, the tractor engine standard for 2027, currently at 441 g/bhp-hr would be updated to 434 g/bhp-hr. An additional consideration is that this SET reweighting partially de-couples the GHG and criteria pollutant engine standards. The agencies should take steps to ensure that this action does not result in increased real world criteria pollutant emissions. [EPA-HQ-OAR-2014-0827-1180-A4 p.12-13]

**Response:**

We have made many changes on the tractor engine standards as described in previous responses.

We appreciate the commenter’s comments on SET reweighting (an error likewise pointed out by several other commenters) which indicate that there was an error in calculating reweighting impact on the engine standards in NPRM. Consequently, we adjusted reweighting impacts on the baseline values in the FRM. See Response 3.3.3.

**Organization:** Natural Resources Defense Council (NRDC)



Increase the stringency of the standards. NRDC believes standards that achieve fuel consumption and emissions reductions of at least 24 percent by 2024 and at least 31 percent by 2027 relative to Phase 1 would meet the agency obligations for setting standards that are maximum feasible (for NHTSA) and appropriate (for EPA). [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

- Important areas where the Phase 2 program stringency can be improved significantly include the standards for tractor diesel engines and for vocational vehicles. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

### ***Increase Stringency of the Tractor Engine Standards***

The stringency of the engine standard should be increased. As proposed, engines are projected to decrease fuel consumption and carbon dioxide emissions by 4.2 percent from 2017 to 2027. In reality, the standard is even weaker—and close to 3 percent—because the proposed re-weighting the Supplemental Emission Test (SET) toward lower engine speeds results in better performance on the test without any new technology addition. NRDC believes that the engine stringency should be strengthened to achieve reductions of at least 8 percent in 2024 and at least 10 percent in 2027 from 2017 levels. These stringency levels should be relative to a 2017 baseline that is adjusted to account for the reweighting of the SET. [EPA-HQ-OAR-2014-0827-1220-A1 p.4]

Analysis by the International Council on Clean Transportation (ICCT) of the U.S. SuperTruck program shows that demonstrated technology can achieve reductions of 12-17 percent.<sup>6</sup> Additional research shows the technology potential of tractor engine reductions of 10 percent even without the application of more advanced technologies such as waste heat recovery.<sup>7</sup> Using the agencies' proposal assumption of a 15 percent penetration of waste heat recovery could justify a 2027 engine standard that achieves more than a 10 percent reduction. [EPA-HQ-OAR-2014-0827-1220-A1 p.4]

Engine advancements that contribute reductions beyond those of the proposal are found in technical analysis performed for NHTSA by the Southwest Research Institute (SwRI). For example, technologies that reduce friction and parasitic losses are found to reduce fuel consumption by 2 to 5 percent<sup>8,9</sup> compared to 1.4 percent assumed by the agencies. The SwRI assessment of reduced friction and parasitic losses are reinforced by the introduction of advanced lubricants that alone are projected to reduce fuel consumption by 1.5 to 2.0 percent and are projected to be available by the beginning of the Phase 2 regulatory period.<sup>10</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.4-5]

Additional analysis demonstrates the potential to more than double the agency assessments of reduction potential from improvements in intake and exhaust air handling, turbocharging efficiency, and exhaust gas recirculation (assumed by agencies at 1.1 percent)<sup>11</sup> and from combustion and controls optimization (assumed by agencies at 1.1 percent).<sup>12</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.5]

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6 Delgado, O., Lutsey, N., "The U.S. Supertruck Program: Expediting the Development Of Advanced Heavy-Duty Vehicle Efficiency Technologies," June 2014. Available at [http://www.theicct.org/sites/default/files/publications/ICCT\\_SuperTruck-program\\_20140610.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_SuperTruck-program_20140610.pdf).

7 Thiruvengadam, A., Pradhan, S., Thiruvengadam, P., Besch, M., Carder, D., Delgado, O., "Heavy-Duty Vehicle Diesel Engine Efficiency Evaluation and Energy Audit," October 2014. Available at <http://www.theicct.org/heavy-duty-vehicle-diesel-engine-efficiency-evaluation-and-energy-audit>.

<sup>8</sup> Reinhart, T. E., *Commercial medium- and heavy-duty truck fuel efficiency technology study - Report #1*, (Report No. DOT HS 812 146), Washington, DC: National Highway Traffic Safety Administration, June 2015.

<sup>9</sup> Reinhart, T. E., *Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2*, Washington, DC: National Highway Traffic Safety Administration, June 2015. (Currently undergoing peer review).

<sup>10</sup> See Fitzpatrick, A., Sutton, M., Meekins, K. and Tennorio, A., Novel fluids for use in off-highway applications to enhance vehicle fuel and operational efficiency, UNITI Conference, April 2015; Graham, S., Dewey, M., Browne, D., Sutton, M. and Nai, P., Fuels and Lubricants Improving Vehicle Efficiency: Real Life Power Gains, Asia F&L Conference, March 2015; Browne, D., Dewey, M., Graham, S., Sutton, M., Munday, M., Blackshaw, J., Clegg, A., and Timmis, P. 'Novel Fuel Efficiency Engine Lubricants for Urban Transit Applications,' SAE Technical Paper 2014-012793; Sutton, M. and Rose, A., The role of additive chemistry in delivering maximum engine oil fuel economy, 19th International Colloquium Tribology, Esslingen Conference 2014; Moore, W., Finch, T., and Sutton, M., 'Development of Heavy Duty Diesel Real World Drive Cycles for Fuel Economy Measurements,' SAE Technical Paper 2013-01-2568; Moore, W., Sutton, M., and Donnelly, K., 'Development of Long Haul Heavy Duty Vehicle Real World Fuel Economy Measurement Technique,' SAE Technical Paper 2013-01-0330.

<sup>11</sup> See Chebli, E., Muller, M., Leweux, J. & Gorbach, A., "Development of an exhaust-gas Turbocharger for HD Daimler CV Engines," MTZ Worldwide, 74, 24-29, February 2013 and Roberts, C., Stovell, C., Rothbauer, R. & Mehta, D., "Advancements in Diesel Combustion System Design to Improve Smoke-BSFC Tradeoff," *International Journal of Automotive Engineering*, 2, 55-60, 2011.

<sup>12</sup> See Delgado and Lutsey, op. cit. and Stanton, D.W., 'Systematic development of highly efficient and clean engines to meet future commercial vehicle greenhouse gas regulations', SAE Technical Paper 2013-01-2421, 2013.

#### **Response:**

We have made many changes to the proposed tractor engine standards. See earlier responses and RIA Chapters 2.3 and 2.7.

### **3.3.2 Spark-Ignited Engine Standard**

The agencies received many comments suggesting that technologies be applied to increase the stringency of the SI engine standard, which technologies in fact are already presumed to be adopted at 100 percent to meet the MY 2016 engine standard. See RIA Chapter 2.6. The commenters did not identify any additional engine technologies that are not already fully considered by the agencies in setting the MY 2016 engine standard, that could be recognized over the HD SI Engine FTP test cycle. The agencies have identified certain improvements in friction reduction and increased use of cylinder deactivation which are reflected in the stringency of the vocational vehicle standard. See RIA Chapter 2.9.1.2.1.

**Organization:** American Automotive Policy Council

#### **Optional 621 g CO<sub>2</sub>/ hp-hr Phase 2 Standard**

The Agencies request comment (80 Federal Register 40160) on alternative Phase 1 standards for Heavy Duty Gasoline Engines of 621 g/hp-hr in 2027MY predicated in part on the use of advanced friction

reduction technology and lubricants yielding benefits of about one percent on the GEM cycles. The Agencies also request comment on whether proposing more stringent standards for gasoline engines would create an incentive for purchasers who would have otherwise chosen a diesel vehicle to instead choose a gasoline vehicle. [EPA-HQ-OAR-2014-0827-1238-A1 p.30]

Given the 1/7 cold and 6/7 hot weight factors for the HDGE test cycle and that Phase 2 GEM fuel mapping will be conducted under hot conditions, AAPC contends it will be nearly impossible to measure the impact of these low friction lubricants over the proposed cycles. Furthermore the infrastructure to produce and distribute such low friction engine lubricants is currently not available in the U.S. If the Agencies wish to incentivize early introduction and adoption of such low friction lubricants in the U.S., AAPC recommends that low friction engine lubricant credits be included in Phase 2 GEM per the table below. [EPA-HQ-OAR-2014-0827-1238-A1 p.30]

[Table of low friction lubricant incentives can be found on p.31 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

AAPC further contends that the increase in stringency of the Phase 2 Heavy-Duty SI standard to 621 g CO<sub>2</sub>/hp-hr has not been thoroughly studied. Given the present stringency impacts of removing idle work for the HDGE calculation changing to low energy ethanol containing test fuel, additional standard reductions are not warranted. [EPA-HQ-OAR-2014-0827-1238-A1 p.31]

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Gasoline engines

The gasoline engines used in vocational vehicles are developed for heavy-duty pickup trucks and vans primarily, but are also sold for use in vocational vehicles (p. 57180). For this reason, the agencies evaluated these engines in parallel with heavy-duty gasoline pickup engines in Phase 1 and based their estimate of improvement potential on technologies such as gasoline direct injection, friction reduction, and variable valve timing.<sup>10</sup> Under the Phase 1 program, fuel consumption of the HD gasoline pickups and vans will decline by 10.8%, of which the agencies estimates almost half could come from engine technologies. Therefore, the 5% fuel consumption reduction required of vocational gasoline engines in Phase 1 was reasonable. [EPA-HQ-OAR-2014-0827-1280-A1 p.13]

In the Phase 2 proposal, fuel consumption of HD gasoline pickups and vans would decline by 16.2%, of which 6-7% would be contributed by engine technologies, including further friction reduction, variable valve lift/actuation, cylinder deactivation, and turbo downsizing. It is highly likely that these technologies will also be used in vocational engines, since they use the same design platform. Using these engine

technologies, vocational gasoline engines can achieve at least 6% reductions in Phase 2. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

10 p. 57171, Federal Register /Vol. 76, No. 179/September 15, 2011

#### *Gasoline engines*

Both boosted and naturally aspirated gasoline engines for vocational vehicles show considerable improvement potential in the revised SwRI report. Valve and EGR technologies were found to offer substantial benefit in gasoline engines, especially at high load. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

#### Impact on proposal

The Phase 2 proposal did not call for improvement of the gasoline engines used in vocational vehicles. The benefits of valve and EGR technologies for these engines, especially at higher loads, as found in the revised SwRI report<sup>22</sup>, make a strong case for strengthening the standards for these engines. [EPA-HQ-OAR-2014-0827-1896-A1 p.7]

#### **Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** California Air Resources Board (CARB)

#### Oppose/ Comment on Topic Where NPRM Requests Comment

#### **Comment – Proposed GHG emission standards for spark-ignited engines**

Under these paragraphs in 40 CFR1036.108 a)(1)(i) and (ii), CO<sub>2</sub> standards for 2016 and later spark-ignited engines remain at the Phase 1 levels of 627 grams per horsepower-hour (g/hp-hr), while compression ignition (and others deemed to be compression ignition in this section) have allowable CO<sub>2</sub> limits that decline over time. U.S. EPA and NHTSA's reasoning is that the volume of gasoline engines is relatively low in these vehicle classes, so reduction requirements will have few benefits to offset the research investment costs. CARB staff believes that some of the technology developed to reduce GHG emissions in the light-duty sector should be transferrable to the medium- and heavy-duty sectors and recommends that declining GHG standards for spark-ignited engines be set based on these technologies. CARB staff believes that such GHG reductions for Phase 2 spark-ignited engines are cost-effective. The NPRM does request comment on reducing the Phase 1 CO<sub>2</sub> standard for spark-ignited gasoline engines by 1 percent to 621 g/hp-hr, based on the use of advanced friction reduction technology. CARB staff supports requiring more stringent standards for gasoline engines, and, at a minimum, supports the proposal in the NPRM to limit CO<sub>2</sub> emissions for Phase 2 spark-ignited gasoline engines to no more than 621 g/hp-hr. [EPA-HQ-OAR-2014-0827-1265-A1 p.29-30]

The NPRM further requests comment on whether *not* requiring more stringent standards for gasoline engines would create an incentive for purchasers who would otherwise choose a diesel engine to instead choose a gasoline engine. CARB staff believes that, all other things being equal, such a switch could well occur. To avoid unintended incentives, CARB staff suggests that Phase 2 gasoline engines be required to meet reduced emission standards beyond the 621 g/hp-hr previously mentioned, the compliance with which would require similar investments and/or have a similar compliance cost as is anticipated for the compression ignition engines and vehicles. Because gasoline vehicles are currently cheaper than diesel, it is particularly important to avoid further incentives for buyers to choose less efficient, gasoline vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.30]

**Response:**

As noted in previous responses, there are persuasive reasons not to adopt more stringent SI engine standards, but rather to recognize SI engine improvements in the stringency of the vehicle standard. By doing so, the agencies believe that there will not be the inappropriate incentive to manufacture SI engines rather than diesel engines for vocational applications.

**Organization:** Center for Biological Diversity

The Proposed Rule also entirely exempts spark-ignition (gasoline) engines from any requirements to improve efficiency. Yet, as acknowledged in the Proposed Rule, there are feasible technologies that could result in fuel savings. There is a significantly wider range of technologies available for gasoline engines than was included in the Proposed Rule. An analysis by the ICCT indicates that up to a 23.5 percent improvement in gasoline engine efficiency is possible.<sup>27</sup> Likewise, the American Council for an Energy-Efficient Economy (“ACEEE”) also found that gasoline engines for heavy-duty pickups and vans could improve by nearly 19 percent from 2010 levels.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.7]

The decision to omit gasoline engines is related to the Agencies’ decision to avoid standards that would require use of every available technology. As discussed above, the very purpose of technology-forcing statutes is to require *maximal* reductions. The Agencies’ concern regarding hardship to manufacturers should some technologies not perform as expected is addressed through the existence of the averaging, banking and trading (“ABT”), early credits and banking/trading safety net. [EPA-HQ-OAR-2014-0827-1460-A1 p.7-8]

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<sup>27</sup> International Council on Clean Transportation, REGULATORY CONSIDERATIONS FOR ADVANCING COMMERCIAL PICKUP AND VAN EFFICIENCY TECHNOLOGY IN THE UNITED STATES, 21, Table 3 (Apr. 2015), available at <http://theicct.org/us-commercial-pickups-vans-efficiency-technology>.

<sup>28</sup> AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, FUEL EFFICIENCY AND GREENHOUSE GAS EMISSIONS STANDARDS FOR HEAVY-DUTY PICKUPS AND VANS: PHASE 2 at 8 (May 2015) (“Pickup Report”), available at <http://aceee.org/sites/default/files/publications/researchreports/t1501.pdf>.

**Response:**

As noted in previous responses, certain improvements in SI engine performance are reflected in the stringency of the vocational vehicle standard. The agencies do not believe that any further increase in the

SI engine standard to be warranted. We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, unfavorable cost proposition for investment in new engine platforms is not easily to be justified. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. See generally RIA Chapters 2.6 and 2.9.1.2.1.

**Organization:** Cummins, Inc.

*Cummins opposes no increase in stringency of gasoline engine standards* [EPA-HQ-OAR-2014-0827-1298-A1 p.20]

Fuel neutral standards are required to ensure this rulemaking achieves the goals set forth by the Agencies. Data (see Figure 10) from recent years has shown gasoline engines displacing diesel in class 3 thru 5. The current proposal keeps gasoline engine standards the same as Phase 1 (see Figure 11), which will encourage essentially no investment and therefore no CO<sub>2</sub> reduction. Conversely, there will be added technology required for diesels to comply, so low cost, low technology, low efficiency and high emitting gasoline engines are more attractive from an initial purchase price standpoint. [EPA-HQ-OAR-2014-0827-1298-A1 p.20]

[Figure 10 and 11 can be found on p.20 and 21 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

The Agencies request comment on reducing the gasoline standards by 1% in Phase 2. Even if the Agencies were to implement this reduction, the significant disparity between gasoline and other HD engines would still exist. Continued lack of improvement on gasoline engines could push a larger fraction of the market to move toward these less efficient engines, thereby emitting more CO<sub>2</sub> emissions than envisioned by the regulation. [EPA-HQ-OAR-2014-0827-1298-A1 p.20-21]

In studies conducted by SwRI's High Efficiency Durable Gasoline Engine (HEDGE)<sup>18</sup> program, several production-available technologies have been used to demonstrate fuel consumption reductions well beyond what is being called for in this proposal. Similarly, through projects with the U.S. Department of Energy (DOE), manufacturers<sup>19,20,21</sup> have demonstrated fuel economy improvements for gasoline engines beyond the Phase 2 standards. Technologies such as turbocharging, direct injection, variable valve timing and cooled EGR are all available in lighter duty products and have been the staples for improved fuel economy in light cars and truck for several years. These same technologies can be engineered for the higher loaded application in order to be durable while providing a fuel economy benefit. In Phase 1 of the rule, the regulation established an offset in gasoline and diesel efficiency that was explained as being needed due to the short timeframe versus the need for development and testing. Phase 2 has ample time for suppliers and manufacturers to develop the technologies in order to meet customer expectations for durability and reliability. By the end of Phase 2, diesel and gasoline engine CO<sub>2</sub> standards should be the same. In fact, the Agencies themselves indicate (80 FR 40519) that gaseous-fueled engines competing with diesel engines should be required to meet the same standards. A similar argument holds for gasoline-fueled engines competing with diesel engines. Cummins agrees with this principle of fuel neutral standards and urges the Agencies to implement such an approach throughout the Phase 2 program, including on gasoline engines. [EPA-HQ-OAR-2014-0827-1298-A1 p.21-22]

*Cummins supports elimination of loose engine provision (40 CFR 1037.50(m)) for spark-ignited (SI) engines* [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

In the Phase 1 program, 40 CFR 1037.150(m) allows engines from spark-ignited (SI) chassis-certified vehicles to be sold separately for use in vocational vehicles, such as incomplete vehicles. For Phase 2, the Agencies indicated that engines intended for vocational vehicles should follow the primary certification path of separately certifying the engine on the FTP cycle and the vehicle using GEM (80 FR 40331). For this reason, the Agencies are proposing to eliminate the interim provision in 1037.150(m). Cummins supports this change as it ensures a fair and consistent evaluation of engines used in these HD vehicles. [EPA-HQ-OAR-2014-0827-1298-A1 p.30]

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18 <http://www.swri.org/4org/ae/hedge/default.htm>

19 Confer, Keith, "Ultra Efficient Light Duty Powertrain with Gasoline Low Temperature Combustion," Delphi DOE Annual Merit Review, June 2015

20 Sczomak, David P., "Lean Miller Cycle System Development for Light-Duty Vehicles," General Motors DOE Annual Merit Review, June, 2015

21 Weaver, Corey E., "Advanced Gasoline Turbocharged Direct Injection (GTDI) Engine Development," Ford DOE Annual Merit Review, June, 2015

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sales volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. We recognized that significant progress has been made by SwRI HEDGE program as well as some of the DOE sponsored gasoline engine programs. However, one of the key issues that has not been addressed is the reliability. Since the operating zones are different between light-duty vehicles and the vehicles in Class 4-7, the heavier vehicles in latter would force the engine to run more frequently in the higher speed and higher load zones than the case with light-duty vehicles, and therefore the reliability would become more of an issue. As a result, the technologies developed under light-duty vehicles would not be straightforward to migrate to those used in Class 4-7 vehicles. All of these reports have not provided a clear path toward production in the timeframe of Phase 2. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** Daimler Trucks North America LLC

**SI Engine Technologies Considered in Vehicle Standard-Setting** - The agencies requested comment on the merits of setting a SI-based vocational vehicle standard predicated on adoption of SI engine technologies. 80 FR 40303. We are concerned that the lack of a forcing engine standard will leave the small volume gasoline engine suppliers, on which we depend for our small volume gasoline-powered vocational vehicles, without impetus to improve the engines. This could make it more difficult for those vehicles to meet the vehicle standards, even with credits. That said, the cost of upgrading small volume gasoline engines to advanced standards could be prohibitive. We think that [redacted]--assuming the

agencies fix the core problems with the vocational vehicle standards. [EPA-HQ-OAR-2014-0827-1164-A1 p.75]

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements. We agree that higher-emitting SI engines (that don't meet the SI engine standard) if installed in vocational vehicles will require additional vehicle-level technology to meet the final SI vocational vehicle standards. See further information on this topic in the Preamble at Section V.C.1 b, and in the RIA Chapter 2.9.1.2.1.

**Organization:** Environmental Defense Fund (EDF)

**Gasoline vocational engine standard should be more robust**

The Agencies decided not to propose new more stringent standards for gasoline engines used in vocational vehicles because of concerns that the manufacturers do not have capital to invest in this segment of the heavy-duty sector. Yet, Navistar and General Motors just announced a joint venture to develop more class 4 and 5 trucks, many powered with gasoline engines.<sup>157</sup> The Agencies go on to conclude that some reduction will occur anyway because the engines used in this application are derived from engines used in pickups and vans. We do not support this rationale. [EPA-HQ-OAR-2014-0827-1312-A1 p.36]

The assertion that multi-billion dollar manufacturers can not make these investments is not supported by the rulemaking record. Furthermore, these gas engines compete – albeit in small numbers – with diesel engines. By allowing weaker standards for gasoline engines, the Agencies are giving them a competitive advantage and incentivizing a shift to gasoline. Indeed, recent data shows there has been a significant increase gasoline engines in medium-duty trucks.<sup>158</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.36]

Historically, EPA has preferred setting fuel neutral standards to maintain a level playing field – and we believe the Agencies should do so here. We recommend that the Agencies set the most feasible, fuel neutral standard based on the capabilities of the technological leader – in this case the diesel engine. If the Agencies decide not to do this, they should at the very least set a standard based on the most advanced gasoline engine technologies deployable in the timeframe the standards take effect. It is reasonable to expect that efficiency improvements made to gasoline engines used in heavy-duty pickups and vans will migrate to those used in vocational vehicles, and that shift should be encouraged by robust standards. A recent SwRI study funded by NHTSA projects that gasoline engines could improve fuel efficiency by up to 8%.<sup>159</sup> We urge the Agencies to set more rigorous standards for gasoline vocational engines based on this and other relevant analyses. [EPA-HQ-OAR-2014-0827-1312-A1 p.37]



157 Straight, B., "Navistar's Kozek: Deal strengthens International, expands GM portfolio," Fleet Owner, (September 30, 2015), available at <http://fleetowner.com/equipment/navistars-kozek-deal-strengthens-international-expands-gm-portfolio>.

158 Berg, T., "Medium-Duty Update: Winners, Losers and Overall Steady Growth," HDT Truckinginfo, (August 2013), available at <http://www.truckinginfo.com/article/story/2013/08/medium-duty-update.aspx?prestitial=1>; NTEA\_IHS Automotive Polk 2nd QTR CV Report\_2014, (2014), available at <http://www.ntea.com/Search/index.aspx?searchtext=automotive%20polk%202nd%20qtr>.

159 Reinhart, T., Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #2, Washington, DC: National Highway Traffic Safety Administration, (June 2015).

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. We recognized the findings made by SwRI reports. However, one of the key issues that have not been addressed is the reliability of the technology. Since the operating zones are different between heavy duty pickups/vans in Class 2b-3 and the vehicles in Class 4-7, the heavier vehicles would force the engine to run more frequently in the higher speed and higher load zones than the case with Class 2b-3 vehicles, and therefore the reliability would become more of an issue. As a result, the technologies developed under pickups and vans would not be straightforward to migrate to those used in Class 4-7 vehicles. All of these behaviors would make it harder to stay fuel neutral. In order to provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** Honeywell Transportation System (HTS)

In addition to the fuel neutrality concerns on heavy duty pickup trucks and vans, HTS is also concerned that the current proposal excludes gasoline engines from the MD/HD Vocational portion of the Phase 2 regulation. While we appreciate that the proposed rule will apply vehicle-level fuel efficiency standards to gasoline powered vocational vehicles that are essentially the same as those applied to diesel vehicles, the lack of a gasoline engine-level standard is counter to the goals of the rule. The cost differential between diesel and gasoline engines has increased substantially over the past 10 years, as diesel engines have adopted technologies to comply with NO<sub>x</sub> and PM regulations. This has made diesel engines less competitive on initial cost, and the industry has seen a steady increase in the market share of gasoline engines in class 3-5 applications. We believe that the proposal as written will further increase the initial cost of diesel engines while allowing gasoline engines a "free pass" on CO<sub>2</sub>. This will likely result in a much larger share for gasoline in these markets and has the potential to create a double negative effect: higher operating cost for vehicle users and higher CO<sub>2</sub> emissions for the fleet. [EPA-HQ-OAR-2014-0827-1230-A1 p.4] These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.259-260.]]

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. Because of these reasons, we don't believe that the rule would result in a much larger share for gasoline engines. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements. We disagree with the commenter that SI engine manufacturers are getting a "free pass." We believe that many have reached a point in development where any cost-effective incremental changes may already be made, and platform redesigns may only be chosen for models with forecasted high production volumes. More particularly, as shown in RIA chapter 2.6, the improvements to SI engines suggested by many commenters are already shown to be adopted at 100 percent to meet the MY 2016 engine standard. See RIA Chapter 2.6.

**Organization:** International Council on Clean Transportation (ICCT)

- *Gasoline engines* – The proposed gasoline standards for Phase 2 indicate no new requirements. Gasoline efficiency technology tends to migrate upward from the heavy-duty pickup and van technologies that are manufactured at higher volume. In addition, a government-funded Southwest Research Institute study indicates that they can reduce fuel use by up to 8% (Reinhart, 2015b). Installing gasoline engine standards and advancing their technology penetration at the similar pace with diesel engine efficiency, as well as at a similar pace with the agencies' assessment of pickup and van gasoline engine efficiency, would meet our assessment of technology availability and help to minimize unintended shifts in the market to higher fuel consumption gasoline products. [EPA-HQ-OAR-2014-0827-1180-A4 p.5]

*Overall gasoline engine efficiency:* Based on the above data, the agencies would include new increasingly stringent gasoline engine standards to reflect the existing technology potential and to ensure that the Phase 2 regulation does not perversely bias the market toward gasoline engines that have higher fuel consumption and higher CO<sub>2</sub> emissions for the same or lesser functionality. We recommend that the agencies require a reduction of fuel consumption for gasoline engines up to 8% in 2024 from baseline 2017 engines, based on Reinhart (2015b). In addition, it is widely recognized that gasoline efficiency technology migrates up from high-volume gasoline heavy light-duty trucks. As acknowledged directly by the agencies, vocational gasoline engines typically are the same engines as those in the pickups and vans. Ford/Ram/GM use much of the same engine technology in their high-workload light- and heavy-duty products, and these companies will likely be deploying 15%+ engine efficiency improvements in the 2020-2025 light-duty context (Lutsey, 2015a). Once these are being deployed at large volume in light-duty there is little reason that many of those same technologies could not be deployed in class 2b/3 pickup/vans, as well as in the vocational gasoline engines. As a result, implementing gasoline engine standards with similar stringency and timing with diesel engine efficiency, as well as at a similar pace with the agencies' assessment of pickup and van gasoline engine efficiency, would match the availability of technology in the rulemaking timeframe. [EPA-HQ-OAR-2014-0827-1180-A4 p.9-10]

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. We recognized the findings made by SwRI reports. However, one of the key issues that have not been addressed is the reliability. Since the operating zones are different between heavy duty pickups/vans in Class 2b-3 and the vehicles in Class 4-7, the heavier vehicles in latter would force the engine to run more frequently in the higher speed and higher load zones than the case with Class 2b-3 vehicles, and therefore the reliability would become more of an issue. As a result, the technologies developed under pickups and vans would not be straightforward to migrate to those used in Class 4-7 vehicles. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements. See also introductory response to this RTC Section 3.3.2.

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Ensure Technology-Neutral, Performance-Based Standards [EPA-HQ-OAR-2014-0827-1274-A1 p.3]**

As for the vocational vehicle category, MEMA is concerned with the agencies' proposals and the potential market impact it may have. Specifically, MEMA objects to the proposal to leave the spark ignition engine standards unchanged in 40 CFR 1036.108(a)(1)(i) and 49 CFR 535.5(d)(3). Regulations that continue to increase the technical complexity of diesel engines relative to gasoline engines will "create an incentive for purchasers who would have otherwise chosen a diesel vehicle to instead choose a gasoline vehicle," and thus may result in a much larger market share for gasoline in this particular space. MEMA urges the agencies to adopt more stringent standards for spark-ignition engines over the MY 2021-2027 timeframe, standards that are harmonized with those for light and medium heavy-duty diesel engines and thereby ensure technology neutrality. [EPA-HQ-OAR-2014-0827-1274-A1 p.4]

**Response:**

We recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. We thus do not accept the comment that a separate SI engine standard, or one not reflecting the commenter's preferred level of stringency, will create a perverse incentive to replace CI engines with SI engines. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** Natural Resources Defense Council (NRDC)

**Increase Stringency of Gasoline Engine Standards**

NRDC recommends that the agencies set a gasoline engine standard that tightens over the period of the Phase 2 standards to reach the 8 percent technology potential found by SwRI. The agencies' proposal requires no improvement to gasoline engine fuel consumption. SwRI shows improvements that can reduce fuel consumption by 8 percent in medium-duty and vocational gasoline engines.<sup>13</sup> In the timeframe of the Phase 2 requirements, NRDC expects light-duty truck gasoline engine technologies to improve meet the 2017-2025 light-duty vehicle fuel economy and greenhouse gas emissions standards. It is reasonable to expect that many of these advancements will migrate to gasoline engines used in heavier vehicle classes.<sup>14</sup> Additionally, the lack of tighter gasoline engine standards could encourage a market shift to gasoline engines that achieve no reductions in carbon pollution from diesel engines that must incur the cost of meeting tighter standards. The result would be more overall carbon pollution when cost-effective technologies are available to avoid those emissions. [EPA-HQ-OAR-2014-0827-1220-A1 p.5]

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13 Reinhart, *Report #2*, op. cit.

<sup>14</sup> Lutsey, N., "Regulatory Considerations for Advancing Commercial Pickup And Van Efficiency Technology in the United States," April 2015. Available at <http://www.theicct.org/us-commercial-pickups-vans-efficiency-technology>.

**Response:**

See introductory response above. In addition, as noted in other responses, we recognize that most gasoline engines still have high brake-specific CO<sub>2</sub> emissions (g/hp-hr). Although low sales volume & low engine power (low hp), coupled with a number of low VMT vehicle applications (e.g., RVs), moderates the adverse inventory impacts from these engines, low sale volume with low market share eliminate ABT program flexibility. In addition, the cost for new SI engine platforms would be high and not cost effective, given the limited volumes of engines produced. At this time, only one manufacturer certified its gasoline engine, but it must rely on significantly de-rated speed and power for an RV application. We recognized the findings made by SwRI reports. However, one of the key issues that have not been addressed is the reliability. Since the operating zones are different between heavy duty pickups/vans in Class 2b-3 and the vehicles in Class 4-7, the heavier vehicles in latter would force the engine to run more frequently in the higher speed and higher load zones than the case with Class 2b-3 vehicles, and therefore the reliability would become more of an issue. As a result, the technologies developed under pickups and vans would not be straightforward to migrate to those used in Class 4-7 vehicles. To provide more flexibility but still recognize the possibility of feasible engine improvements, the final standards include increased stringency of the vocational vehicle standard to reflect feasible SI engine improvements.

**Organization:** Union of Concerned Scientists (UCS)

Gasoline engines. In Phase 2, the agencies have not set a separate gasoline engine standard for vocational engines due to market considerations surrounding the engines' use in the pick-up and van market. However, they did note that engine improvements for vocational engines beyond Phase 1 would still be considered in setting the vocational vehicle stringency, and the agencies did apply additional friction reduction of 1 percent to the 60 percent of gasoline-powered vehicles that would not yet achieve this level as part of the MY2016 spark-ignited engine package. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

Engine friction reduction does not capture all of the potential for gasoline engines, however. SwRI noted a number of other technologies: improvements to variable valve lift and timing, stoichiometric exhaust gas recirculation (which could also be compounded with downspeeding on turbocharged engines), direct

injection (for naturally-aspirated vehicles) or turbocharger efficiency improvements (for turbocharged engines), and lean-burn operation. Due to timeline considerations and concerns raised in the first SwRI report (Reinhart 2015a), we did not include lean-burn GDI as part of the technology package for vocational vehicles. Similarly, because of concerns with the downsized EGR package raised around high idle duty cycles, we considered only the stoichiometric EGR package. Finally, we excluded cylinder deactivation as well for the V8 engine, focusing instead on engine friction reduction. [EPA-HQ-OAR-2014-0827-1329-A2 p.21-22]

Both diesel and gasoline engines have additional improvement opportunities beyond the NPRM based on analysis by the Southwest Research Institute (SwRI). These improvements are characterized by drive cycle. To translate those to duty cycle, they have been reduced by idle fraction (10 percent for regional vehicles, 15 percent for multipurpose, and 20 percent for urban). While some technologies like downsizing may increase idle fuel usage, generally this assumption should result in a conservative approach to assessing the certifiable stringency of these vehicles because most technologies that reduce fuel use under load will reduce it at idle as well. In all comparisons to SwRI data, we have taken the 100-percent payload value, which is most consistent with the agencies' vehicle payload in GEM (8,860 pounds for the T-270, compared to the agencies' value of 11,200 pounds for MHD vocational vehicles). This generally results in the most conservative application of the SwRI results, particularly on engine friction reduction. [EPA-HQ-OAR-2014-0827-1329-A2]

The SwRI analysis used two different baseline engines in its assessment of gasoline-powered vehicles, a turbocharged V6 and a naturally-aspirated V8 (Table 6). While the V6 is not currently in production for vocational vehicles, it is designed to be comparable to a 6L V8 and is extensively used in Class 2a pickup trucks. Furthermore, we have heard from some fleets who were disappointed when V6 gasoline engines went off the market due to a platform redesign because it forced them to move to V8 engines that were overpowered for their needs (and therefore wasted fuel relative to the V6). Therefore, we believe that there is opportunity for turbodownsizing in the gasoline market in the right application, and so we have additionally considered a V8>V6 package based on the relative difference in efficiency between the two SwRI engines. It should be noted that this would result in some differences in performance, and therefore we have only conservatively applied this technology, to just 10 percent of the gasoline-powered vocational fleet. [EPA-HQ-OAR-2014-0827-1329-A2 p.22]

In assessing the overall effectiveness for future gasoline engines, we turn to SwRI Package #16 for the 3.5L V6 (VVA+EGR) and SwRI Package #22 for the 6.2L V8 (GDI+EGR+EFR+dual cam phasers). Taken altogether, the gasoline package would achieve an average 7.4 percent improvement for spark-ignited vocational vehicles. [EPA-HQ-OAR-2014-0827-1329-A2 p.22]

[Table 6, 'Effectiveness of vocational gasoline engine packages', can be found on p.22 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

**Response:**

Because none of the technical data referenced by commenters who asked for more stringent SI engine standards provided information on how these technologies perform over the HD gasoline engine FTP test procedure, the agencies are considering these to be comments on the GEM-based vocational vehicle standards, not comments on the separate FTP-based SI engine standard.

The final SI vocational vehicle standards are calculated using an engine that meets the MY 2016 standard. In response to comments and with careful consideration of the SwRI data as well as information on

technologies for HD pickup and vans, the final vehicle-level standards for vocational vehicles powered by SI engines include additional reductions we believe can be achieved by additional engine technologies over the GEM vehicle cycles amounting to 0.8 percent beginning in MY 2021. See RIA Chapter 2.9.1.2.1. This is more stringent than the 0.6 percent of engine improvements on the vehicles proposed by the agencies that would have begun in MY 2027. We disagree with commenters asking for as much as 8 percent improvement. All of the referenced SwRI packages compare the future vehicle performance to a pre-Phase 1 baseline, thus counting all the improvements already presumed in the MY 2016 engine standard, so the delta between what the commenters seek and what the agencies proposed is considerably less than initially appears (and less than the commenter appeared to believe). We agree that higher-emitting SI engines (that do not meet the SI engine standard) if installed in vocational vehicles will require additional vehicle-level technology to meet the final SI vocational vehicle standards. See further information on this topic in the Preamble at Section V.C.1 b, and in the RIA Chapter 2.6 and Chapter 2.9.1.2.1.

### 3.3.3 Additional Discussion of Baseline Engines

**Response:**

*Background*

Phase 1 applied different test cycles depending on whether the engine is used for tractors, vocational vehicles, or both, and we are continuing this approach. Tractor engines are subject to standards over the SET (EPA’s steady-state heavy-duty test cycle), while vocational engines are subject to standards over the FTP (EPA’s transient heavy-duty test cycle).

The SET cycle was adopted by EPA in 2000 and modified in 2005 from a discrete-mode test to a ramped-modal cycle (RMC) to broadly cover the most significant part of the speed and torque map for heavy-duty engines, defined by three non-idle speeds and three relative torques. The low speed is called the “A speed,” the intermediate speed is called the “B speed,” and the high speed is called the “C speed.” As is shown in the below, the SET cumulatively weights these three speeds at 23 percent, 39 percent, and 23 percent.

**SET Modes Weighting Factor in Phase 1**

| Speed, % Load | Weighting factor in Phase 1 (%) |
|---------------|---------------------------------|
| Idle          | 15                              |
| A, 100        | 8                               |
| B, 50         | 10                              |
| B, 75         | 10                              |
| A, 50         | 5                               |
| A, 75         | 5                               |
| A, 25         | 5                               |
| B, 100        | 9                               |
| B, 25         | 10                              |
| C, 100        | 8                               |
| C, 25         | 5                               |
| C, 75         | 5                               |
| C, 50         | 5                               |
| Total         | 100                             |

|                    |    |
|--------------------|----|
| Cumulative A Speed | 23 |
| Cumulative B Speed | 39 |
| Cumulative C Speed | 23 |

The C speed is typically in the range of 1800 rpm for current heavy heavy-duty engine designs. However, it is becoming much less common for engines to operate at such a high speeds in real-world driving conditions, and especially not during cruise vehicle speeds in the 55 to 65 mph vehicle speed range. This trend has been corroborated by engine manufacturers’ in-use data that has been submitted to the agencies in comments and presented at technical conferences.<sup>38</sup> Thus, although the current SET represents highway operation better than the FTP cycle, it could be improved by adjusting its weighting factors to better reflect modern trends in in-use engine operation. Furthermore, the most recent trends indicate that manufacturers are configuring drivetrains to operate engines at speeds down to a range of 1050-1200 rpm at a vehicle speed of 65mph.

To address this trend toward in-use engine down-speeding, the agencies are finalizing as proposed refined SET weighting factors for the Phase 2 CO<sub>2</sub> emission and fuel consumption standards. The new SET mode weightings move most of the C weighting to “A” speed, as shown in the table below. To better align with in-use data, these changes also include a reduction of the idle speed weighting factor. These new mode weightings do not apply to criteria pollutants or to the Phase 1 CO<sub>2</sub> emission and fuel consumption standards.

**New SET Modes Weighting Factor in Phase 2**

| <b>Speed/% Load</b> | <b>Weighting factor in Phase 2 (%)</b> |
|---------------------|--|
| Idle                | 12                                     |
| A, 100              | 9                                      |
| B, 50               | 10                                     |
| B, 75               | 10                                     |
| A, 50               | 12                                     |
| A, 75               | 12                                     |
| A, 25               | 12                                     |
| B, 100              | 9                                      |
| B, 25               | 9                                      |
| C, 100              | 2                                      |
| C, 25               | 1                                      |
| C, 75               | 1                                      |
| C, 50               | 1                                      |
| Total               | 100                                    |
| Total A Speed       | 45                                     |
| Total B Speed       | 38                                     |
| Total C Speed       | 5                                      |

<sup>38</sup> “OEM perspective – Meeting EPA/NHTSA GHG/Efficiency Standards”, 7th Integer Emissions Summit USA 2014, Volvo Group North America.

*NPRM Baselines*

In the Phase 2 proposal we assumed that the numeric values of the Phase 1 standards were the baselines for Phase 2. The Table below shows the Phase 1 standards for diesel engines.

**Phase 1 MY 2017 Diesel Engine CO<sub>2</sub> and Fuel Consumption Standards**

| <b>UNITS</b>      | <b>HHD SET</b> | <b>MHD SET</b> | <b>HHD FTP</b> | <b>MHD FTP</b> | <b>LHD FTP</b> |
|-------------------|----------------|----------------|----------------|----------------|----------------|
| g/bhp-hr          | 460            | 487            | 555            | 576            | 576            |
| gal/100<br>bhp-hr | 4.5187         | 4.7839         | 5.4519         | 5.6582         | 5.6582         |

We applied our technology assessments to these baselines to arrive at the Phase 2 standards for MY 2021, MY 2024 and MY 2027. In other words, for the Phase 2 proposal we projected that starting in MY 2017 engines would, on average, just meet the Phase 1 standards and not over-comply. However, based on comments we received on how to consistently apply our new SET weighting factors in our analysis and based on recent MY 2016 engine certification data, we realized the change in test procedures caused in a change in measured results that impacts the appropriate level of the standards. We also realized that the proposed FTP baseline misrepresented baseline performance for vocational engines. As described below, we are updating our Phase 2 baseline assumptions for both the SET and FTP.

*Revision to the SET Baseline*

With respect to the SET, in the proposal we compared our proposed Phase 2 standards, which are based on these new Phase 2 weighting factors, to the Phase 1 numeric standards, which are based on the current Phase 1 weighting factors. Because we continue to use the same 13-mode brake specific CO<sub>2</sub> and fuel consumption numeric values we used for the proposal to represent the performance of a MY 2017 baseline engine, we are not projecting a different technology level in the baseline. Rather, this is simply correcting an “apples-to-oranges” comparison from the proposal by applying the Phase 2 weighting factors to the MY 2017 baseline engine. While this did not impact our technology effectiveness or cost analyses, it did impact the numeric value of our baseline to which we reference the effectiveness of applying technologies to the 13 individual modes of the SET. Because the revised SET weighting factors result in somewhat lower brake specific CO<sub>2</sub> and fuel consumption numeric results for the composite baseline SET value, this correction, in turn, lowers the numerical values of the final Phase 2 SET standards. Making this particular update did not result in a change to the relative stringency of the final Phase 2 numeric engine standards (relative to MY 2017 baseline performance), but our updated feasibility analysis did; see Section II.D.(2)(a) of the FRM preamble.

This issue was raised by several commenters on the NPRM (in particular UCS, Cummins, ICCT and EDF in their public comments) who generally noted that the impact of not accounting for the different SET weightings would be to make the standards less stringent in actual effect. In other words, by over-estimating the emissions of MY 2017 engines when measured using the new SET weighting factors, we would enable manufacturers to comply with the standards using less technology than projected and, consequently, achieve less improvement in actual use. Several manufacturers addressed this issue in supplemental comments and in comments on the NODA.

Each of the tractor engine manufacturers provided supplemental information to us including 13-mode test results for their engines. All of this information was claimed as CBI. These data showed some variation,



but most showed the new weighting factors to reduce cycle-average emissions by slightly more than one percent.

The agencies have updated our analysis of SET baselines to be consistent with these data, and applied our projected per cent reductions to the revised SET baseline to obtain revised the numerical values of the standards. See Section 3.3.4 below (as well as certain responses in Section 3.3.1) for a discussion of how we considered the potential impacts of IRAFs on the baselines and the standards.

#### *Revision to the FTP Baseline*

The agencies also made adjustments to the FTP baselines, but these adjustments were not made because of test procedure changes. Rather, MY 2016 FTP certification data showed an unexpected step-change improvement in engine fuel consumption and CO<sub>2</sub> emissions. These data were not available at the time of proposal, so the agencies relied upon the MY 2017 Phase 1 *standard* as a baseline. EDF publicly commented in response to the NODA that the more recent certification data revealed this new step-change. MY 2016 certification data submitted to the agencies<sup>39</sup> as well as to ARB<sup>40</sup> show that many engines from many manufacturers already not only achieve the Phase 1 FTP standards, but some were also below the MY 2027 standards proposed for Phase 2. This was not the case for the SET, where most manufacturers are still not yet complying with the MY 2017 Phase 1 SET standards. In view of this situation for the FTP, the agencies are adjusting the Phase 2 FTP baseline to reflect this shift.

The underlying reasons for this shift are mostly related to manufacturers optimizing their SCR thermal management strategy over the FTP in ways that we (mistakenly) thought had already occurred in MY 2010 (i.e., the Phase 1 baseline). As background, the FTP includes a cold-start, a hot-start and significant time spent at engine idle. During these starting and idling portions of the FTP, the NO<sub>x</sub> SCR system can cool down and lose NO<sub>x</sub> reducing efficiency. One simplistic strategy to maintain SCR temperature is to inefficiently consume additional fuel, such that the fuel energy is lost to the exhaust system in the form of heat. There are more sophisticated strategies to maintain SCR temperature, however, but these apparently required additional time from MY 2010 for research, development and refinement. (As discussed in Section 3.3.4 below, in updating these baseline values, the agencies did consider the concerns raised by manufacturers about the potential baseline impacts of IRAFs, which can also be related to thermal management.)

At the time of Phase 1 we had not realized that these improvements were not already in the Phase 1 baseline. These include optimizing the use of an intake throttle to decrease excess intake air at idle and SCR catalyst reformulation to maintain SCR efficiency at lower temperatures. Based on this information, which was provided to the agencies by engine manufacturers, but only after the agencies' specifically requested it, the agencies concluded that in Phase 1 we did not account for how much further these kinds of improvements could impact fuel consumption over the FTP. Conversely, only by reviewing the new MY 2016 certification data did we realize how little SCR thermal management optimization actually occurred for the engine model years that we used to establish the Phase 1 baseline – namely MY 2009 and MY 2010 engines.

Like the change to the SET baseline, this change to the FTP baseline does not impact the agencies' projections of potential compliance pathway, cost, and stringency. This is because we never accounted for this kind of improvement in our Phase 2 proposal's stringency analysis for meeting the Phase 2

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<sup>39</sup> <https://www3.epa.gov/otaq/certdata.htm#oh>.

<sup>40</sup> <http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/2016.php>.

proposed FTP standards. Therefore, we continue to apply the same improvements that we proposed, but we apply them to the updated FTP baseline.

*FRM Baseline SET and FTP Values*

The table below **Error! Reference source not found.** shows the Phase 2 diesel engine final CO<sub>2</sub> baseline emissions. The gasoline engine CO<sub>2</sub> baseline for Phase 2, which is not shown, is the same as the Phase 1 HD gasoline FTP standard, 627 g/bhp-hr. More detailed analyses on these Phase 2 baseline values of tractor and vocational vehicles can be found in Chapter 2.7.4 of RIA.

**Phase 2 Diesel Engine Final CO<sub>2</sub> and Fuel Consumption Baseline Emissions**

| <b>UNITS</b>      | <b>HHD SET</b> | <b>MHD SET</b> | <b>HHD FTP</b> | <b>MHD FTP</b> | <b>LHD FTP</b> |
|-------------------|----------------|----------------|----------------|----------------|----------------|
| g/bhp-hr          | 455            | 481            | 525            | 558            | 576            |
| gal/100<br>bhp-hr | 4.4695         | 4.7250         | 5.1572         | 5.4813         | 5.6582         |

Some manufacturers argue that these changes represent increases in the “stringency” of the engine standards. As already noted, there are different ways in which the term “stringency” can be used. We recognize that the changes to the baselines and the test procedures being made for the FRM have resulted in numerically lower emission standards. However, the agencies do not consider these changes to be true changes in stringency because they are independent of the projected technology. Nevertheless, rather than engaging in the semantic debate of whether or not these changes represent a change in “stringency”, we note that the greatest significance of these changes is that they make the numerical standards consistent with the projected costs and in-use benefits of the proposed and FRM analyses. Thus, the final technological cost and feasibility analyses fully support the final engine standards.

*Baseline Maps*

In addition to estimating baseline SET and FTP values, the agencies also developed complete baseline maps to use as GEM inputs. For the NPRM, we started with the maps used in Phase 1 to represent engines compliant with the 2017 engine standards. Based the best available information, we modified these maps to better represent actual engine technology. In some ways these modified engine maps reflected more efficient engines than were used in Phase 1. However, based on comments, including confidential data from manufacturers we revised the NPRM maps to be more representative of MY 2017/2018 engines.

Navistar referred to these maps as hypothetical, but we find that term to be misleading. Although these maps do not reflect any single engine, they each are derived from real engine maps. The agencies developed these maps to represent the average performance of multiple real maps. Nevertheless, as already noted, we did agree that the NPRM maps could be improved and have done so for the FRM.

**3.3.4 Additional Discussion of IRAFs**

**Response:**

The current engine test procedures also require the development of regeneration emission rates and frequency factors to determine infrequent regeneration adjustment factors (IRAFs) that account for the emission changes for criteria pollutants during an exhaust emissions control system regeneration event.

In the 2011 Phase 1 final rule, the agencies adopted provisions to exclude CO<sub>2</sub> emissions and fuel consumption due to regeneration. In large part, this was because manufacturers had just begun using SCR on their engines and they had not yet optimized regeneration strategies.

However, for Phase 2, we are requiring the inclusion of CO<sub>2</sub> emissions and fuel consumption due to regeneration over the FTP and SET cycles, as determined using the IRAF provisions in 40 CFR 1065.680. While some commenters opposed this because of its potential impact on stringency, we do not believe this will significantly impact the stringency of these standards because manufacturers have already made great progress in reducing the frequency and impact of regeneration emissions since 2007. Rather, the agencies are including IRAF CO<sub>2</sub> emissions for Phase 2 to prevent these emissions from increasing in the future to the point where they would otherwise become significant. While some manufacturer comments on the NPRM opposed the inclusion of IRAFs, some qualitatively acknowledged the likely already small and decreasing magnitude of IRAF CO<sub>2</sub> emissions in their comments. For example, EMA stated, “the rates of infrequent regenerations have been going down since the adoption of the Phase 1 standards” and that IRAF “contributions are minor.” Nevertheless, we believe it is prudent to begin accounting for regeneration emissions to discourage manufacturers from adopting criteria emissions compliance strategies that could reverse this trend. Manufacturers expressed concern about the additional test burden, but the only additional requirement would be to measure and report CO<sub>2</sub> emissions for the same tests manufacturers are already performing to determine IRAFs for other pollutants.

At the time of the proposal, we did not specifically adjust baseline levels to include additional IRAF emissions because we believed them to be negligible and decreasing. Commenters opposing this proposed provision provided no data to dispute this belief in their comments on the NPRM (and, as just quoted, EMA’s comments corroborate the agencies’ approach at proposal). More recently, a few manufacturers have raised the possibility that IRAFs may be more significant than we believed – especially for the FTP. However, at least one manufacturer has provided CBI data to show that their IRAFs for CO<sub>2</sub> would be very small for both the SET and FTP. After considering this more recent information, we continue to believe that regeneration strategies can be engineered to maintain these negligible rates. Thus, we do not believe the regeneration emissions are of fundamental significance for our baselines in the FRM. Highway operation includes enough high temperature operation to make active regenerations unnecessary. Furthermore, recent improvements in exhaust after-treatment catalyst formulations and exhaust temperature thermal management strategies, such as intake air throttling, minimize CO<sub>2</sub> IRAF impacts during non-highway operation, where active regeneration might be required. Finally, as discussed in Section 3.3.3 above, recent significant efficiency improvements over the FTP cycle show that FTP emissions can be even lower than we have estimated in our updated FTP baselines, which would provide additional margin for manufacturers to manage any minor CO<sub>2</sub> IRAF impacts that may occur.

In summary, we believe that with proper design, regeneration event can be very infrequent and the emissions can be very low so that the impact of applying an IRAF should be less than 0.1 percent. We have considered this impact in our analysis of baseline emission rates, along with other marginal factors. Although manufacturers have recently given us some CBI data on their current engines that inform our estimated baseline values, this data set is still limited and leaves some uncertainty. To be prudent, we addressed this uncertainty by being somewhat conservative in the extent to which we adjusted the baselines downward.

For any manufacturers that currently have non-negligible IRAFs, we believe market forces would drive them to reduce fuel consumption during regenerations. Thus, we do not believe any costs to control fuel consumption during regenerations would be attributable to the Phase 2 program. Nevertheless, we note that the cost for such control would be limited to the cost of recalibration work, which should be low.

Even if that cost occurs and should have been attributed to Phase 2 (a premise with which we do not agree), including such costs would not have altered any decisions about the Phase 2 engine standards. Throughout the rulemaking, we did not find costs or cost-effectiveness to be a significantly limiting factor in determining the stringency of the standards.

### 3.4 Projected Engine Technologies, Effectiveness, and Cost

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

#### Engine technology effectiveness

The Phase 2 engine package draws on research done by Southwest Research Institute (SwRI).<sup>3</sup> However, the agencies sometimes use lower effectiveness values than SwRI finds, without offering a justification. First and foremost is the case of engine friction reduction. The SwRI study considered potential friction reduction from any component needed for engine operation, including engine piston, ring, liners, bearings, valve train, and gear train. It also considered reduced friction from variable speed oil and water pumps, from reduced-power fuel pumps, and by using low viscosity engine oil. While the SwRI study estimated more than 4% fuel consumption reduction from friction reduction, the agencies estimated 1.4% reduction from engine friction and parasitic reduction. [EPA-HQ-OAR-2014-0827-1280-A1 p.10]

Improvement in combustion and control is another area where the agencies underestimated effectiveness. The agencies estimated 1% improvement from combustion and control, while Cummins Inc. has estimated 4% thermal efficiency improvement, or almost 8% fuel efficiency improvement, beyond Phase 1 from combustion, air-handling, and after-treatment improvement.<sup>4</sup> Similarly, industry sources have indicated 2% and 1% minimum fuel savings from combustion and engine controls, respectively.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1280-A1 p.10-11]

Additional fuel consumption reduction is possible from waste heat recovery (WHR) in the form of either turbo compounding or Rankine cycle. Volvo reported 2 to 4% fuel savings from turbo compounding in line haul applications (p. 40196), yet the agencies assumed only 1.8%.<sup>6</sup> In Phase 1 the agencies reported 2.5% to 5% fuel savings from mechanical turbocompounding.<sup>7</sup> Similarly, while the agencies assume 3.6% fuel savings for Rankine Cycle over the SET, the SwRI study estimated 4.4% fuel savings over a weighted average of transient, 55 mph and 65 mph cycles. The benefits of Rankine cycle would not accrue on the transient cycle, so one would not expect the fuel savings on the SET to be lower than the weighted SwRI results. Furthermore, Cummins Inc., in a recent presentation to the Air Resources Board, claimed 4.5% average fuel savings from Rankine cycle in their SuperTruck project.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1280-A1 p.11]

#### Engine technology penetration

The Phase 2 proposal estimates 100% penetration of all engine technologies in the 2027 timeframe except engine downsizing, turbo compounding and Rankine cycle. More than 40 percent of all energy loss in an engine is lost as heat to the exhaust and engine coolant (p. 40196). Therefore, manufacturers are actively pursuing WHR in at least one form. Hence we believe the agencies' estimate of 15% penetration for Rankine cycle and 10% penetration for turbo compounding in Phase 2 are far too low. Both turbo compounding and Rankine cycle are suitable for the steady-speed operation that is typical in line haul operation. Furthermore, turbo compounding is part of the Phase 1 package for 2017 model year engines, so 10% penetration in next ten years is an overly conservative estimate. Two major manufacturers, Daimler Truck North America and Volvo, are likely to use this technology before 2020 (p. 40196). Cummins Inc., another major engine manufacturer, has invested in Rankine cycle and used it in their SuperTruck program. Therefore, we believe it is more appropriate to expect all line haul tractor trucks (62% of all tractor trucks) to take advantage of one of these two WHR technologies in the Phase 2 timeframe. [EPA-HQ-OAR-2014-0827-1280-A1 p.11]

#### Overlapping benefits

After calculating the combined benefits of engine technologies using a multiplicative approach, the agencies appear to have applied a further 15% discount to the benefits to account for overlapping benefits of the technologies. We agree that the percent fuel savings realized by a given technology may be lower when the technology is used with another technology, and this issue should be addressed in estimating combined benefits. However, no explanation is offered for how the 15% figure was arrived at, and this value does not appear to be justified in this case. [EPA-HQ-OAR-2014-0827-1280-A1 p.11]

Any attempt to quantify such overlaps in benefits should be based on considerations specific to the technologies to be combined. For example, the effectiveness of a waste heat recovery will be lower in combination with technologies that reduce the amount of waste heat available. However, we are unaware of other overlapping benefits among the particular technologies in the agency engine package. [EPA-HQ-OAR-2014-0827-1280-A1 p.12]

Using the above-mentioned effectiveness and penetration of these technologies, we estimate that the fuel consumption of tractor track engines can be reduced by 9% and 10% in 2024 and 2027, respectively. Table 2 summarizes the potential engine efficiency improvements for 2027 model year and compares with the proposed standards. Table A1 in the Appendix shows the corresponding comparison for model year 2024. [EPA-HQ-OAR-2014-0827-1280-A1 p.12]

[Table 2 can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1280-A1, and Table A1 can be found in Appendix A on p.12 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

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3 Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #1 NHTSA report no. DOT HS 812 146, June 2015, Submitted to the Phase 2 rule docket

<sup>4</sup> <http://aceee.org/files/pdf/conferences/workshop/heavy-duty/salemme-cummins.pdf>

5 Stakeholder workshop report on tractor trailer efficiency technologies, 2015-2030, <http://aceee.org/files/pdf/conferences/workshop/heavy-duty/hdv-workshop-report.pdf>

<sup>6</sup> Test cycles may not be comparable.

<sup>7</sup> p. 57205, Federal Register /Vol. 76, No. 179/September 15, 2011

<sup>8</sup> [http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2\\_7\\_wayne\\_e\\_cummins.pdf](http://www.arb.ca.gov/msprog/onroad/caphase2ghg/presentations/2_7_wayne_e_cummins.pdf)

**Response:**

The finding from SwRI's report on friction is consistent with agencies estimate if the exactly same certification cycle weighting factors on tractors and the certification vehicle weights are used. Using the same principle for overall technology effectiveness reported by SwRI, specifically from their revised report, their findings again support the agencies' findings. We do not believe that 4% reduction on combustion is feasible for Phase 2 using an existing engine platform over 13 composite SET modes. Based on discussions with OEMs and consideration of CBI, the agencies believe that the type of reduction posited by the commenter could be achieved only by a new engine platform with significant capability of sustaining extremely high peak cylinder pressure. Most of the heavy duty engines currently marketed are relatively new; new engine platforms are not generally being contemplated. The cost of

designing a new engine platform outside the normal redesign cycle is enormous, and has not been considered by the commenter. Our effectiveness of WHR Rankine cycle technology is based on the credible information directly from one of the OEMs. Volvo's finding on WHR turbo-compound benefits is from an on-highway operations. In contrast, we have to evaluate any technology benefits over the 13 modes of the SET cycle, where turbo-compound actually has negative benefits in the low loads and low speed regions. We are confident that the WHR effectiveness used represents the state-of-the-art values. Based on many constructive comments and the agencies' further investigation on dis-synergy effect or overlapping effect, these values were adjusted for the final rule. An example if this is with the 2027 tractor engines, where we increased the dis-synergy factor from 0.85 to 0.9.

**Organization:** American Trucking Associations (ATA)

Specific technology MPRs under the Phase 2 Rule appear to be overly aggressive and must be adjusted downward for fleets to afford flexibility in spec'ing equipment, avoid excessive downtime due to unforeseen maintenance requirements, and maintain equipment affordability. The specific market penetration rates of concern are as follows: [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

### **Waste Heat Recovery (15% in 2027)**

Waste heat recovery ("WHR") was explored as a potential fuel efficiency technology under the U.S. Department of Energy's SuperTruck initiative – a program developed to advance the fuel efficiency of tractor-trailers by 50% over baseline models. The SuperTrucks equipped with WHR were developed and unveiled by heavy-duty manufacturers in project demonstration vehicles funded through federal and private sector sources. However, these prototype trucks are currently not production-ready and therefore have not been thoroughly tested across the challenging and widely varied duty-cycles that exist within our industry. ATA member fleets have clearly expressed their desire to only purchase technologies that are thoroughly tested, verified, affordable, and proven to be both durable and affordable. [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

### **Waste Heat Recovery**

The agencies assume Waste Heat Recovery ("WHR") technology will cost \$10,523 in 2021. Figures derived from the DOE SuperTruck program ranged from \$7,200 - \$15,000. Because WHR is not currently in the market, the actual costs remain unknown. Some OEMs state that the agencies' costs are actually higher than this figure while another OEM says it is overinflated. This wide-ranging pricing uncertainty should raise a cautionary flag to the agencies. WHR is the highest cost menu item under the current heavy-duty engine technology listings. The agencies must be more transparent in how they derived such cost figures given they are being so widely contested by all the OEMs. As you can imagine, these cost uncertainties have only escalated fleet concerns over the future pricing of equipment under Phase 2. [EPA-HQ-OAR-2014-0827-1243-A1 p.11]

### **Response:**

We understand ATA's concerns on the projected WHR market penetration. On the other hand, we received data and credible CBI information from one of the engine manufacturers as well as their public comments (EPA-HQ-OAR-2014-0827-1298) that their WHR system could be put into production in the 2021 timeframe. In addition to our response in RTC Section 3.4.1 below, Chapters 2.3 and 2.7 of the RIA detail the justification of WHR as one of the technologies used in our stringency development. We have reconsidered our WHR costs in the final rule and provide more detail for how it was derived. Please refer to RIA Chapter 2.11.2.15 for more detail on our final WHR cost estimates.

**Organization:** Caterpillar Inc, et al.

Waste Heat Recovery: 15% - Waste heat recovery technology is not currently in the market, has technical challenges for which production-viable solutions have not been identified, and is therefore not proven. Customers are concerned with the complexity of the system as well as likely maintenance and downtime increases, which will prevent uptake of this non-proven technology. EPA should not assume any penetration of waste heat recovery technology by 2027. [EPA-HQ-OAR-2014-0827-1215-A1 p.6]

**Response:**

We received data and credible CBI information as well as public comments (EPA-HQ-OAR-2014-0827-1298) from one the engine manufacturers that their WHR system could be put into production in the 2021 timeframe. With a technology effectiveness of 3.6% used in engine standards, it only translated to a total of reduction about 0.9% in 2027. Considering that the technology path proposed by the agencies is only one of many paths that can achieve the standards, this 0.9% reduction can be made up by many other means. In addition to our response in RTC Section 3.4.1 below, Chapter 2.3 and 2.7 of the RIA for detailed justification.

**Organization:** Clean Air Task Force et al.

We continue to find that achieving a 40% improvement in oil consumption in 2025 (over 2010 levels) is feasible and cost-effective. Further, there are some areas where the new data support our initial recommendations for strengthening. The report from Southwest Research Institute shows that heavy-duty engines for tractors, pick-ups, and vocational vehicles can all be much more efficient than the proposed targets. [EPA-HQ-OAR-2014-0827-1925-A1 p.1-2]

**Response:**

See earlier responses. Also, the commenter's suggested improvement is over the 2010 baseline whereas the more germane comparison is over a 2017 MY baseline.

**Organization:** Clean Fuels Ohio (CFO)

Opportunities improving truck fuel efficiency are also great (and growing) based on already-existing technologies and others in the R&D pipeline that show future promise: [EPA-HQ-OAR-2014-0827-1192-A1 p.1]

**Response:**

See earlier responses.

**Organization:** Controlled Power Technologies, Inc.

I am writing to inform the EPA and the public about CO2 reduction-enabling technologies from Controlled Power Technologies (CPT). Simulink performance models are available and may be suitable for inclusion in GEM. [EPA-HQ-OAR-2014-0827-1307 p.1]

COBRA stands for COntrolled Boosting for Rapid response Applications. It is a fully integrated electric supercharger including all control and power electronics. [EPA-HQ-OAR-2014-0827-1307 p.1] By supplying instantaneous on demand air COBRA is an enabling technology which can support a number of



CO2 and emission reducing solutions. COBRA compliments engine downsizing by supporting the low end torque gap allowing for the same drivability as a larger powertrain. [EPA-HQ-OAR-2014-0827-1307 p.1]

COBRA's on demand over boost enables the use of down speeding, longer gearing and a simplified transmission to provide the same fuel cost benefits. The increased airflow delivered by COBRA not only improves acceleration and response times it also provides the ability to maintain the correct Air-Fuel ratio at key points to avoid transient smoke limit. [EPA-HQ-OAR-2014-0827-1307 p.1-2]

Additional information is contained in the attachment: CPT COBRA\_4pp\_APR2014\_4print.pdf [See docket number EPA-HQ-OAR-2014-0827-1307-A1]

SpeedStart/SpeedTorq motor-generator from Controlled Power Technologies [EPA-HQ-OAR-2014-0827-1310 p.1]

The SpeedStart/SpeedTorq e-motor/generator is capable for providing idle-reduction (stop-start) functionality, additional torque assist to the engine. It can be used to drive auxiliary devices such as air conditioning compressors, while also providing a means of energy recuperation. [EPA-HQ-OAR-2014-0827-1310 p.1]

The key CPT SR e-Motor, aka SpeedStart and SpeedTorq, advantages are: No rare earth permanent magnets - price volatility and special recycling requirements are not a factor Design simplicity enables commonality of components across variants; 95% of the CPT SR e-Motor content is common across 12V, 24V and 48V variants. Provides the OEM with an option for multi-variants based on a common core motor design (e.g. P0, P4 hybrid in automotive applications) High efficiency (>80%) over a broad speed range Low inductance design and independent phase control allows quick response time to change in torque request. 0 - 100% Torque is possible in 1 electrical cycle Low rotating inertia reduces mechanical load on engine Zero generation capability, the ability to generate no electricity when the rotor is turning is a key safety characteristic which is important for ASIL C/D applications (e.g. electrified rear axle or transmission applications) High thermal efficiency - delivers peak performance over extended events independent of engine bay temperatures Advanced flexible control system enables the following programmable features Belt pre-tensioning for comfort stop-start Faster change-of-mind Electric drive Torque profiling 4 quadrant control for hybrid driveline applications. [EPA-HQ-OAR-2014-0827-1310 p.1-2]

additional information is contained in the attachment: Speedstart\_05.15 [See docket number EPA-HQ-OAR-2014-0827-1310-A1]

WASTE EXHAUST ENERGY RECOVER TECHNOLOGY (AKA 'TIGERS') FROM CONTROLLED POWER TECHNOLOGIES [EPA-HQ-OAR-2014-0827-1313 p.1]

## TIGERS

Waste to Watts - Powering the Planet with TIGERS TIGERS (Turbo-generator Integrated Gas Energy Recovery System) is a liquid cooled switched reluctance generator coupled to an exhaust driven turbine. [EPA-HQ-OAR-2014-0827-1313 p.1]

It is capable of operating in exhaust temperatures up to 750C, at speeds up to 45,000rpm, delivering a peak power of 2kW-4kW. The TIGERS system includes an electronically controlled full flow external by-pass that ensures the desired proportion of exhaust gas is delivered to the turbo-generator as

determined by the control system. [EPA-HQ-OAR-2014-0827-1313][EPA-HQ-OAR-2014-0827-1313 p.1-2]

Applications and Benefits [EPA-HQ-OAR-2014-0827-1313 p.2]

- \* Waste exhaust heat energy is converted into useful electrical power
- \* More efficient electrical power generation compared with a conventional alternator at medium to high engine load
- \* Compact machine (240mm x210mm x 175mm) delivering high power (0.5 - 2kW @ 12v)
- \* Can be packaged any wherein the exhaust system\* Integrated power & control electronics
- \* Internally controlled bypass valve system
- \* Able to control pressure limit, voltage limit and current limit commands over CAN
- \* Utilizes a be spoke low pressure turbine to extract power from exhaust flow with a minimal impact on back pressure [EPA-HQ-OAR-2014-0827-1313 p.2]

additional information is contained in the attachment: CPT TIGERS\_8 13\_4print.pdf [See docket number EPA-HQ-OAR-2014-0827-1313-A1]

**Response:**

We appreciate the commenter's willingness to share their model with the agencies. However, GEM relies on the engine fuel map to represent all of the engine technologies that are quantified by the engine dynamometer tests. We will not model individual components that are part of the engine.

**Organization:** Cummins, Inc.

*Cummins expects market demand to drive performance that meets or exceeds the proposed engine standards, and the technologies will be available*

The SuperTruck programs have demonstrated the capability of new engine technologies to increase efficiency and reduce fuel consumption and CO<sub>2</sub> emissions. The Cummins-Peterbilt program<sup>5</sup> demonstrated almost a 20% CO<sub>2</sub> reduction from a 2009 baseline engine. [EPA-HQ-OAR-2014-0827-1298-A1 p.13]

Potential technologies for CO<sub>2</sub> reduction on engines are found in Table 1. HHD tractor engine technologies are evaluated over the RMCSET certification cycle while MHD vocational engine technologies are evaluated over the FTP certification cycle. By using an engine system-level evaluation for the technologies in Table 1, the total cycle improvement numbers account for any inherent dis-synergies. [EPA-HQ-OAR-2014-0827-1298-A1 p.13]

[Table 1 can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

As noted in Cummins' comments to NHTSA<sup>3</sup>, key areas of improved engine efficiency for tractor applications are combustion, air handling, friction and parasitic reduction, and WHR technology. Higher compression ratios, injection pressures and engine structural capability such as higher peak cylinder pressures are also showing benefits in engine efficiency. Organic Rankine Cycle (ORC) WHR technology has the capability to provide 4 to 5% improvement in fuel consumption on tractor drive cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.13]

Many of the technologies that can reduce tractor engine CO2 can also reduce vocational engine CO2. Combustion and air handling improvements will exist in the same form as for tractors; however, CO2 improvements differ between the two markets due to the lower average cycle power of the vocational market. [EPA-HQ-OAR-2014-0827-1298-A1 p.13]

Cummins expects market demand to drive performance that meets or exceeds the proposed engine standards. Given that the time span of this rule covers approximately three typical engine development cycles, we expect that the engine technologies listed will be reliably and cost effectively introduced to production engines within the Phase 2 timeframe. In fact, the engine standard changes of 0.5 to 0.6% in 2027 are within the CO2 measurement variability and compliance margin, so it can be expected that this final step will not drive meaningful additional technology adoption. [EPA-HQ-OAR-2014-0827-1298-A1 p.14]

*WHR will be a viable technology to comply with the Phase 2 GHG/FE standards for tractor engines*  
[EPA-HQ-OAR-2014-0827-1298-A1 p.15]

The Agencies have identified WHR as a potential Phase 2 technology for tractor engines, and Cummins agrees with this assessment. However, we believe the Agencies underestimate the commercial viability of the technology and overstate the development challenges and timing in the Draft RIA. Cummins expects WHR systems to be commercially viable and available in production as early as 2020 and will exceed the Agencies' estimates for market penetration over the period of the rule. [EPA-HQ-OAR-2014-0827-1298-A1 p.15]

The Agencies have estimated 3.6% SET weighted CO2 reduction with WHR in tractor engines (Preamble, Table II-6). This is generally in line with Cummins experience of 4 to 5% improvement in fuel consumption on tractor drive cycles, as demonstrated in our SuperTruck program. [EPA-HQ-OAR-2014-0827-1298-A1 p.15]

The Agencies have stated that Waste Heat Recovery technology is "on the flat portion of the learning curve" (Draft RIA 2.12.2.15), particularly relating to cost reduction potential. This is incorrect. [EPA-HQ-OAR-2014-0827-1298-A1 p.15]

The WHR estimate in the NHTSA report referenced in the Draft RIA is based on references<sup>6,7,8,9</sup> that are five or more years old. Table 3 shows the development progression of WHR technology at Cummins. With each generation, improvements have addressed system cost, packaging (weight and size) and reliability. Figure 7 shows the Generation 3 system integrated in the Cummins-Peterbilt SuperTruck, which includes significantly enhanced tractor aerodynamics with WHR compared to today's truck designs. As we have continued WHR development, we have focused on a smaller system footprint, improved integration with the engine and vehicle and low-GWP working fluid, resulting in the much more compact and integrated Generation 4 system shown in Figure 8. This latest design will begin evaluation in extended customer testing by the end of 2015, and results of that experience will inform further technology development and product engineering leading to expected commercial product availability in the 2020 timeframe. Furthermore, given that the time period of the proposed rule

encompasses multiple typical product development cycles, the opportunities for further development for reduced cost and improved performance and reliability during this time period are significant. [EPA-HQ-OAR-2014-0827-1298-A1 p.15-16]

[Table 3 can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1298-A1 and figure 7 and 8 can be found on p.17 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

The Agencies should also consider how duty cycles are evolving for regional haul as well as long haul applications. Increased focus on asset utilization by regional haul fleets is significantly increasing the vehicle miles traveled (VMT) of individual vehicles in those applications, which will extend the economic viability and market potential of WHR technology beyond typical long haul applications. [EPA-HQ-OAR-2014-0827-1298-A1 p.16]

Other manufacturers are investigating WHR systems as well. In 2015, three SuperTruck programs<sup>13,14,15</sup> had WHR systems running on trucks. In 2012, Cummins Turbo Technologies<sup>16</sup> announced the development of WHR turbine expanders (Figure 9) for the HD automotive market “for specific applications on behalf of a number of customers.” [EPA-HQ-OAR-2014-0827-1298-A1 p.18]

[Figure 9 can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

WHR has significant potential for fuel saving and CO2 reduction to the benefit of truck operators and the environment. By not recognizing the evolution of design integration and component simplification at the engine and vehicle level subsequent to the cited studies, the Agencies have overestimated the cost of WHR technology in the timeframe of the Phase 2 rule compared to other available technologies and underestimated its market potential. We encourage the Agencies to apply a learning curve calculation that is more consistent with the continuing evolution of WHR system design and integration as they assess WHR relative to other technologies. [EPA-HQ-OAR-2014-0827-1298-A1 p.18]

(b) In setting the engine standards, the Agencies applied a dis-synergy factor (EPA-HQ-OAR-2014-0827-0712 Docket Memo) in their assessment of various technologies. However, the dis-synergy factor’s derivation is not described in any detail by the Agencies. Considering the importance of this factor to the engine standards, the Agencies should provide more reference data for the origin of the values used. [EPA-HQ-OAR-2014-0827-1298-A1 p.36]

Cummins uses an engine system-level modeling approach to evaluate the benefits of CO2-reduction technologies, such as those tabulated in Table 1. This inherently takes into account any synergies or dis-synergies across the individual technologies. Cummins urges the Agencies to take a similar system-level approach when evaluating engine technologies and setting engine standards to make standard-setting more explicit and to avoid the need for a separate dis-synergy discount factor. [EPA-HQ-OAR-2014-0827-1298-A1 p.36]

With respect to the proposed Phase 2 engine standards, Cummins is confident we have the engine technologies necessary to meet or exceed the required GHG/FE improvements. In fact, we expect our customers will demand even more improvement than the standards, and we are prepared to meet their demands with cost-effective and reliable products. Specifically with regard to WHR, based on recent progress we believe it can be available as a product as early as 2020. [EPA-HQ-OAR-2014-0827-1298-A1 p.42]

5 Koeberlein, David “Cummins SuperTruck Program, Technology and System Level Demonstration of Highly Efficient and Clean, Diesel Powered Class 8 Trucks,” Cummins DOE AMR 2014

6 “Reducing Heavy-Duty Long Haul Combination Truck Fuel Consumption and CO2 Emissions.’ Washington, D.C.: International Council on Clean Transportation (ICCT). October 2009.

7 National Research Council. “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles.” 2010.

8 National Highway Traffic Safety Administration. ‘Factors and Considerations for Establishing a Fuel Efficiency Regulatory Program for Commercial Medium- and Heavy-Duty Vehicles.’ October 2010.

9 ‘Assessment of Fuel Economy Technologies for Medium- and Heavy- Duty Vehicles’, TIAX report to National Academy of Sciences, November 2009

13 Gible, John, “Volvo SuperTruck – Powertrain Technologies for Efficiency Improvement,” Volvo DOE Annual Merit Review, June 2015

14 Zukouski, Russ, “SuperTruck – Development and Demonstration of a Fuel-Efficient Class 8 Tractor & Trailer Engine Systems,” Navistar DOE Annual Merit Review, June 2015

15 Singh, Sandeep, “ SuperTruck Program: Engine Project Review,” Detroit Diesel Corporation DOE Annual Merit Review, June 2015

16 <http://www.cumminsturbotechnologies.com/CTT/CTTContent/CTTUS/SiteContent/en/BinaryAsset/PDFs/Downloads/HTiEdition17.pdf>

**Response:**

The final standards are largely consistent with this persuasive comment. In particular, the effectiveness, projected penetration rate, and estimated cost of WHR technology are informed by, and consistent with this comment. In addition, for tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the tractor engine standards’ projected stringency over the baseline increased from 4.2% to 5.1% in 2027. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. Largely based on the CBI information the commenter provided together with other sources, we made changes on the cost related to WHR as indicated by Chapter 2.11.2.15 of the RIA. We agree with Cummins that an engine system-level modeling approach would be the best approach to evaluate the benefits of CO<sub>2</sub>-reduction technologies, which takes dis-synergy and synergy among all available energy into consideration. However, the agencies have added considerable detail to explain why we cannot take this approach while showing the reasonableness of our single dis-synergy factor approach. In addition to our response in RTC Section 3.4.3 below, see Chapter 2.7.5 of the RIA.

**Organization:** Daimler Trucks North America LLC

**Thermodynamic Improvements** - DTNA’s heavy duty diesel engine products have maintained a long standing status of industry leading fuel efficiency stemming from its expertise in developing engine designs utilizing leading edge combustion and controls designs. For example, today’s engine utilize

unique second generation advanced Amplified Pressure Common Rail fuel injection systems and proprietary asymmetric turbocharger / EGR control systems. Higher performing combustion systems than those currently in production have been explored in research programs supported by the Department of Energy. These programs aid in Daimlers understanding of the limitations and tradeoffs of stretch technologies between improved efficiency and both design constrains of today's materials and criteria pollutant emissions. [redacted] [EPA-HQ-OAR-2014-0827-1164-A1 p.21]

**Alternative 4 is Too Stringent and Too Fast** – Although the agencies premise their engine stringencies, including Alternative 4, on the idea of individual technologies being incorporated into engines, which is not the case. Rather, even individual changes like changing the piston bowl shape or larger changes like combustion improvements, friction reduction, or aftertreatment improvements require complete engine redesign. Unlike vehicle-side standards which may change simply because of increased penetration rates of technologies, engines require much more of a binary change—we cannot just adopt a few more new aftertreatment technologies or changes to meet the next set of standards. Rather, not until the whole engine family can change over can we radically change any one engine over. Further, any change can affect criteria pollutant emissions and must continue to deliver near zero NOx and PM emissions, plus meet the new N2O standards. Additionally, the significant time requirements to develop OBD diagnostics must be considered. On the development timeline, validation of stringent OBD diagnostics can only begin after final emissions calibrations are finalized. The consequence is that whereas prior to OBD implementation calibration changes could be refined and finalized near to production dates, now, with OBD time additional time is required after calibrations are finalized and final emissions control calibrations may have to be revisited depending on results of OBD testing. And the systems must often be tested for DFs. So, in short, we have individual changes requiring major engine redesign, drawing in the need for many other certifications and tests. Plus, we have the need to premise stringency steps on technologies that can be adopted across an entire engine family, not merely on a portion, so these constraints limit the pace at which engine standards can be tightened. [EPA-HQ-OAR-2014-0827-1164-A1 p.23]

g. Waste Heat Recovery (WHR)

- **WHR Is Not Yet Feasible For Production** - DTNA in its Super Truck program has expended considerable development effort on its waste heat recovery technology and has identified a number of areas in need of significant additional development effort or invention to reach a production viable design. These developments needs have been explained in its updates to DOE program management and to the regulators. Additional design and development effort continues to be needed relative to reducing cost, improving packaging / space claim, reducing weight, developing controls, selecting an appropriate working fluid, developing working fluid seals of sufficient reliability and durability, implementing OBD diagnostics that can be expected to be required, and achieving the necessary reliability and durability goals of its customers. The available energy and therefor the utility of WHR systems may diminish in the future. Fuel efficiency improvements from WHR are a function of available heat for recovery. Available heat for recovery is in turn a function of the engine duty cycle in its actual application and the engine's efficiency since combustion heat that is not converted to work is rejected in the form of heat to the cooling or exhaust systems. As engines are tuned for increased fuel efficiency, less heat is lost to exhaust gases, and the temperature of exhaust gas decreases. Consequently, both the heat flux to the WHR system decreases and the recoverability decreases due to the reduced exhaust gas temperature. Additionally, as aftertreatment performance is improves, EGR rates may be able to be reduced, once again reducing available heat for the WRH system. It is interesting to note that EPA proposes that benefit is available from both clutched turbocharging and from WHR. However, both technologies seek to recoup energy from the same exhaust heat source. Since these technologies compete for recovery of the same wasted heat they cannot be considered to be additive towards fuel efficiency improvement. Also countering the

efficacy of WRH technology is and will continue to be the trend towards improved vehicle efficiency. As tractor and trailer aerodynamics improve, rolling resistance of tires decreases and as drivelines become more efficient, the power demanded of the engines will also decrease. As power demand decreases so too will the available recoverable waste energy. For these reasons and others, DTNA estimates a potential of [redacted] fuel efficiency improvement in tractor applications from WHR technology. Packaging and heat rejection impacts on vehicle efficiency must be considered in assessment of WHR fuel efficiency gains from a vehicle perspective. Tractor cab under hood design must accommodate the space claim needed by additional heat exchangers integral to the WHR system and at the same time minimize the compromise to aerodynamic efficiency. EPA aggressively projects penetration of 1/5/15% in MY2021/2024/2027. DTNA at this time considers the development maturity of the technology to be inadequate to base market penetration projections with any level of confidence, and considers even a 5% penetration in MY2027 to be overly aggressive. [EPA-HQ-OAR-2014-0827-1164-A1 p.94-95]

- **WHR's Cost And Other Concerns Make the Technology Not Yet Feasible** – In section 2.7.4 of the RIA, the agencies state several concerns about WHR, including high technology cost, a need for extensive field testing to ensure reliability before the product is ready for market, and a need to gain commercial acceptance for the technology. We agree that these are concerns with the technology that suggest it should not be the basis of stringency calculations. 2.7.4 of the RIA [EPA-HQ-OAR-2014-0827-1164-A1 p.95]

- **WHR Creates Large Cooling Load That Must Be Overcome** - The agencies discussed the ability of the WHR system decreasing the cooling load on the vehicle (80 FR 40197). We disagree with the agencies position on this matter. Through testing and running a WHR system in Super Truck we have concluded that there would be a net increase in cooling burden due to the WHR system of about 30 to 40% compared to a vehicle without WHR. This is essentially because the primary waste heat source to be recovered, with reasonable heat recovery efficiency, is that of exhaust and EGR. Exhaust energy simply escapes the tail pipe on today's truck. However, with the WHR system a small portion of that exhaust energy is recovered as useful work, but at the same time a larger portion of that energy has to be rejected under hood at low temperatures through additional radiators and condensers. (See Figure 1). Our vehicles cooling packages are optimized to run with the fan off as it draws a large amount of energy. With the addition of the WHR the fan on time will increase in several drive cycle scenarios and compromise some of the recovered energy from WHR. The agencies on 80 FR 40197 also refer to recovering energy available in the coolant. This may be possible in principle, but extremely challenging and possibly impractical in reality. The low temperatures of the coolant make the heat recovery efficiency extremely low and will require impractically large heat exchangers. In summary, approaches to recover waste heat other than exhaust and EGR may prove to be very complex, impractical with low performance, and not cost effective for automotive and truck applications. The only reasonable waste heat recovery from exhaust and EGR will increase the vehicle cooling burden by 30 to 40% as describe above, has performance potential in the range of [redacted] FE improvement, and requires further R&D in several areas including reliability, durability, sealing, working fluid choice, cost effectiveness etc. [EPA-HQ-OAR-2014-0827-1164-A1 p.95]

**Response:**

Regarding the comments on WHR, we understand DTNA's concerns. We appreciate DTNA's detailed physics explanations on WHR through the law of thermodynamics and the impacts on packaging, cooling and potential high cost. We also understand that some WHR systems can have a negative impact on the cooling. On the other hand, we received data and CBI information from one engine manufacturer as well as public comments (EPA-HQ-OAR-2014-0827-1298) that shows that their WHR system could be put into production in 2021 timeframe. In addition, most of publicly available data is mainly from the DOE

SuperTruck program and indicates that WHR efficiency should be in the range of 4 to 5%, which is much higher than what we used, 3.6%. Thus, our 3.6% WHR effectiveness takes into consideration the negative impact on packaging and cooling. With the technology effectiveness of 3.6% used in the engine standards, this only translates to a total vehicle reduction of about 0.9% in 2027. Considering that the technology path proposed by the agencies is only one of many paths that can achieve the standards, this 0.9% reduction can be done by many other means. In addition to our response in RTC Section 3.4.1 below, Chapter 2.3 and 2.7 of the RIA details the justification.

**Organization:** Daimler Trucks North America, Navistar Inc., Paccar Inc., and the Volvo Group

### **Engine Test Process Considerations**

The Charlton/Walsh Paper proposes two conflicting approaches. First that down-speeding (and down-sizing) should be considered as engine technologies (recommendation 4). Second that alignment between criteria emissions and GHG emissions must be maintained (recommendation 5). The former approach requires that engine test cycles be adjusted based on the installed driveline and power demand of the vehicle. The second approach requires fixed engine cycles not connected to the vehicle application, barring a complete new approach to criteria emissions testing. In fact, vehicle OEMs fully agree that down-speeding should be an important part of the GHG regulation, and both down-speeding and down-sizing are incorporated into the complete vehicle assessment, the only feasible way to do so. We note that down-speeding, in addition to extensive transmission design and control development, requires integrated engine-transmission controls, along with engine design and optimization for low-speed torque, efficiency, emissions, and vibration. The effectiveness of down-speeding is also linked to reductions in vehicle road load, facilitated by reduced aerodynamic drag, efficient tires, and other features such as predictive cruise control. [EPA-HQ-OAR-2014-0827-1894-A1 p.4]

The conflicting arguments in the subject paper demonstrate that overly stringent separate engine standards are inappropriate, unnecessary, and counterproductive. As we have argued, it is fundamental that the engine influence on the vehicle (size, weight, cooling demand, and cost) and the vehicle influence on the engine (power demand, gearing, and controls) must be considered. Furthermore, from a purely economic perspective, OEMs should be able to develop and choose the efficiency technologies that best fit with their capabilities and expertise to meet regulatory GHG objectives and customer requirements. This will increase competition and innovative approaches while providing optimized products with greater market acceptance. EPA should support this and acknowledge that the engine specific regulation is meant to ensure a level of improvement to be achieved with minimal potential tradeoffs on other vehicle efficiency features, and to ensure some continued link to criteria emissions testing. [EPA-HQ-OAR-2014-0827-1894-A1 p.4-5]

### **Demonstration vs. Commercial Feasibility**

Most of the technologies discussed in the subject paper have only been demonstrated (or partially demonstrated) in the lab or in one-off vehicles. Such demonstrations over the years have frequently met major obstacles that prevent commercialization. These include operation under all necessary duty cycles and ambient conditions, full emissions control, real time dynamic control capability, durability and reliability limitations, and costs (including development, material, labor, amortization of development and tooling, operation, maintenance, and down time). In light duty, the most efficient production passenger cars have efficiencies from 58-88 mpg for PHEVs. The hybrid MY 2000 Honda Insight was rated at 53 mpg, Toyota Prius at 50 mpg, and the 1986 Chevrolet Sprint (1 liter, 3 cylinder, 5 speed manual) at 48 mpg. Yet the 2025 light duty standard was set at an average level of 54.5 mpg, clearly in consideration of



commercial feasibility and customer acceptance, not simply technical feasibility. [EPA-HQ-OAR-2014-0827-1894-A1 p.5]

### **Funding and Resource Allocation**

The Charlton/Walsh paper states “if this rule moves forward in its current form it will stall investment in the advanced engine technologies already demonstrated in the SuperTruck Program as providing a 15-20% reduction in GHG emissions and fuel consumption. R&D funds are a scarce resource that will be withdrawn or reallocated to other priorities.” And later, “Given the 12 year lead time to product launch in 2027 and the relaxed engine standards proposed; if this rule moves forward in its current form it will make it impossible for truck and engine OEMs and tier 1 suppliers to continue to make investments in advanced engine technologies at the levels we have seen during the past 5-10 years.” The inherent assumption here is that engine efficiency development will occur only if forced by specific engine regulation. This flies in the face of many years of intense heavy duty engine efficiency development that had occurred despite the lack of fuel efficiency regulations<sup>2</sup>. Additionally, and despite fuel efficiency being a lesser priority for light duty customers, the experience in that market has been that engine efficiency has played an important role in the vehicle efficiency portfolio, even without any engine efficiency regulations. OEMs and suppliers will allocate efficiency resources to the most productive and effective vehicle efficiency technologies (including the engine) in response to vehicle efficiency regulation and competitive pressures. Engine efficiencies with adequate payback will be developed and deployed as soon as possible, considering reliability, durability, and all the other aforementioned requirements. [EPA-HQ-OAR-2014-0827-1894-A1 p.5-6]

If OEMS and suppliers choose not to invest in engine efficiency, it can only be because such investment is judged as inadequate to meet customer and competitive expectations, or inferior to other efficiency investments to meet vehicle efficiency regulated targets. If technologies were proven and cost-effective, as the subject paper declares, these investment decisions would easily be supported. If not, then society is well ahead because better alternative investments were chosen to achieve target objectives. [EPA-HQ-OAR-2014-0827-1894-A1 p.6]

### **Dis-synergies**

Slide 8 of the presentation<sup>3</sup> related to the subject paper provides a breakdown of the supposed technology mix to support a recommended standard of 390 g CO<sub>2</sub>/hp-hr and claims this accounts for dis-synergies. Though recognizing a few minor dis-synergies, the paper fails to recognize the broad range of dis-synergies that exist within the engine alone, and within the vehicle-engine interaction. The “minor offsetting effect” from Waste Heat Recovery (WHR) is noted, when, in fact, the offset from aerodynamic impact of the cooling system (if designed for larger engines) can consume around half the efficiency benefit of the WHR system. Furthermore, since OEMs cannot afford multiple cab designs, the aerodynamic penalty is carried by all cabs, whether the installed engine is the larger available engine or not, and whether that engine is using WHR or not. This impact is not necessarily seen when packaging WHR into existing cabs, but becomes clear when comparing future optimized aero cabs with and without provision for WHR. Volvo has done this and finds about a 2% loss of fuel efficiency (4% drag increase) associated with cabs designed to accommodate a larger engine with WHR both due to the frontal area required and the impact on air flow through the cooling package and engine compartment. The negative aerodynamic impact is greatly increased for day cabs if packaging requires extension of the wheel base resulting in an increased trailer gap (already an issue due to packaging emissions equipment and for natural gas fuels systems). In the end, this means that for vehicles produced using a cab/hood designed to be WHR capable, the CO<sub>2</sub> reductions achieved by those actually equipped with WHR are likely to be

negated by the population sold where WHR is not inappropriate for the application, yet the vehicle is bearing the efficiency penalty of being WHR capable. [EPA-HQ-OAR-2014-0827-1894-A1 p.6-7]

There are many other significant dis-synergies:

- Down-speeding or down-sizing greatly reduces friction and pumping losses, and therefore the potential benefits to be gained from additional friction and pumping reduction technologies. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Down-speeding below what is already applied in certain down-spiced production drivetrains provides minimal additional efficiency and compromises available exhaust backpressure required to drive EGR needed to control NOx. Correcting this will drive up pumping losses. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Continuous improvement in combustion efficiency, vehicle aerodynamic drag, driveline efficiency, tire rolling resistance, and more will diminish available exhaust energy for WHR. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Use of turbo-compounding reduces exhaust temperature for Rankine waste heat recovery and for effective NOx catalysis. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Improvements in combustion efficiency via increased cylinder pressure will increase bearing and piston ring loads which results in increased friction losses which counteract benefits. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Conventional combustion efficiency improvements drive up flame temperature and NOx formation. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Higher injection pressure for combustion improvement significantly increases pumping power losses to the injection system. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Low temperature combustion (homogenous, premixed, partially premixed) requires massive EGR to control ignition timing and to avoid excessive rates of heat release such that the combustion efficiency benefits are largely consumed by the pumping losses. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- Down-speeding and down-sizing cannot be measured on fixed engine test cycles, so must be considered in the vehicle simulation, not a separate engine test. In fact, down-sizing has a small negative impact on efficiency when measured on a cycle that is proportional to the engine's power output (rather than vehicle power demand) due to well-established physics that heat transfer losses are proportionally reduced in larger engines. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]
- It is incorrect to compare best point BTE (brake thermal efficiency) to cycle efficiency since the effectiveness of many technologies is significantly lower on the actual operating cycle than at the best operating point. [EPA-HQ-OAR-2014-0827-1894-A1 p.7]

### **SwRI Study and Proposed Engine Efficiency Target**

Due to these dis-synergies, single technology engine efficiency gains cannot be added together, but must be considered as a system including the vehicle impacts, control of criteria emissions, and all other

requirements. The SwRI study referenced in the subject paper took this approach, although the authors could not fully account for the impacts of many requirements. Relative to this, the Charlton/Walsh paper notes first: “The study included a literature review to identify potential fuel saving technologies and to assess the state of the art. A large number of engine and vehicle technologies were selected for analysis, and their fuel saving performance was simulated to assess the fuel savings potential of each technology over a wide range of duty cycles.” But later the paper says: “The study is simply exploring the parametric design space, and makes little attempt to assess or extrapolate the state of the art between 2015 and 2027.” [EPA-HQ-OAR-2014-0827-1894-A1 p.7-8]

In fact, the charter given to SwRI includes “...assessing the effectiveness and cost of potential fuel efficiency/GHG improving technologies for the Phase 2 timeframe (post MY 2018 for vehicles and engines). When considering potential fuel efficiency/GHG-reducing technologies, NHTSA directed SwRI to include a range of factors: design, functionality, duty cycle, use (type of work done by the vehicle), and factors that can influence the effectiveness, feasibility, and cost. Vehicle safety, utility, and performance are also to be considered.”<sup>4</sup> [EPA-HQ-OAR-2014-0827-1894-A1 p.8]

SwRI fully considered both the available literature on engine efficiency research as well as their own extensive internal research programs in developing their recommendations. However, these were tempered by the requirements to consider effectiveness, feasibility, cost, safety, utility, and performance, all areas that the Charlton/Walsh paper chooses to ignore. [EPA-HQ-OAR-2014-0827-1894-A1 p.8]

The SwRI study concludes that a reasonable goal of 44.6-45.9 cycle brake thermal efficiency (BTE) is achievable with known technology, but includes down-speeding to 1051 rpm at cruise speed. Although the reweighted RMC does provide some impact from down-speeding, it is nowhere near this aggressive. Hence the regulated limit for 2027 of 44.6 BTE (with a reweighted RMC that does not fully account for down-speeding to the extent considered by SwRI) is entirely justified. [EPA-HQ-OAR-2014-0827-1894-A1 p.8]

The revised version of the SwRI report<sup>5</sup> notes that an error was made in the first report relative to the baseline version of the engine. Quoting from the revised report: [EPA-HQ-OAR-2014-0827-1894-A1 p.8]

“The results presented in this section have been revised since the original draft version of the report. Three errors were discovered during the independent peer review and public release of the draft report that have been corrected in this final version. The first error was the use of the wrong fuel map to represent the model year 2019 DD15 engine baseline. The fuel map inadvertently used was a model year 2011 baseline turbocompound engine with a 1% benefit from combustion duration, but otherwise unchanged. The analysis for this section should have used a fuel map representative of the more efficient 2013 DD15 engine as the baseline to allow exploration of improvements beyond the Phase 1 standards.” [EPA-HQ-OAR-2014-0827-1894-A1 p.8]

The revised report further notes:

“The revised results included in this version of the report show the following effects: [EPA-HQ-OAR-2014-0827-1894-A1 p.9]

- There is now a larger difference between the 2011 and 2019 DD15 baseline engine results, particularly on the CARB and WHVC cycles [EPA-HQ-OAR-2014-0827-1894-A1 p.9]
- The fuel savings benefits of all the DD15 technology combination packages are reduced by up to 3.3% depending on the technology packages and driving cycles compared to the original draft, primarily

because the post-Phase 1 2019 DD15 baseline now has lower fuel consumption [EPA-HQ-OAR-2014-0827-1894-A1 p.9]

- The relative benefit of waste heat recovery is essentially unchanged.” [EPA-HQ-OAR-2014-0827-1894-A1 p.9]

Although this revision does not affect the SwRI recommended engine BSFC capability, it does significantly reduce the relative benefit of further engine improvements beyond the 2019 baseline engine. This further supports our contention that efficiency expectations should be focused on the integrated vehicle, not the engine alone. [EPA-HQ-OAR-2014-0827-1894-A1 p.9]

### **History of Long-range, Technology Forcing Regulation**

The Charlton/Walsh Paper points to the promulgation of the 2010 emissions standards in 2001: “This very successful program is an outstanding example of technology forcing standards combined with adequate lead time, and the commitment of industry. “ The reality is that the industry was so concerned about the weakness of the technology feasibility demonstration EPA performed to support this rule that Cummins, the largest supplier of diesel engines to the US heavy-duty market at the time of that rulemaking, challenged that 2007/2010 rule in court, arguing according to court documents that “...no NOx control system will be capable of meeting the EPA's 2007 standards.”<sup>6</sup> And later, Cummins argues “...the EPA acted arbitrarily and capriciously in concluding that engine manufacturers will be able to develop emissions-control systems satisfying the new rule.” We would argue that today’s level of development of waste heat recovery and stop-start technologies is no further advanced for the typical manufacturer of heavy-duty engines to the US highway vehicle market than EPA’s proposed Lean NOx Trap technology was at the time that it served as the basis of the 2007/2010 rule. [EPA-HQ-OAR-2014-0827-1894-A1 p.9]

In the end, this “very successful program” involved the deployment of completely different NOx control technology than the Final Rule envisioned (SCR rather than LNT). In the end, when coupled with the 2007 product cost increases, the full scope of the EPA “clean diesel” program drove up class 8 vehicle purchase and maintenance cost by as much as 40%, more than doubled engine system cost, increased lifetime operating cost (including downtime) around \$20K, and resulted in customers purchasing a high volume of trucks prior to 2007 to avoid the new technologies and cost increases associated with the 2007 engines. This no-buy in 2007 resulted in large-scale layoffs of manufacturing workers. This is an example that should temper any viewpoint that we can accurately forecast long-range technology, costs, or market reaction. [EPA-HQ-OAR-2014-0827-1894-A1 p.9-10]

In Table 1, we can see the impact of the 2007 engine launch that introduced diesel particulate filters to meet a 90% reduction in the PM standard. Among the consequences was an almost 50% reduction in the heavy-duty OEM labor force, with corresponding impacts on suppliers, and a cascading effect on the overall economy. [EPA-HQ-OAR-2014-0827-1894-A1 p.10]

[Table 1 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1894-A1]

### **Rankine Waste Heat Recovery**

The Charlton/Walsh Paper states “WHR technology is an important component of the technology package that can deliver a 15% or greater reduction of GHG emissions and fuel consumption by 2027, as recognized by NAS 21CTP Report #3, September 11, 2015 [41].” Aside from the fact that the NAS report does not say WHR can deliver 15%, most reports on WHR systems that exploit all available heat sources

show between 3 and 6% efficiency gain on optimal vehicle duty cycles, not considering the negative impacts to vehicle weight, cooling and aerodynamics already discussed in the section above on dis-synergies. WHR efficiencies are highly dependent on operating conditions -- load, speed, terrain, and ambient temperature. [EPA-HQ-OAR-2014-0827-1894-A1 p.10-11]

The paper states: "...the only valid meaning of 'adoption rate' is in determining which real world applications should logically be included and excluded on the basis of effectiveness. In the case of WHR there is broad agreement that line-haul tractor trailer applications and heavy-haul applications (at least) will benefit from adoption of WHR. These applications form a high percentage of the Class 7-8 fleet (greater than 65%)." In fact EPA has correctly recognized that WHR effectiveness and therefore adoption rate depends on a large number of factors, including the installed engine size (impacting BMEP, exhaust temperature, and cooling demand), vehicle load factors, terrain (less effective in rolling hills), ambient temperature (avoid excessive radiator temperatures), and customer acceptance (if forced into the market, customers may delay purchases). [EPA-HQ-OAR-2014-0827-1894-A1 p.11]

The SwRI study notes that:

"Some of key technologies, such as waste heat recovery, would not be effective for a day cab engine, and therefore the overall benefits over the agencies' certification categories would be further reduced." [EPA-HQ-OAR-2014-0827-1894-A1 p.11]

"Because bottoming cycles have very slow transient response, there is a large drop-off in fuel savings between a steady-state test cell evaluation and real, on-road performance under transient conditions. The model does not include the effects of transient response, so the bottoming cycles were not run on the more transient drive cycles (CARB and WHVC). Real world performance of the bottoming cycles will be hurt by transient response issues, even at steady speed operation. Steady speed rarely involves steady load." [EPA-HQ-OAR-2014-0827-1894-A1 p.11]

Furthermore, all indications are that long-haul trucking will be reduced as a fraction of total US road freight, as more marine shipments are delivered to ports on the Gulf of Mexico and Atlantic coast and more long-haul freight is delivered by rail. The growing regional road freight hauls are more constrained by traffic and rolling terrain, which is less conducive to effective deployment of WHR. Packaging of WHR systems in day cabs may also introduce further aerodynamic losses if extended wheelbases result in larger trailer gaps. These factors must be considered in establishing penetration expectations. [EPA-HQ-OAR-2014-0827-1894-A1 p.11]

Without firm designs, cost estimates for WHR systems are likely to be significantly under-estimated, as is typical for any early design estimate. Costs almost always inflate as the complexity of real world requirements drive up need for more robust designs, sensors, controls, control hardware, and complete vehicle integration. Development costs will be huge and must be amortized with limited volumes. Furthermore, the industry experience with such complex systems is that maintenance, repair, and down-time cost can be much greater than the initial purchase cost. [EPA-HQ-OAR-2014-0827-1894-A1 p.11]

## **Combustion Efficiencies**

The subject paper quotes the RIA: "Alternative combustion processes such as homogeneous charge compression ignition (HCCI), premixed charge compression ignition (PCCI), low-temperature combustion (LTC), and reactivity controlled compression ignition (RCCI) technologies were not included in the feasibility analysis for Phase 2." It then goes on to criticize: "Given the significant research efforts on advanced combustion (Appendix A, Figure 17) and the progress being demonstrated [27, 28, 31], it is

to be expected that some level of improvement in combustion technology will bleed through into product development programs over the next 12 years, providing reductions of GHG emissions and fuel consumption.” [EPA-HQ-OAR-2014-0827-1894-A1 p.11-12]

The reality is that, despite many years of heavy research within industry and academia, the promise of low temperature combustion (including HCCI, PCCI, LTC, and RCCI) has not materialized. The fundamental problem with these technologies is that ignition timing and rate of combustion are no longer managed by fuel injection timing and rate. Instead, combustion control must be managed by control of the intake charge mixture and temperature, typically by managing EGR rate, carefully timed multiple fuel injections, and/or mixtures of various fuels, all of which must react to rapid changes in load, varying ambient conditions, and varying fuel properties. There is no assurance that this will ever be effectively managed outside of controlled lab conditions, much less within some assumed time frame. Furthermore, as previously mentioned, the required high rate of EGR increases pumping losses, negating much of the claimed benefit, barring some new breakthrough in turbocharger efficiency. [EPA-HQ-OAR-2014-0827-1894-A1 p.12]

### **SuperTruck and the National Academy Sciences Report on 21st Century Truck Program**

In comparing what SuperTruck has accomplished, it is necessary to separate what is accomplished by engine, tractor, and trailer technology from simply carefully controlling the vehicle’s operation. In fact, there are reports of production trucks in commercial operation today that achieve an average between 9 and 11 mpg with loads above 60,000 lbs.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1894-A1 p.12]

Furthermore, SuperTruck had no requirement for commercial feasibility or full regulatory compliance such as deterioration or OBD. Cost, maintenance, reliability, and durability were not considered, though they are key factors for market readiness and customer acceptance. SuperTruck vehicles were not developed to be driven in the same manner as a production vehicle and, indeed, these prototype designs are not representative of production-level components capable of full service life. SuperTruck sets the bar for future R&D toward potential commercialization of some technologies, but certainly does not demonstrate commercial feasibility to meet customer product longevity expectations. SuperTruck technologies were focused on specific long-haul duty cycles that showcased the best possible efficiency gains. Furthermore, the 50% BTE target was required only at a single operating point, not over the engine’s typical operating range or certification test cycles. In reality, the truck market has widely differing application requirements. SuperTruck should be viewed as creating a menu of potential technologies, not a formula for the majority of trucking applications. [EPA-HQ-OAR-2014-0827-1894-A1 p.12-13]

Figure 1 shows a typical tractor engine map. This is a representative 2018MY tractor map available in the EPA GEM simulation model that is used to set the baseline for the GHG Phase 2 regulations. The modes for the RMC are overlaid and show the weighting as proposed in the NPRM. From this figure it is clear that the authors have extrapolated the achievements of SuperTruck in their recommendation of 50% BTE in the RMC cycle. At the A-speed, which is the highest weighted speed, the BTE of a typical engine that meets 2017MY GHG will range from 39% at the lower torque to a maximum of 46% at the 75% load point. In order for such an engine to meet a composite number of 50% with the assumption of a flat map the part load points would need to improve over 11% efficiency points and this is without the appropriate engineering margins. Furthermore, the assumption of a flat map is counter to the physics and the optimization of the systems that support the function of the engine as is demonstrated by what EPA considers state-of-the-art today. Within the space of the RMC cycle, excluding the idle point, BTE ranges from 34% to the maximum already stated of 46%. Hence, in the event that a manufacturer had to design for the 50% BTE, the engine would have to significantly exceed the achievements of the SuperTruck

program by having the cruise point be well above 55% BTE in order to achieve the composite number given the typical shape of the map. [EPA-HQ-OAR-2014-0827-1894-A1 p.13]

[Figure 1 can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1894-A1]

### Stringency

The Charlton/Walsh paper recommends engine stringency stretching to 50.4% brake thermal efficiency (BTE) over the test cycle by 2027. As already discussed, the regulated GHG emissions and efficiency targets are based on the engine cycle average, not at a single operating point at or near the best BTE. Since the cycle average includes operation at light load and higher speeds, the best point BTE would likely need to be about 54-55% to achieve 50.4% cycle average BTE. Such a level has never been demonstrated by a multi-cylinder heavy-duty on-highway diesel engine, even in a controlled lab setting. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]

According to the paper:

“To achieve these technology forcing standards it will be necessary for the following technologies to be developed:“ [EPA-HQ-OAR-2014-0827-1894-A1 p.14]

- *Waste Heat Recovery / Organic Rankine Cycle*

Comment: This technology is already included at appropriate penetration in the NPRM targets. Negative impacts on aero design and application limits must be considered. [EPA-HQ-OAR-2014-0827-1894-A1 p.14]

- *Advanced Combustion*

Comment: Presumably this refers to Low Temperature Combustion. See previous comments on this technology. [EPA-HQ-OAR-2014-0827-1894-A1 p.15]

- *Reduced Frictional Losses*

Comment: This will be part of the package to achieve standards. Note that down-speeding and down-sizing reduce effectiveness. Increased cylinder pressure and injection pressure increases frictional losses. [EPA-HQ-OAR-2014-0827-1894-A1 p.15]

- *Reduced Accessory Losses*

Comment: This is not part of the engine test cycle and should be considered at vehicle level. [EPA-HQ-OAR-2014-0827-1894-A1 p.15]

- *Reduced Open Cycle Losses*

Comment: There is no explanation of what this is. It seems to be another name for combustion improvement and reduced pumping. [EPA-HQ-OAR-2014-0827-1894-A1 p.15]

- *Engine Design for Down-speeding*

Comment: Down-speeding impact is already included within the vehicle GHG standard and cannot be measured on fixed engine cycles. Down-speeding efficiency impact, as shown on the plot, is approximately 2% when lowering cruise RPM from 1400 to 1100. Further down-speeding provide little additional efficiency based on known engine technology, but does drive up NOx due to operation below levels at which EGR can be pumped. [EPA-HQ-OAR-2014-0827-1894-A1 p.15]

[Figure 2 can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1894-A1]

Figure 3 shows the substantial increase in engine out NOx as engine speed is lowered and torque is increased. To operate at speeds below 1000 rpm requires significantly increased SCR efficiency and urea consumption that more than offsets any added fuel savings. [EPA-HQ-OAR-2014-0827-1894-A1 p.16]

[Figure 3 can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1894-A1]

Relative to down-speeding the subject paper states: “While the agencies have acknowledged that engine downspeeding is a key technology trend and have modified the engine test cycle to reflect this trend, they have failed to include the CO2 and fuel consumption savings in the stringency of the engine limit standards. In fact quite the opposite – by changing the test cycle the agencies have relaxed the stringency by 1-2% (section 3.2.1). By not including downspeeding in setting limit standards for engines, they have in effect further relaxed the standards – by as much as 2-4% per SWRI report #1 [42]. The combined relaxation is 3%-6%, which exceeds the overall reduction proposed in the NPRM [14]. Even by the agencies estimate of 1.8% reduction due to downspeeding, the combined relaxation is 2.8%-3.8%.” [EPA-HQ-OAR-2014-0827-1894-A1 p.16]

It is illogical to say that the engine standard has somehow been relaxed because down-speeding is not included in the engine standard limits, especially since the engine test cycle cannot measure the impact of down-speeding. Down-speeding is correctly included in setting the vehicle standards, where it is measured within the Greenhouse Gas Emissions Model (GEM). [EPA-HQ-OAR-2014-0827-1894-A1 p.16-17]

The subject paper cites a master’s thesis from Chalmers University<sup>8</sup> to support claims that down-speeding can provide up to 3.38% improvement in efficiency. There are serious problems with the methodology in this paper. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]

First, this work is done only via simulation, and much of the efficiency improvement results from reduced in-cylinder heat transfer that supposedly results from reduced gas velocities at lower engine speed. What this fails to account for is the increased time for heat transfer or to effectively account for impacts of swirl. In-cylinder heat transfer is notoriously difficult to model, and improved models (proprietary within Volvo Group) since the Chalmers paper do not support the claim of reduced heat transfer. An engine efficiency expert within Volvo stated “this model response is seriously wrong when looking at rpm changes.” [EPA-HQ-OAR-2014-0827-1894-A1 p.17]

Much of the improved efficiency in the Chalmers paper comes from additional technologies, not just down-speeding. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]

- Peak cylinder pressure is increased by 25%. This can improve combustion efficiency, but requires total redesign of the cylinder head, head gasket, piston, rings, rod bearing, main bearing, crankshaft, and block. In short, this requires a complete engine redesign that is problematic and unproven. Furthermore, without some break-through in bearing technology, the increased size of the bearings will increase friction. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]



- Turbochargers (two stage turbos are used in this study) are re-matched to low speed operation. This would greatly reduce power and efficiency at higher speeds and loads that are still required when hauling heavy loads or on steep hills. Without this re-matching, it would not be feasible to drive the EGR necessary to control in-cylinder NO<sub>x</sub> at such low engine speeds. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]
- Torque response is greatly compromised due to reduced mass flow. This will further exaggerate the drivability problem associated with lack of power at higher engine speeds. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]
- Torque is increased to 3250 Nm at engine speed down to 850 rpm (compared to current engine at 2500 Nm at 1050 rpm). Aside from the problems with cylinder pressure already noted, this will create unresolved issues with engine and driveline vibration. [EPA-HQ-OAR-2014-0827-1894-A1 p.17]

In short, the design of this ultra-down-spiced engine requires infeasible design trade-offs, unproven technologies, and double counts combustion improvements already accounted for. Even so, the model greatly overstates the benefits and is not backed up by any testing. In fact, the current level of down-speeding in US trucking is already near the optimum level with little more to be gained, barring new technology breakthroughs. [EPA-HQ-OAR-2014-0827-1894-A1 p.17-18]

- *Advanced NO<sub>x</sub> and PM Aftertreatment*

Comment: Expect any advances in this area to be consumed by future lower NO<sub>x</sub> expectations [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

- *Advanced Adaptive Controls*

Comment: It is unclear how these might be factored into any test process, especially until it is clear what these might be. Adaptive control cannot be considered within fixed engine test cycles. [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

- *Advanced Sensors*

Comment: Sensors contribute nothing to FE unless utilized for advanced combustion and control. Advanced sensors (and actuators) will be necessary, but lack of these is a barrier to commercialization. [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

- *Increased Turbocharger Efficiency*

Comment: Although more efficient turbochargers can be built (at significant cost), it is unclear that they can maintain high levels of efficiency due to abrasion of blades and carbon build up. In order to be effective, high turbo efficiency must be coupled with turbo-compounding or new EGR systems. Otherwise, there is likely insufficient exhaust back pressure to drive EGR. [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

### **Input from DOE Efficiency Symposium presented at DEER, Oct. 2011**

Although there are countless publications on combustion engine efficiency, one study is particularly significant. On March 3-4, 2010, the US Department of Energy gathered top engine efficiency experts

from around the world with the express purpose of establishing the maximum potential efficiency that might ultimately be achieved.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

On page 11 the symposium presentation states: [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

“Increasing engine efficiency involves a Whack-a-mole (or Gopher) approach.”

“Reduction of one loss term tends to result in an increase of another, for example,...Reducing in-cylinder heat loss tends to increase exhaust energy rather than piston work Lean operation increases piston work but increases combustion irreversibility and decreases exhaust energy” [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

This is clearly stating that the dis-synergies are critical considerations in increasing efficiency. [EPA-HQ-OAR-2014-0827-1894-A1 p.18]

Although the consensus was that 60% best-point BTE might be the upper limit for a conventional crank-slider engine, it was fully acknowledged that this is a theoretical limit with many practical constraints. Each further incremental step toward this limit requires tremendous engineering effort and potentially complex systems with high cost and unreliability. Furthermore, it was acknowledged that larger engines are inherently more efficient, while power density and an engine optimally sized for vehicle power demand create constraints on engines for on-road operation. Also, NO<sub>x</sub> emissions were not considered in these discussions. [EPA-HQ-OAR-2014-0827-1894-A1 p.18-19]

Some key conclusions are noted on page 25 of the presentation, reproduced here: [EPA-HQ-OAR-2014-0827-1894-A1 p.19]

[Figure can be found on p.19 of docket number EPA-HQ-OAR-2014-0827-1894-A1]

Earlier in the presentation on slide 15 in a discussion about the irreversible nature of the internal combustion process, the presenter concludes: [EPA-HQ-OAR-2014-0827-1894-A1 p.19]

“Significant reductions (in fuel consumption) will require radical changes in how combustion occurs in engines: Thermochemical recuperation, staged reactions (chemical looping), etc.” [EPA-HQ-OAR-2014-0827-1894-A1 p.19]

These viewpoints from this group of global internal combustion engine experts highlight the level of complexity, dis-synergy, and unsolved technical challenges that stand in the way of achieving extreme levels of brake thermal efficiency. [EPA-HQ-OAR-2014-0827-1894-A1 p.19]

### **Conclusion:**

Although there is tremendous speculation about the potential for heavy duty diesel engine efficiency improvement, this is accompanied by a huge number of unsolved issues, including whether any technology can reliably and effectively manage the full range of requirements while avoiding offsetting efficiency penalties in the vehicles. Impacts on reliability, cost, downtime, and maintenance must be considered. The ability of the engine to meet criteria emissions limits and related requirements, including certification, in-use requirements, OBD, and deterioration, must be taken into account. The effectiveness of each technology must be considered in setting target penetration levels. Many engine technologies are only possible when combined with the vehicle drivetrain and all should be evaluated against the steadily

reducing power demand dictated by the Phase 2 proposed rule. [EPA-HQ-OAR-2014-0827-1894-A1 p.20]

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2 For a more complete analysis of advantages offered by vehicle simulation approach, see SAE 2015-01-2772, Kopin and Musselman, “Complete Vehicle Standards for Heavy-Duty Trucking: Optimizing Freight Efficiency Benefits to Meet U.S. Greenhouse Gas Emission Standards.”

3 <http://www.regulations.gov#!documentDetail;D=EPA-HQ-OAR-2014-0827-1472> Note that this document appears to contain additional detail to the Charlton/Walsh Paper, and was posted to the docket on February 1, 2016.

4 <http://www.regulations.gov#!documentDetail;D=EPA-HQ-OAR-2014-0827-0554>

5 Final Southwest Research Institute Report to NHTSA: Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study - Report #2 <http://www.regulations.gov#!documentDetail;D=EPA-HQ-OAR-2014-0827-1623>

6 National Petrochemical Refiners Ass’n. v. EPA, 287 F.3d 1130, 1137 (D.C. Cir. 2002)

7 <http://www.overdriveonline.com/topping-10-mpg-former-trucker-of-the-year-blends-driving-strategy-equipment/>

8 <http://publications.lib.chalmers.se/records/fulltext/147782.pdf>

9 A summary report from this work can be found at: [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/deer\\_2011/wednesday/presentations/deer11\\_edwards.pdf](http://www1.eere.energy.gov/vehiclesandfuels/pdfs/deer_2011/wednesday/presentations/deer11_edwards.pdf)

**Response:**

We appreciate the comments made by these four major vehicle OEMs. While we believe that the separate engine standard is necessary, we do agree significantly with most of the points that the four major vehicle OEMs have made. We agree with their assessment of the SwRI report. More importantly, the SwRI findings, specifically their revised report, supports the agencies’ stringency when taking the agencies’ certification procedure including vehicle weight, and cycle weighting factors, and WHR market penetration, into consideration. We also largely agree with this report’s statements on DOE’s SuperTruck program, which are solely used for technology demonstration in an R&D environment. We also appreciate their comments on many items, including the sections on demonstration vs. commercial feasibility, funding resource and allocation, and dis-synergy. We agree in principle with the commenter’s comments on down-speeding, specifically that the Walsh/Charlton report on down speeding is impractical. We also found that many technical comments on various technologies, such as WHR, combustion with HCCI and PCCI concepts, friction, adaptive control, and advanced NOx and PM control are extremely helpful. These comments have further helped us to justify why we cannot use the Charlton/Walsh report as our base to increase the stringency to the level they recommend. See also response to EDF in Section 3.3.1 above.

**Organization:** Diesel Technology Forum

## **1. NEW CLEAN DIESEL TECHNOLOGY WILL CONTRIBUTE TO FURTHER EFFICIENCY GAINS AND CONTINUE TO BE THE PRIMARY POWERTRAIN FOR COMMERCIAL VEHICLES.**

More than 95 percent of all heavy duty trucks on the road today are diesel-powered as are a majority of medium duty trucks. Advances in diesel engine technology will continue to contribute to the overall efficiency gains of vehicles under the proposed rule, and as a result we expect diesel technology to remain the primary power-plant for commercial trucks into the foreseeable future. Diesel will continue to be the technology of choice because it offers an unmatched combination of power, increasing energy efficiency, work capability, reliability and now near-zero emissions environmental performance, along with an ability to utilize a variety of low-carbon renewable diesel fuels. [EPA-HQ-OAR-2014-0827-1171-A2 p.1-2] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.120-121.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.108-109.]]

Since 2000, the leaders in clean diesel technology and the EPA worked together in establishing a regulatory pathway that brought about the introduction of an entire new generation of clean diesel engines for both on- and off-road applications. Manufacturers have met the challenge to virtually eliminate both NOx and particulate emissions from diesel engines, reducing emissions by as much as 98 percent from previous levels. [EPA-HQ-OAR-2014-0827-1171-A2 p.2] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 121.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.109.]]

In fact, last year the American Lung Association, in its annual State of the Air Report identified cleaner diesel fleets as one of the two main contributors to helping the nation achieve cleaner air and meet the national ambient air quality standards for ozone and particulate matter. [EPA-HQ-OAR-2014-0827-1171-A2 p.2] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 121.]]

[Image, 'Clean Diesel', can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1171-A2]

These new technology clean diesel engines are being widely embraced by customers as evidenced by the increasing penetration into the vehicle population. According to state vehicle registration data for 2014, of the roughly 9.2 million Class 3-8 heavy-duty vehicles on the road nationwide, about 37 percent, or 3.4 million vehicles are deployed with a 2007 or newer model year engine. Of these, almost 21 percent or roughly 1.9 million vehicles on the road meet the 2010 emissions milestone that requires near zero levels of both particulate matter and nitrogen oxide emissions.<sup>1</sup> [EPA-HQ-OAR-2014-0827-1171-A2 p.2-3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 121.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.109-110.]]

Illinois is a leader in adoption of new clean diesel technology: 40 percent of class 3-8 trucks on the road are 2007 and newer making Illinois number 4 in the country for the largest population of heavy duty diesel trucks model year 2007 and newer (130,432). Twenty-one percent (58,157) are 2010 and newer making it 5th in the nation for registration of 2010 and newer commercial trucks. [EPA-HQ-OAR-2014-0827-1171-A2 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 121.]]

Last year (2014) was a very strong year for new truck sales across the industry, with over 186,000 new medium duty trucks sold (Class 4-7) along with over 230,000 heavy-duty (Class 8) trucks sold. The overwhelming majority of these vehicles are powered by clean diesel technology with just a few thousand units powered by other fuels. [EPA-HQ-OAR-2014-0827-1171-A2 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 122.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.109.]]

According to the Fuels Institute, as of 2013, diesel represents about 98 percent of the engines found in medium and heavy-duty vehicles including those that are covered by the proposed rule. By 2023, the Fuels Institute estimates that diesel engines will power between 95 and 97 percent of these vehicles despite the introduction of alternative fuels and powertrains including all-electric, fuel cell and continued introduction of natural gas powered vehicles. [EPA-HQ-OAR-2014-0827-1171-A2 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 122.]]

## **2. CLIMATE, FUEL SAVINGS AND CLEAN AIR BENEFITS FROM NEW TECHNOLOGY DIESEL ENGINES IN COMMERCIAL TRUCKS IN OPERATION TODAY ARE SIGNIFICANT AND GROWING**

New diesel technology on the road today is delivering real world benefits in the form of fuel savings and reducing carbon emissions. According to research commissioned by the Diesel Technology Forum, in just the last four years—between 2010 and 2014-- technologies developed to meet strict emissions standards beginning for model year 2010 engines have generated substantial fuel savings and emission reductions. [EPA-HQ-OAR-2014-0827-1171-A2 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p. 122.]] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.110-111.]]

Now 18 months into the first ever fuel economy and greenhouse gas reduction rules for these medium and heavy-duty vehicles – the so called Phase 1 rules – are expected to save 530 million barrels of crude oil and eliminate 270 million tons of carbon emissions between 2014 and 2018 according to EPA and NHTSA. In this population of vehicles, diesel is the predominant powertrain found in about 98% of trucks. Industry estimates have diesel maintaining over 90 percent of this market over the lifetime of the rule. [EPA-HQ-OAR-2014-0827-1171-A2 p.3]

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1 <http://www.dieselforum.org/index.cfm?objectid=090207D5-01F9-11E4-91B7000C296BA163>

### **Response:**

We appreciate Diesel Technology Forum's comments.

**Organization:** Diesel Technology Forum

Advanced truck and engine designs that reduce emissions provide significant fuel savings for their owners and clean air benefits for everyone. [EPA-HQ-OAR-2014-0827-1171-A2 p.6]

Now achieving near zero emissions, clean diesel technology powers the overwhelming majority of medium and commercial trucks today and thanks to these improvements, is poised to continue as the prime powertrain technology for commercial vehicles in the future. [EPA-HQ-OAR-2014-0827-1171-A2 p.6]

The engine may look and perform somewhat differently, and may be burning different kinds of low carbon fuels. But in the end, it will still be a diesel engine and an integral component of meeting the needs of a growing economy and a cleaner and more sustainable future. [EPA-HQ-OAR-2014-0827-1171-A2 p.7]

**Response:**

We appreciate Diesel Technology Forum's comments.

**Organization:** Diesel Technology Forum

**California Clean Diesel Adoption and Benefits**

With one of the largest medium and heavy duty fleets in the country, California stands to benefit the most from these proposed Phase 2 rules. Already, model year 2010 and newer engines that are found in Class 3 – 8 vehicles in the state have eliminated 120,000 tons of NOx and 580,000 tons of carbon dioxide and saved 1.4 billion barrels of crude oil between 2010 and 2014, according to our most recent research. According to the Air Resources Board, the further adoption of new and newer diesel engines in heavy-duty applications in California is expected to reduce emissions of oxides of nitrogen by fifty percent between 2012 and 2020. [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows: [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

- **The program must consider the longstanding trade-off between NOx and CO2.** The rule should avoid driving technologies that realize gains in fuel efficiency at the expense of NOx, reversing the huge achievements of clean diesel technology in recent years and limiting the potential for further reductions in the future. As we have stated previously, technologies developed to meet the current emission standard established for model year 2010 maximize reductions in NOx and CO2. The maximization of this trade-off may become jeopardized if pushed too far. [EPA-HQ-OAR-2014-0827-1171-A2 p.6]

**Response:**

We appreciate Diesel Technology Forum's comments. We will work with all stakeholders to explore the trade-off between NOx and CO<sub>2</sub>. See also response in RTC Section 15.8.

**Organization:** First Industries Corporation

The following EPA-proposed penetration rates are too aggressive and in our estimation must be adjusted downward: [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

Waste Heat Recovery: 15% - Waste heat recovery technology is not currently in the market, has technical challenges for which production-viable solutions have not been identified, and is therefore not proven. Customers are concerned with the complexity of the system as well as likely downtime, which will prevent uptake of this non-proven technology. This is the type of technology that is likely to cause a pre-buy/no-buy scenario. EPA should not assume any penetration of waste heat recovery technology by 2027. [EPA-HQ-OAR-2014-0827-1145-A2 p.2-3]

The estimated costs of the following technologies as presented in the proposed rule are too low: [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

Waste Heat Recovery — EPA assumes this technology will cost up to \$11,000. Because waste heat recovery is not currently in the market, the actual costs are unknown. However, step changes in

technology typically cost more. Moreover, the additional costs for maintenance and downtime need to be accounted for in the rule. With the phase-in implementation of new emission standards in 2007, fleets saw substantial extra costs in terms of missed loads, late loads, etc. Fleet owners also risk losing drivers if they are operating with new, unproven technology, and other fleets are operating with proven technology. This is a major reason fleets will pre-buy to avoid such technology. It is also a major cost that must be accounted for in the rule. EPA must also recognize that the potential benefits of waste heat recovery vary substantially depending on the duty cycle and powertrain. [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

**Response:**

We recognize the WHR concerns of First Industries Corporation. Downtime and cost are two of the many key concerns, specifically for an emerging technology that has not been extensively tested on the market. We explain in RIA Chapter 2.3.9 how these challenges can be successfully met in the lead time provided by the Phase 2 rule. We received data and CBI information from one engine manufacturer as well as public comments (EPA-HQ-OAR-2014-0827-1298) that shows that their WHR system could be put into production in 2021 timeframe. Given their large market share in the class 8 engine sector, a 25% market share utilizing WHR by 2027 is certainly possible. In addition to our response in RTC Section 3.4.1 below, Chapter 2.3.9 and 2.7 of the RIA details the justification.

**Organization:** He, Leard, McConnell

## **2 Sources of Improvements in Fuel Economy**

### **2.1 Engine Efficiency and Vehicle Design**

Some technologies improve fuel economy through helping the engine operate more efficiently. For example, in a turbocharger, the radial exhaust-driven turbine drives the radial compressor to increase the air density going into the engine, therefore improving the efficiency of the compressor or turbine. Alternative combustion cycles are available to improve the efficiency, such as low-temperature combustion, homogeneous charge compression ignition, and premix charge compression ignition. Variable valve actuation is designed to facilitate the use of nonconventional combustion modes during the power stroke, allowing the valve actuation to be adjusted independently from the crankshaft angle. Another technology, low-temperature exhaust gas recirculation, increases engine efficiency by reducing peak combustion temperatures and thus cooling the exhaust gas before it returns to the engine intake manifold. Thermal insulation reduces heat rejection to the engine coolant (from exhaust ports) or to the ambient air (from manifolds), therefore reduces energy loss during operation. [NHTSA-2014-0132-0115-A1 p.2]

We do not directly measure the adoption of these technologies and vehicle design characteristics over time. Instead, the effects of these advances are absorbed by model year fixed effects in our estimation. Therefore, the time period fixed effects potentially reflect the adoption of a combination of these technologies. [NHTSA-2014-0132-0115-A1 p.3]

### **2.2 Trade-off Factors**

Some truck attributes have a negative correlation with fuel economy, *ceteris paribus*. We examine closely two of these trade-off attributes, engine displacement and vehicle weight. [NHTSA-2014-0132-0115-A1 p.3]

While engine performance is usually measured by its horsepower and torque at the wheels, we argue that engine displacement serves as a good indicator of engine power. Engine displacement, by definition, measures the size of explosion inside the cylinders, which largely determines the power of the engine. The rotational force generated is torque at the engine. Horsepower is a man-made number, and it is defined as the product of torque at the engine and revolutions per minute (RPM), divided by 5,252. Torque at the wheels is the combination of torque at the engine with the torque magnification given by the transmission through gearing. [NHTSA-2014-0132-0115-A1 p.3]

### **3 Data and Graphical Evidence**

The Vehicle Inventory and Use Survey was conducted by the Census Bureau from 1963 to 2002. We use data collected every five years from 1982 to 2002. Random samples are generated for every state, with surveys asking for detailed information about trucks' physical and operational characteristics. [NHTSA-2014-0132-0115-A1 p.4]

The trade-off relationship between MPG and vehicle weight (including cargo), as well as between MPG and engine displacement, for combination trucks can be illustrated in the two graphs below. [NHTSA-2014-0132-0115-A1 p.4]

[Figure 2, 'Trade-off between MPG and vehicle weight for class 7, 8 combination trucks', and 3, 'Trade-off between MPG and engine displacement for class 7, 8 combination trucks', can be found on p.5 of docket number NHTSA-2014-0132-0115-A1]

#### **Response:**

We appreciate your comments, specifically on the trade-off between vehicle weight and engine displacement. The empirical correlation (equation 1) used in the report is also interesting.

#### **Organization:** Honeywell Transportation System (HTS)

Additionally, HTS' internal reviews, based on test results and on-engine simulation, show that air systems currently available for performance demonstration can reduce engine fuel consumption by nearly 2 percent relative to the current proposal's 2017 baseline. Some of this technology, like ball bearing-equipped turbochargers, is available today and the rest can be in production by 2021, all with an end-user payback that is substantially less than the agencies' proposed two-year threshold. An advanced turbocharger concept, including turbo-compounding, is under development, with series production planned before 2025. This advanced air system architecture is projected to reduce fuel consumption by nearly 3 percent over the 2017 baseline engine. Given that HTS can account for the majority of the regulated fuel economy reduction with only air systems changes, we believe that there is room for a stronger engine-level standard, given significant advancements in engine efficiency building blocks under development by engine OEM's and other component suppliers. [EPA-HQ-OAR-2014-0827-1230-A1 p.3]

Beyond air systems, waste heat recovery technology like Organic Rankine Cycle (ORC) has shown the capability to improve engine fuel efficiency by 5 percent or more in laboratory and over-the-road trials. At the current time, being on the early end of the cost curve, ORC does not yet have a proven 2 year end-user payback. However, industry has repeatedly shown that technology costs can be reduced dramatically given sustained demand and market competitiveness. We are confident that if there is long-term regulatory certainty, industry will develop reliable technologies that can cost-effectively meet a more stringent standard. [EPA-HQ-OAR-2014-0827-1230-A1 p.3]



HTS appreciates the agencies' continued recognition that turbochargers can contribute significantly to the reduction of GHG, NO<sub>x</sub> and PM emissions from the transportation sector. [EPA-HQ-OAR-2014-0827-1230-A1 p.5]

**Response:**

We appreciate HTS's comments on the technologies related to air systems and WHR with ORC. All of these technologies are part of our technology road map and were taken into consideration by the agencies when developing the standard. We have made many changes to the engine standards to increase the stringency from that proposed. See responses in Section 3.3.1 above.

**Organization:** International Council on Clean Transportation (ICCT)

**Technology potential**

This section provides ICCT's comments on the agencies' determination of the stringency of the standards. It is emphasized, per our Section II comments above, that the agencies' proposed 2027 standards can be moved forward by three years due to the maturity of the necessary technologies to achieve compliance with those proposed efficiency levels. Generally, the development of long-lead time regulations allow greater time to reduce technology investment risk, sustain long-term capital investments, and allow more widespread deployment of advanced technologies in the marketplace (See Lutsey, 2012). Based on the ICCT's latest research, as well as the research literature, there are several areas where the agencies do not fully incorporate available technology that is applicable in the 2027 timeframe. [EPA-HQ-OAR-2014-0827-1180-A4 p.6]

**Engine efficiency**

One area where the proposed standards diverge from the available technology potential is in the engine area, where the agencies proposed to reduce the tractor diesel engine fuel use by 4% from 2017 to 2027. The engine standards would likely remain in effect for three additional years, so the standards would apply until 2029 or 2030. This would mean engine CO<sub>2</sub> emissions would be reduced on average by 0.3% to 0.4% per year from 2017 through 2030. Moreover, our analysis of the specific Phase 2 GEM engine maps shows that the Phase 2 baseline engine CO<sub>2</sub> emission levels over the re-weighted SET cycle is reduced by 1.5% when compared to the results over the originally weighted SET. By providing a 1.5% fuel consumption benefit for the re-weighting, the stringency of the agencies proposed tractor engine standard in 2027 is actually 2.5%, not 4.0%. [EPA-HQ-OAR-2014-0827-1180-A4 p.6] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.39.]]

Based on our own recent technical analysis and the research literature – much of which was not yet referenced or acknowledged in the rulemaking analysis – the agencies could include greater application of known technologies in their stringency determination for diesel tractor engines. With the exception of the Reinert (2015a, 2015b) studies, the referenced literature below [see p.19-22 for list of referenced literature] all appears to be new data to the agencies' analysis. A recent engine audit and analysis indicates that tractor-trailer diesel engines can improve by over 10% from a 2017 baseline in the 2020-and-beyond timeframe (Thiruvengadam et al, 2014). The ICCT follow-on analysis that includes real-world synergies indicates that the same tractor engine technologies can achieve a 7% fuel consumption benefit without waste heat recovery (WHR) and 10-12% with more advanced WHR technologies – and also offer attractive payback periods that are comfortably less than 2 years (Delgado and Lutsey, 2015; Meszler et al, 2015). Work by the Southwest Research Institute for NHTSA indicates that diesel tractor engines can see reduced fuel consumption of 7%—and up to 10% with waste heat recovery—from a 2019

baseline within the Phase 2 timeframe (Reinhart, 2015). In addition, the highest-volume tractor engine manufacturer, Cummins, indicates that engines can achieve a 9%–15% fuel use reduction from 2017, within the 2020–2030 timeframe (Eckerle, 2015). With higher technology penetration rates for U.S. DOE SuperTruck technologies, the standards could go further yet. Teams led by Cummins, Daimler, Navistar, and Volvo have already physically demonstrated engine improvements of 12%–17% from a 2010 baseline (Delgado and Lutsey, 2014). The SuperTruck programs follow-on goal would go further, with a brake thermal efficiency of 55% in peak conditions (Wall, 2014). [EPA-HQ-OAR-2014-0827-1180-A4 p.6]

Lutsey (2015a) assessed the above references and analyzed the prospects to increase the penetration of the above technology levels and compare to the proposed stringency levels. Based on the latest research, there is sufficient technology availability to reduce tractor engine fuel consumption by at least 7% from incremental efficiency technology (i.e., from improvements from friction reduction, parasitics, air handling, aftertreatment, combustion optimization, and advanced controls), about double what the agencies included in the proposed rule for 2027. With greater penetration of the incremental technologies and 15% penetration of organic Rankine cycle WHR system (as assumed by the agencies), a fleet-wide CO<sub>2</sub> improvement of up to 10% in 2027 is feasible. With greater penetration of WHR and U.S. DOE SuperTruck technologies, the technology potential is higher still. The particular underlying data assumptions that appear to drive the agencies' unduly conservative engine stringency analysis would ideally be modified to reflect the recent state-of-the-art technical work in the following areas: [EPA-HQ-OAR-2014-0827-1180-A4 p.6-7] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 39-40.]]

Engine friction reduction: To reflect the most recent data, we recommend the agencies increase technology effectiveness in this area from 1.4% to 3%. The recent data on this from Reinhart (2014a) indicates that a 24% improvement is feasible in this area. In addition, engine friction reduction from technologies including electrified variable-speed oil and water pumps delivered an absolute improvement of about +1% brake thermal efficiency (BTE) for at least a 2% fuel consumption reduction in the Navistar and Cummins/Peterbilt SuperTruck demonstrations (Delgado and Lutsey, 2014). Koeberlein (2012) indicates a 3% improvement. [EPA-HQ-OAR-2014-0827-1180-A4 p.7]

Aftertreatment. We recommend the agencies increase technology effectiveness in this area from 0.6% to 1%. Advances in substrates to reduce back pressure and SCR system improvements to better optimize engine controls are already being commercialized. Stanton (2013) indicates that aftertreatment improvements could deliver a 2% fuel consumption benefit. Similarly, the Cummins/Peterbilt SuperTruck project delivered a +0.5% BTE gain or at least a 1% fuel consumption benefit (Delgado and Lutsey, 2014). Sisken and Rotz (2012) indicated a 2% improvement. In addition, expert stakeholder workshop findings pointed to the potential for 2-4% improvements in efficiency that are enabled from improved aftertreatment systems in the Phase 2 timeframe (Lutsey et al, 2014). [EPA-HQ-OAR-2014-0827-1180-A4 p.7]

Intake and exhaust air handling, turbocharging, and EGR improvements. We recommend the agencies increase technology effectiveness in this area from 1.1% to 3%. Reinhart (2014a) indicates that 1.6% fuel consumption reduction is feasible from a more advanced turbocharger. Stanton (2013) found that 3% fuel consumption reduction is feasible from EGR, ports, and turbomachinery efficiency enhancements. In addition, another study indicates a 4% improvement just from an advanced asymmetric turbocharger system (Chebli, et al, 2014). Advanced piston design and injector geometry contribute to a peak improvement of 5% and overall improvements of about 3% (Roberts et al, 2011; Thiruvengadam et al, 2014). Jadin (2012) indicates about a 4% improvement from air handling technologies. [EPA-HQ-OAR-2014-0827-1180-A4 p.7]

Combustion, control optimization: We recommend the agencies increase technology effectiveness in this area from 1.1% to 3%. The Navistar SuperTruck program demonstrated a 3% BTE improvement from increased compression ratio pressure and in-cylinder pressure (Delgado and Lutsey, 2015), equivalent to an approximate 6% fuel consumption improvement. Stanton (2013) indicates that 2.5% fuel consumption improvement is feasible from improved heat transfer and compression ratio-related improvements. A stakeholder workshop of industry experts indicated that up to 4% improvement is available from combustion optimization and up to 4% from model-based engine controls (Lutsey et al, 2014). The National Research Council (NRC) (2014) indicates that increased fuel injection pressures with piezoelectric nozzle use could make 6% fuel consumption reduction realizable in real operating conditions. Finally, real-time combustion control, advanced fuel injection concepts, and alternative combustion strategies can contribute to an additional 1 to 4 percent reduction in fuel consumption (NRC, 2014) [EPA-HQ-OAR-2014-0827-1180-A4 p.7]

Turbocompounding: We recommend that the agencies increase tractor turbo compounding penetration to at least 15% in 2024, and to over 25% in 2027, and also increase the technology's fuel consumption effectiveness from 1.8% to 3%. Navistar's SuperTruck project achieved a 1.5% brake thermal efficiency improvement (Delgado and Lutsey, 2014), which in turn offers a 3-4% fuel consumption improvement, from its electric turbo compounding system. Thiruvengadam et al (2014) indicates that a 3.5% benefit is achievable from turbo compounding. This could be an alternative for companies that do not find waste heat recovery as attractive for their particular operations or technology preferences. [EPA-HQ-OAR-2014-0827-1180-A4 p.7]

Waste heat recovery: We recommend that the agencies increase the waste heat recovery effectiveness from 3.6% to 5% fuel consumption reduction to better match the available research on the technology. Salemme (2013) indicates the technology could result in 5-7% fuel use reduction. Similarly, Stanton (2013) found a 5% benefit. The recent SwRI study indicated the technology could deliver a 3-6% benefit (Reinhart, 2015a), and we believe that over the long timeframe of this rule the upper bounds of this technology are likely to be most appropriate, especially if the technology is only limited to 15% of the tractor market, which presumably would be the tractors for which the duty cycles are matched to where the technologies' benefit is greatest. [EPA-HQ-OAR-2014-0827-1180-A4 p.7-8]

Dis-synergy factors: We recommend the agencies increase their synergy adjustment factor from 0.85 to 0.9 in 2024, and 0.85 to 0.95 in 2027. The agencies appear to be incorporating an engineering assumption that is not validated and cuts across all the technologies above, thus greatly reducing the stringency determination for tractor engines. The multiplicative accounting between the various engine efficiency factors is already intended to account for the interaction effects whereby the multiple technologies together results in less benefit than the simple sum of the technologies' effectiveness. Reinhart (2015a, b) results appear to indicate greater overall engine improvements than the agencies determined, and the agencies' dis-synergy factors appear to substantially diverge from the government-contracted work. Model-based control is an enabling technology that reduces such losses from interactions between the technologies. In addition, the extensive co-development of engines and engine components among suppliers and vehicle manufacturers – as a general practice, and demonstrated in the SuperTruck projects (Delgado and Lutsey, 2014) – all go directly toward minimizing such losses. In addition, the long lead-time of the standards, through model year 2027, provides the appropriate timeframe for minimizing undesirable negative synergies and maximizing positive synergies. The dis-synergy factors should ideally be based on supported data. Engine simulation tools can prove useful to account for such interactions (e.g., the Reinhart 2015a, b analysis). If such adjustment factors are continued, we recommend their impact be reduced over time, to 0.9 in 2024 and 0.95 in 2027 (from 0.85 as proposed). [EPA-HQ-OAR-2014-0827-1180-A4 p.8]

Table 1 summarizes the technology effectiveness values assumed in the Phase 2 proposal, along with comparable technology values in the research literature. Whether looked at from the perspective of overall engine improvements on studies that incorporated multiple technologies or from the perspective of each of the individual technology areas, the agencies were conservative across the board based on best available data on directly applicable tractor efficiency technologies. [EPA-HQ-OAR-2014-0827-1180-A4 p.8]

[Table 1 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1180-A4]

**Response:**

We have received many constructive comments on the engine standards with many differing views. We have made many changes to the engine standards which increased the stringency of the standard from that proposed. See responses in Section 3.3.1 above.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The report is consistent with our views that waste heat recovery technology at this high cost and level of complexity is not ready for the road. At various points, waste heat recovery is described as: [EPA-HQ-OAR-2014-0827-1895-A1 p.3]

- *Complex and expensive technologies that are not fully developed*
- *High cost and uncertainty of reliability and warranty*
- *Exotic and untried*

The UAW recognizes and supports the high level of communication and collaboration between regulators, the industry, and other stakeholders in crafting a very complex standard. We urge all parties to continue working together to solve outstanding issues before regulations are finalized. To take one example, the proposed standard's prohibition of the conversion of on-road motor vehicles to dedicated racing vehicles is problematic and the final regulations must arrive at a workable solution. [EPA-HQ-OAR-2014-0827-1895-A1 p.3]

**Response:**

Many commenters share the same concerns on WHR with UAW. Downtime and cost are two of the key concerns, specifically for an emerging technology that has not been extensively tested in the market. These concerns are addressed in Chapter 2.3.9 of the RIA where the agencies indicate how current challenges can be successfully addressed in the lead time provided by the rule. We received data and CBI information from one engine manufacturer as well as public comments (EPA-HQ-OAR-2014-0827-1298) that shows that their WHR system could be put into production in 2021 timeframe. Given their large market share in the class 8 engine sector, a 25% market penetration of WHR by 2027 is certainly possible. In addition to our response in RTC Section 3.4.1 below, Chapter 2.3 and 2.7.5 of the RIA details the justification.

**Organization:** Lubrizol Corporation

The Phase 2 Proposal estimates that shifting to today's higher-performing engine lubricants will result in increased fuel economy and CO2 benefits of 2.4-3.4 percent in 2027, compared with 2010 engines. Low-viscosity axle lubricants are estimated to add another 0.5 percent improvement. According to Shell, every 1 percent increase in fuel economy will reduce CO2 emissions by 4,000 tons per year and will reduce fuel consumption by one million gallons per day, which is roughly comparable to removing 23,000 trucks

from the road and saving fleets and owner-operators roughly \$3 million per day.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.3-4]

The benefits in 2027 should be even higher. Starting in 2017, the lubricants in the market will be far superior from the perspectives of fuel economy, emissions reduction, engine performance, and engine durability than the CJ-4 lubricants that are the basis for the estimates in the Phase 2 Proposal. These benefits will only increase in later years, as even better formulations enter the market. [EPA-HQ-OAR-2014-0827-1325-A1 p.4]

To meet the objectives of the Phase 2 Rule without compromising engine performance and durability, the American Petroleum Institute (API), at the request of the Engine Manufacturers Association (EMA), is developing a new industry standard for HPLs that will be used in the trucks covered by the Phase 2 Rule.<sup>8</sup> This specification, currently designated as PC-11, will bring a new generation of HPLs to the market by 2017. [EPA-HQ-OAR-2014-0827-1325-A1 p.4]

As will be discussed further below, the benefits of the new specification will be significant. Today's lubricants, which meet API's CJ-4 specification, will be replaced by PC-11 lubricants that will combine lower viscosity for improved fuel economy and lower emissions with advanced additives for improved durability and engine performance. [EPA-HQ-OAR-2014-0827-1325-A1 p.4]

For the first time, consumers of lubricants will have a choice of two different specifications. PC-11A lubricants will replace today's CJ-4 lubricants, and will be compatible with all trucks on the road. They will be suitable for use in today's existing trucks and in future trucks. PC-11B lubricants will be designed for new engines. Both will enter the market by 2017. PC-11B lubricants will be specially designed to contribute to greater fuel economy and CO2 emissions benefits while maintaining engine protection and durability. The two categories will largely be distinguished by their High Temperature High Shear (HTHS) viscosity rates. (Simply put, HTHS provides a better way to measure the impacts of a lubricant on fuel economy). [EPA-HQ-OAR-2014-0827-1325-A1 p.4]

The benefits of PC-11B lubricants are expected to be comparable to, or greater than, the benefits of using low rolling resistance tires. As with low rolling resistance tires, however, it will be important to take steps to help ensure that they penetrate the truck market, and that they are used throughout the useful life of the trucks that are initially certified with them. To reap the full, real-world environmental benefits of the Phase 2 Rule, EPA should consider provisions in the final Phase 2 Rule to help ensure that PC-11B lubricants are used throughout the useful life of future trucks and engines. [EPA-HQ-OAR-2014-0827-1325-A1 p.4]

## Engine Oils and Lubricants

### A Primer on Engine Lubricants

The choice of lubricants impacts nearly every part of the energy conversion process that occurs in a commercial vehicle. Until recently, high viscosity lubricants were typically used to lubricate and protect automotive engines.<sup>11</sup> However, their high viscosity required more energy to pump the lubricant throughout the inner walls of the engine, which resulted in reduced engine efficiency. In order to achieve higher engine efficiency, better fuel economy, and lower emissions, OEMs increasingly desire lower viscosity synthetic and semi-synthetic lubricants for their engines, as well as for their transmission and drivetrain lubricants. [EPA-HQ-OAR-2014-0827-1325-A1 p.6]

Shifting to low viscosity engine lubricants reduces pumping losses associated with moving the lubricant around the engine to maintain sufficient lubrication. While low viscosity increases efficiency because less pumping work is required, the low viscosity lubricant must still provide sufficient wear protection. Not only must they provide wear protection that is comparable with the protection provided by higher viscosity lubricants, but they must be able to achieve this performance at the higher temperatures and pressures experienced by today's advanced engine technologies. [EPA-HQ-OAR-2014-0827-1325-A1 p.6]

Higher temperatures further complicate the switch to low viscosity lubricants. As temperature increases, viscosity decreases. Because today's engines experience a wide range of operating temperatures, lubricants are required to maintain ideal viscosity across these conditions. Balancing the lowest viscosity lubricant capable of providing sufficient film thickness across a wide range of operating conditions is the key to improving efficiency while also ensuring engine components are adequately protected. [EPA-HQ-OAR-2014-0827-1325-A1 p.6]

As OEMs push efficiency to new heights in the coming decade, ensuring robustness and durability will become increasingly important. Improved lubricants will be required to protect engine integrity under increasingly harsh environments, and they will have to deliver this performance at lower viscosities in order to provide additional efficiency improvements. In order to provide improved performance under more demanding conditions, new higher-performing lubricants that are tailored to specific operating conditions, engine strategies, and advanced technologies will need to be developed and commercialized. [EPA-HQ-OAR-2014-0827-1325-A1 p.6]

In sum, HPLs provide OEMs with two opportunities:

As an enabler of advanced engine strategies and technologies: HPLs will provide the viscosity, frictional, and durability characteristics that allow advanced engine strategies and technologies to be used without concerns over premature product failures, engine and driving performance, and durability over the oil drain interval or throughout the engine's useful life. [EPA-HQ-OAR-2014-0827-1325-A1 p.6]

**As a strategy that delivers improved fuel economy:** HPLs have been demonstrated to increase fuel economy by 1-3 percent.<sup>12</sup> Because OEMs will need to consider every available tool to meet their 2027 requirements in the most cost-effective manner, HPLs should play an increasingly important role in OEM's compliance strategies. [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

To address this challenge, additive packages are being formulated that can be blended into low viscosity base oils to maintain their performance characteristics across a range of operating conditions, while improving efficiency and reducing emissions. Some of the most common additives that will be blended with base oils will include:[EPA-HQ-OAR-2014-0827-1325-A1 p.7]

- Viscosity modifiers: polymers that help control the viscosity of a lubricant over a specified temperature range;<sup>13</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.7]
- Friction modifiers: organic (carbon, hydrogen, and oxygen) and metal-containing friction modifiers that reduce sliding and rolling friction between metal components;<sup>14</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.7]
- Antioxidants and detergents: blended with base oils to reduce sludge formation, reduce deposit formation on pistons, and prevent against the effects of poor fuel quality;<sup>15</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

- Dispersants: solubilizes sludge that can otherwise form blockages in an engine's inner walls,<sup>16</sup> and [EPA-HQ-OAR-2014-0827-1325-A1 p.7]
- Anti-wear additives: protect key engine parts from excessive wear which can degrade engine performance.<sup>17</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

In sum, HPLs can play an important role in each manufacturer's compliance strategy, whether by enabling other strategies, by directly improving fuel economy, or both. [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

### **A New Generation of PC-11 Engine Oils Are Being Developed to Meet the CO<sub>2</sub>, Fuel Consumption, and Performance Needs of the Phase 2 Rule's Engines**

Truck engine design and combustion technology are already undergoing a period of significant change, driven by the need to meet the requirements of the Phase 1 Rule and other EPA emission standards, as well as industry demands for better driving performance, durability, and reliability. [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

These changes include, without limitation: [EPA-HQ-OAR-2014-0827-1325-A1 p.7]

- Engine downsizing;
- Downspeeding;
- Active oil temperature control;
- Advanced combustion design;
- Higher oil temperatures;
- Start/Stop technology; and
- Variable valve timing. [EPA-HQ-OAR-2014-0827-1325-A1 p.8]

Each of these changes require improved engine lubricants that will enable the new technologies and hardware designs to work properly. [EPA-HQ-OAR-2014-0827-1325-A1 p.8]

As noted above, today's truck lubricants are designed to meet API's CJ-4 specification. While CJ-4 is not a "fuel economy" specification *per se*, EPA SmartWay data shows that current, low-viscosity CJ-4 lubricants provide fuel consumption and CO<sub>2</sub> benefits that are comparable to low rolling resistant tires. According to SmartWay and as shown in Figure 2 below, the typical combination truck will reduce its fuel consumption by roughly 500 gallons per year by using low rolling resistance tires, while typical combination trucks that use low-viscosity lubricants will reduce their fuel consumption by an average of 485 gallons per year. In other words, SmartWay estimates that both strategies will cut fuel savings by roughly 3 percent. Similarly, the typical combination truck will reduce CO<sub>2</sub> emissions by 4.93 metric tons in a typical year, while using low-viscosity lubricants will reduce CO<sub>2</sub> emissions by 5.08 metric tons.<sup>18</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.8]

[Figure 2 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1325-A1]

Going forward, API will soon finalize a new set of lubricant specifications that will provide even greater fuel economy and CO<sub>2</sub> benefits. These specifications are the result of a consensus-based process that involves the oil and additives industries and the engine manufacturers, as well as millions of dollars of research and development and millions of miles of field testing over a period of years. [EPA-HQ-OAR-2014-0827-1325-A1 p.9]

To develop the new specifications, currently designated as PC-11, at least five different categories of work are involved, including: [EPA-HQ-OAR-2014-0827-1325-A1 p.9]

- Test development, which is typically conducted by OEMs working in conjunction with oil and/or additive companies; [EPA-HQ-OAR-2014-0827-1325-A1 p.9]
- Test validation, which is typically done on an industry-wide, collective basis; [EPA-HQ-OAR-2014-0827-1325-A1 p.9]
- Formulation development, which is the process by which additive companies conduct tests to determine the impact of formulation changes; [EPA-HQ-OAR-2014-0827-1325-A1 p.9]
- Customer programs, which includes conducting specific tests for oil companies and on the specific products that they are considering selling; and [EPA-HQ-OAR-2014-0827-1325-A1 p.9]
- Field testing, which includes tests of the various formulations being considered [EPA-HQ-OAR-2014-0827-1325-A1 p.9]

Lubrizol's own PC-11 field testing demonstrates the rigor and seriousness of the investments to create the new PC-11 lubricants. Since 2010, in anticipation of PC-11 lubricants being introduced, Lubrizol has accumulated in excess of 35 million miles of field testing on prototype PC-11 lubricants. This testing has been conducted across more than 140 vehicles representing a cross section of OEMs products. This investment alone will amount to in excess of \$2 million, which will be dwarfed by the full extent of testing required to prove out products to meet the PC-11 specification. [EPA-HQ-OAR-2014-0827-1325-A1 p.10]

PC-11 lubricants are being designed to address the following needs: [EPA-HQ-OAR-2014-0827-1325-A1 p.10]

- Increased fuel economy and reduced CO2 emissions;
- Improved oxidative stability;
- Increased resistance to aeration;
- Increased wear protection;
- Increased shear stability; and
- Full compatibility with all existing and new vehicles. [EPA-HQ-OAR-2014-0827-1325-A1 p.10]

First licensing of PC-11 lubricants is expected by the end of 2016. The new PC-11 specifications will, for the first time, divide the market into two categories that are distinguished by their High Temperature High Shear (HTHS) viscosity. Most pertinent to the Phase 2 Rule, distinguishing lubricants by their HTHS performance and viscosities will allow truck users to improve their fuel economy by using the right oils. PC-11A oils will be higher viscosity HTHS fluids, and will replace the current CJ-4 oils with new formulations that offer higher levels of protection and performance. These oils will be backwards compatible, and will be suitable for all engines. PC-11B oils will be designed for new engines only—engines that are designed for thinner lubricants with better HTHS performance (i.e., lower HTHS viscosity rates) to maximize engine performance, durability, fuel economy, and emissions reduction.<sup>20</sup> [EPA-HQ-OAR-2014-0827-1325-A1 p.10]

Table 1 summarizes some basic distinctions between PC-11-A and PC-11B: [EPA-HQ-OAR-2014-0827-1325-A1 p.10]

[Table 1 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1325-A1]



It is worth noting that the PC-11 process is part of a broader move towards low HTHS lubricants that is occurring in both the U.S. and Europe. In both cases, OEMs are demanding cleaner and thinner lubricants that enable engines to deliver higher efficiency and lower emissions while maintaining or improving engine performance and durability. In the U.S., EMA initiated the drive to create PC-11 with its initial request to API in 2011.<sup>23</sup> In Europe, the European Automobile Manufacturers Association (ACEA) is planning to update its current ACEA E6/E9 specifications in 2018 with F6-18 specifications to meet the demand for engines that deliver high efficiencies. It is reasonable to assume that these specifications may be updated again by 2027, providing the potential for even greater benefits in years to come. [EPA-HQ-OAR-2014-0827-1325-A1 p.11]

It is worth noting that EPA and EU Euro emissions standards have been the catalyst for lubricant reformulations for many years. EPA's 1998 heavy-duty engine standards and Euro II led to turbocharged engines that introduced higher temperatures and pressures that required improved thermal and oxidative stability. Euro III, Euro IV, and the EPA 2004 standards introduced retarded injection and exhaust gas recirculation, which created a demand for lubricants that delivered improved acid and corrosion control, as well as improved soot handling. Euro V and the EPA 2007/2010 standards led to the widespread use of selective catalytic reduction and diesel particulate filters, which set the stage for the current CJ-4 specification and its restrictions on sulfur, sulfated ash, and phosphorus. Today, API and its members are working together to develop PC-11 to help the OEMs meet the expected requirements of the Phase 2 program. [EPA-HQ-OAR-2014-0827-1325-A1 p.11]

### **Summary of Comments Related to Engine Oils and Lubricants**

As currently drafted, the Phase 2 Proposal does not mention the development of PC-11 for post-2017 engine oils and does not appear to anticipate its implementation and benefits. This has two ramifications: [EPA-HQ-OAR-2014-0827-1325-A1 p.11]

- Assumptions of fuel economy and CO2 emissions reductions from the use of HPLs are based on CJ-4 lubricants in the market today, rather than PC-11 oils that will be in the market in 2017 and thereafter; and [EPA-HQ-OAR-2014-0827-1325-A1 p.11]
- The Proposal does not include provisions to help encourage the use of PC-11B lubricants beyond the first use (the so-called "factory fill"). [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

As noted above, we expect that the proper use of PC-11B lubricants will improve fuel economy and reduce CO2 emissions by 1.5-2.0 percent in real world applications, compared to the baseline CJ-4 lubricants available today. As EPA and NHTSA consider the feasibility of the various alternatives proposed for the Phase 2 program, correctly assessing the benefits of the lubricants that will actually be in the market in 2017 and thereafter will be critical. [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

In addition, while it is to be hoped that OEMs will use PC-11B lubricants in their certification testing and factory fills, the Phase 2 Proposal does not take any steps to help ensure or encourage that these lubricants are used in certification testing, factory fills, or so-called "service fills" that happen throughout an engine's useful life. It may be reasonable to assume that OEMs are adequately incentivized to use PC-11B lubricants in their certification testing and factory fills by the performance advantages of doing so. Because using PC-11B lubricants in service fills will maximize lubricant-related fuel economy and CO2 benefits, and will help ensure that no emissions degradation will occur over the oil drain interval and throughout the engine's useful life, EPA and NHTSA should consider strategies to help ensure or encourage that PC-11B HPLs are properly used throughout an engine's useful life. [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

There are many strategies that can be taken to help ensure or encourage that PC-11B HPLs are properly used throughout an engine's useful life. Indeed, prior EPA emissions rules and other programs have used an array of strategies to help ensure the widespread use of emissions-cutting components in other contexts, including credits and other incentives, labeling, warranty requirements, sensors, onboard diagnostics (OBD) approaches, and even engine derating (e.g., when urea is not present in SCR systems). [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

As EPA and NHTSA consider these comments and develop the final Phase 2 Rule, we would be very interested in discussing the range of possible strategies that might be appropriate to encourage or ensure that PC-11B lubricants are used throughout the useful life of Phase 2 engines. Selecting the right strategies will help ensure that the public reaps the full environment and health benefits of the Phase 2 program, and that truck fleets and users maximize the durability and performance of their engines. [EPA-HQ-OAR-2014-0827-1325-A1 p.12]

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7 Shell, "PC-11: What is it all about," June 10, 2015, slides 4 and 5.

8 "Beyond CJ-4: Introducing PC-11, the New HDDEO Performance Category." HDDEO, Lubrizol. <http://www.hddeo.com/IntroducingPC-11.html>.

11 A lubricant's viscosity is defined as the fluid's internal resistance to flow at a given temperature.

12 Canter, N. "Fuel Economy - The role of friction modifiers and VI improvers." TechBeat, 2013. <http://www.dow.com/ucon/pdfs/tltechbeat.pdf>. (Hereafter cited as "Canter, N. (2013)")

13 "Passenger Car Engine Oils, Part 1 - Understanding The Fundamentals Of Viscosity Modifiers For Automotive Engine Oils." Passenger Car Engine Oils, The Lubrizol Corporation. <http://pceo.com/ViscosityModifierPart1.html>.

14 TechBeat, 2013.

15 Howard, K. "Turbocharged Direct-injection Is Engine Oil's Next Big Hurdle." Lubes 'N' Greases Magazine, January 2013. <http://gf-6.com/sites/default/files/Turbocharged%20Direct%20Injection%20Is%20Engine%20Oils%20Next%20Big%20Hurdle.pdf>. (Hereafter cited as "Howard, K. (2013)")

16 Howard, K. (2013)

17 Howard, K. (2013)

18 See <http://epa.gov/smartway/about/outreach.htm>. Data is based on a typical combination truck at highway speeds. See <http://www.epa.gov/smartway/forpartners/documents/trucks/techsheets-truck/420f12076.pdf> for lubricants and <http://epa.gov/smartway/forpartners/documents/trucks/techsheets-truck/420f10041.pdf> for low-rolling resistance tires.

19 See <http://epa.gov/smartway/about/outreach.htm>. Data is based on a typical combination truck at highway speeds. See <http://www.epa.gov/smartway/forpartners/documents/trucks/techsheets-truck/420f12076.pdf> for lubricants and <http://epa.gov/smartway/forpartners/documents/trucks/techsheets-truck/420f10041.pdf> for low-rolling resistance tires.

20 Along with new performance criteria, new tests will be introduced, including for oil oxidation, shear stability, and aeration.

23 "Beyond CJ-4: Introducing PC-11, the New HDDEO Performance Category." HDDEO, Lubrizol. <http://www.hddeo.com/IntroducingPC-11.html>.

**Response:**

We appreciate Lubrizol's comprehensive comments on lubricants. Although PC-11 has not been specifically mentioned in our rulemaking, any new technologies that can be measured and recognized during an engine dynamometer test will be accounted for in the engine's GHG emission result. The reason is that the Phase 2 GHG rule allows OEMs to provide their own engine fuel maps that are measured by testing the engine on an engine dynamometer, which means that any technology, such as advanced lubricant, that can be accounted for by the engine fuel map test procedure would be accounted for while conducting vehicle certification using GEM. We also are finalizing the use of an axle test procedure to quantify the power loss; thus, the actual efficiency of the axle can be used to replace the default power loss specified by the agencies. Thus, the overall benefits to the vehicle will be recognized by the certification using GEM.

**Organization:** Manufacturers of Emission Controls Association (MECA)

Our industry and the regulatory agencies have invested significant resources to insure that the current structure delivers cost-effective and durable emission reductions. Manufacturers have made significant investments in developing engine-based technologies under the first phase of heavy-duty GHG standards that will continue to deliver environmental benefits under this second set of GHG regulations. Engine and powertrain CO<sub>2</sub> reductions are verifiable and future OBD systems can be used to insure reductions over the life of the vehicle. The proposal includes a number of engine and vehicle technologies that demonstrate significant reductions but may not remain on the vehicle over its lifetime. These include, low friction lubricants, aerodynamic fairings, low rolling resistance tires among others. To achieve the goals of this regulation, we urge EPA to develop methodologies and policies that insure that the real emission reduction benefits from all technologies remain through the end of life and multiple owners of the vehicle. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

There is a large set of technologies that can significantly reduce, either directly or indirectly, mobile source emissions of CO<sub>2</sub>, N<sub>2</sub>O (as well as other NO<sub>x</sub> emissions), CH<sub>4</sub>, and black carbon. A range of powertrain technologies can be applied to both heavy-duty gasoline and diesel powertrains to help improve overall vehicle efficiencies, reduce fuel consumption, both of which can result in lower CO<sub>2</sub> exhaust emissions. In many cases, the application and optimization of advanced emission control technologies on advanced heavy-duty powertrains can be achieved in a manner that lowers overall fuel consumption while reducing criteria emissions. Our comments focus on available engine efficiency and exhaust emission control technologies and the impacts these technologies can have on greenhouse gas and criteria emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

**Control of Black Carbon with Particulate Filters**

Black carbon is a major component of particulate matter emissions from mobile sources and is believed to have a significant net atmospheric warming effect by enhancing the absorption of sunlight. Black carbon is a mix of elemental and organic carbon, in the form of soot, emitted by fossil fuel combustion, bio-mass burning, and bio-fuel cooking. Black carbon is a dominant absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon are transported over long distances and are most

concentrated in the tropics where solar irradiance is highest. Because of the combination of high absorption, a regional distribution roughly aligned with solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are thought to be the second strongest contribution to current climate change, after CO<sub>2</sub> emissions. The glacier retreat has accelerated since the 1970s and several scientists have speculated that solar heating by soot in atmospheric brown clouds and deposition of dark soot over bright snow surfaces may be an important contributing factor for the acceleration of glacier retreat. A study published in a 2009 issue of *Nature Geoscience* (vol. 2, 2009) by researchers from the NASA Goddard Institute and Columbia University found that black carbon is responsible for 50% of the total Arctic warming observed from 1890 to 2007 (most of the observed Arctic warming over this timeframe occurred from 1976 to 2007). [EPA-HQ-OAR-2014-0827-1210-A3 p.10]

It is estimated that 70% of the black carbon emissions from mobile sources are from diesel-fueled vehicles, with the assumption that 40% of gasoline PM is black carbon and 60% of diesel PM is black carbon. The black carbon concentration and its global heating will decrease almost immediately after reduction of its emission. Black carbon from diesel vehicles can be significantly reduced through emission control technology that has been required on every U.S. heavy-duty diesel truck manufactured since 2007. The basis for the design of wall-flow particulate filters is a ceramic honeycomb structure with alternate channels plugged at opposite ends. As the gases pass into the open end of a channel, the plug at the opposite end forces the gases through the porous wall of the honeycomb channel and out through the neighboring channel. The porous wall and the filter cake of particulate matter that forms within and on the surface of the wall serve as the filter media for particulates. Since the filter can fill up over time by developing a layer of retained particles on the inside surface of the porous wall, the accumulated particles must be burned off or removed to regenerate the filter. This regeneration process can be accomplished with a variety of methods including both active strategies that rely on generating external sources of heat (e.g., fuel burners, fuel dosing strategies that utilize fuel combustion over a catalyst, electrical elements, intake air throttling) and passive strategies that utilize catalysts that are displayed directly on the filter element or upstream of the filter. During the regeneration of DPFs, captured carbon is oxidized to CO<sub>2</sub> but this filter regeneration still results in a net climate change benefit since the global warming potential of black carbon has been estimated to be as high as 2,200 times higher than that of CO<sub>2</sub> on a per gram of emission basis. It is estimated that the installation of DPFs has reduced PM emissions from U.S. heavy-duty diesel vehicles by 110,000 tons per year. The ACES Phase 2 study that evaluated the PM emissions from 2010 technology heavy-duty engines showed that DPF equipped engines emit PM at one to two orders of magnitude below the current standard of 0.01 g/bhp-hr and deliver over 99% PM capture efficiency over their lifetime. MECA encourages EPA to develop policies and/or incentives that reward vehicle and engine manufacturers for employing technologies such as particulate filters that provide significant reductions in mobile source black carbon emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.10-11]

Looking ahead, transportation greenhouse gas emissions are forecast to continue increasing rapidly, reflecting the anticipated impact of factors such as economic growth, increased movement of freight by trucks, ships, and rail, and continued growth in personal travel. The transportation sector is the largest source of domestic CO<sub>2</sub> emissions, representing 33% of the nation's total in 2006. There are significant opportunities to reduce greenhouse gas emissions from the transportation sector through the design of fuel efficient powertrains that include advanced exhaust emission controls for meeting even the most stringent criteria pollutant standards being discussed today in California. These emission control technologies allow all high efficiency powertrains to compete in the marketplace by enabling these powertrains to meet current and future criteria pollutant standards. [EPA-HQ-OAR-2014-0827-1210-A3 p.14]

**Response:**

We appreciate MECA's comments on control of black carbon with a DPF. We will work with MECA in the future to evaluate technologies such as particulate filters that provide significant reductions in mobile source black carbon emissions.

**Organization:** NAFA Fleet Management Association

Fleets are concerned about the incremental investment and operating costs of complex new engine technology. Putting excessive emphasis on the engine as a stand-alone component can result in costly engine technology that would bring little or no benefit in many real world applications. Fleets have already seen significant increases in vehicle costs and more expensive maintenance associated with increasingly complex engine and after treatment systems. Engines are best evaluated based on how they operate in the vehicle, considering the engine size and power output, the vehicle power demand, and the driveline characteristics – that is, by the full vehicle approach [NHTSA-2014-0132-0111-A1 p.1-2]

**Response:**

We understand that the NAFA comment is more or less related to a separate engine standard that could result in costly engine technology that would bring little or no benefit in many real world applications. We have extensively evaluated the benefits of all certification options, including with and without separate engine standards. We also received a large number of comments on certification options, specifically on whether a separate engine standard should be adopted. As one can imagine, opinions and recommendations are split. After taking all factors into consideration, we believe that a separate engine standard would be the best option. Section II of Preamble details our justification on why we are moving forward with a separate engine standard.

**Organization:** National Automobile Dealers Association (NADA)

## Waste Heat Recovery

The Phase 2 proposal assumes that 15 percent of MY 2027 tractors will utilize waste heat recovery. This is a very aggressive assumption given that the technology is very costly, has only been used in demonstration projects, and is nowhere near production-ready. Given the cost, reliability, and design constraints associated with this technology, ATD suggests that the proposal's MY 2027 tractor MPR for be revised downward to 2 percent. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

These technology uptake concerns should be taken seriously since, as mentioned above, real or perceived reductions in vehicle choice or increases in vehicle costs associated with questionable compliance technologies will cause commercial customers to avoid new tractors to the detriment of OEMs, suppliers, dealerships, and the Phase 2 public policy objectives. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

**Response:**

Downtime and cost are two of the many key concerns, specifically for an emerging technology that has not been extensively tested in the market. At the same time, others are pushing for a lot more aggressive market penetration. We received data and CBI information from one engine manufacturer as well as public comments (EPA-HQ-OAR-2014-0827-1298) that shows that their WHR system could be put into production in 2021 timeframe. Given their large market share in the class 8 engine sector, a 25% market

share utilizing WHR by 2027 is certainly possible. In addition to our response in RTC Section 3.4.1 below, Chapter 2.3 and 2.7.5 of the RIA details the justification.

**Organization:** Navistar, Inc.

- Lubricants, though efficient, have long lead times for development and adoption; usage of certain lubricants can bring lifetime cost impacts and can require changes to hardware to support newer lubricants

**Response:**

We recognize the issue associated with lubricant, specifically on its reliability and cost that can result in a long lead time. Because of this reason, we carefully lump this technology together with friction and parasitic loss reduction into one technology package, where the effectiveness is only 1.4%. See also response to Lubrizol in this section.

**Organization:** Navistar, Inc.

Walsh and Charlton's claims and recommendations were summarized as 11 major findings and are focused on tractor engines. In the proposed Phase 2 regulations, these engines are certified in the ramp modal cycle (RMC) for CO<sub>2</sub> and the FTP for the other GHG constituents. The NPRM also proposed a reweighing of the modes in this cycle that departs from that used for criteria pollutants, but that aim to align the engine standard to the real world or in-vehicle usage of these engines. In the following, Navistar highlights the major concerns with the authors' findings. [EPA-HQ-OAR-2014-0827-1919-A2 p.9]

*Finding 4:* In as much as the rule is intended to be technology-forcing, it cannot also be technology-selecting. The premise of SuperTruck, for example, was to result in a wide breadth of technologies that would then be evaluated for production and commercial feasibility in order to achieve engine and vehicle efficiency improvements. The authors specifically challenge the EPA's adoption rates for waste heat recovery ("WHR"). In WHR systems efficiency is tied to sourcing the highest T or P from the engine systems. With the expected increases in the engines' base BTE over the lifetime of this rule, there will be a resulting reduction in available "waste" pressure and temperature or potential for waste heat recovery. The rule itself becomes a dis-synergy to this technology. This is further compounded by the proposed reweighting of the RMC, which reduces the weighting in the rated speeds and loads where the WHR has the highest potential, but reflects the integration of the engine with the vehicle drive cycle. Furthermore, the agencies have found it is critical to include adoption rate, based on experience from previous rulemaking and the need to truly have an environmental impact. [EPA-HQ-OAR-2014-0827-1919-A2 p.12]

Beyond the benefit being significantly less than originally proposed, the cost is still prohibitively high. Additional concerns for the vehicle manufacturers include the following: [EPA-HQ-OAR-2014-0827-1919-A2 p.12]

- WHR working fluids have a significant GHG impact based on their high GWP
- Packaging and weight penalty will negatively impact the aggregate freight efficiency

Unlike SCR technology, which was deployed in Europe prior to adoption in the US, there are no commercially available systems of this technology in production at this time in mobile source application.

Given the size and complexity of the system, its application in a mobile platform is not ideal. The agencies' assumed penetration rates acknowledge that there are still major developments needed to make this a commercially viable solution, but are encouraging the continued investigation for a longer term objective. [EPA-HQ-OAR-2014-0827-1919-A2 p.12]

*Finding 5:* The technology path proposed to achieve the GHG Phase 2 NPRM targets for engine already includes technology improvements in combustion. However, the advanced combustion processes such as HCCI, PCCI, low-temperature combustion and RCCI (reaction controlled compression ignition) were excluded as these are not commercially feasible now or in the Phase 2 timeframe. Though these processes have been demonstrated in laboratory environments, in the case of HCCI for over 20 years, production feasibility has yet to be demonstrated due to the breadth of conditions and variability in the real world. Moving these technologies from the laboratory to the production environment requires advances in control strategies, sensor sets and manufacturing processes in order to ensure robustness and reliability. [EPA-HQ-OAR-2014-0827-1919-A2 p.13]

In addition, although some of the different combustion regimes show strength in certain areas of an engine operating map they are not applicable to the entire map. This will translate into limited improvement with no payback. In Navistar's experience, some of these processes (e.g., PCCI and low-temperature combustion) have been demonstrated to be effective in criteria pollutant control, but have been demonstrated to increase the CO<sub>2</sub> emissions in key areas of the operating regions of the engine map. [EPA-HQ-OAR-2014-0827-1919-A2 p.13]

*Finding 6:* The authors argue that this downspeeding technology should be accounted for in the engine standard rather than on the vehicle standard. Downspeeding is when the vehicle powertrain matched in such a way that the engine operates at a lower engine speed, but higher torque. This results in a net improvement in fuel consumption due to lower parasitic losses and higher BMEP operation for the engine. Without the adequate powertrain match, the gains cannot be achieved. Thus, it is appropriate to have downspeeding as currently included in the proposed Phase 2 NPRM in the *vehicle* standards, as it is a technology that requires the integration with vehicle and is not possible with just an engine. Demonstration of the benefits of downspeeding requires the definition of entire drivetrain and how it operates over the prescribed vehicle drive cycles. [EPA-HQ-OAR-2014-0827-1919-A2 p.13]

*Finding 8:* Costs included in Phase 2 RIA from the agencies are underestimated for the technology selection, deployment and validation of a fully US compliant 1Million-mile vehicle. The DOE sponsored SuperTruck program has definitely been instrumental to OEMs in understanding the possibilities in bridging the gap between today's products and the product needs of the future as driven by the GHG regulations. However, the majority of the technologies are in their infancy and have not been assessed to the full extent that is needed for commercialization and real world operation. The technologies demonstrated in the SuperTruck program need to be vetted for full tailpipe compliance, OBD compliance, real world robustness, customer acceptance/satisfaction, and reliability/warranty impact. [EPA-HQ-OAR-2014-0827-1919-A2 p.13]

With any technology-forcing standard, selection of the enabling technology for commercialization has many facets including: customer acceptance, cost/affordability, technology maturity, packing and weight, manufacturability, reliability and supporting infrastructure. Supporting infrastructure for the technologies is one of the first hurdles. For example, it was clear that to enable PM control to the regulatory-required level, the Sulphur content of diesel fuel needed to be reduced. Beyond being a significant cost to the petrochemical companies to change the production of fuel, there were unintended and unaccounted consequences to this change. Sealing technologies that were tried-and-true in engines had to be

redeveloped for the new fuel. These costs are difficult to estimate. [EPA-HQ-OAR-2014-0827-1919-A2 p.13-14]

Also, as technologies are developed toward production, the commercial aspects start to weigh more and can change the course of technology adoption. For example, as the 2007/2010 tailpipe rules were being finalized, the NO<sub>x</sub> control technologies were less understood and Lean NO<sub>x</sub> Trap (LNT) was envisioned as the primary technology. SCR, which was the prevalent, in-production NO<sub>x</sub> control strategy in Europe, was not the envisioned technology. This was primarily because catalyst durability along with perceived issues with DEF (cost, availability or infrastructure, freezing/thawing issues, additional need for on-board fluid, etc.). In the end, PGM (platinum group metal) costs associated with the technology and its complexity and durability of the LNT for the HD market quickly led to reconsideration of SCR. However, the deployment of SCR into the US market still had its own significant challenges given the extent of US regulations, which have lower NO<sub>x</sub> standard, wider ambient condition NTE requirements and the EPA's concerns with the substrate technology in Europe. Hence, this case shows that even a technology already in production in another market still poses unknown or unaccounted risks in the commercialization. Cost estimates in the rulemaking stage are typically under predicted. [EPA-HQ-OAR-2014-0827-1919-A2 p.14]

*Finding 11.* Charlton and Walsh argue that the agency arbitrarily assigned a dis-synergy factor to the composite benefit of the technologies identified in the roadmap. They almost seem to argue that dis-synergies do not exist. The dis-synergies do exist and it is unrealistic to definitively assign values without prescribing the design and system functions of all individual engines. The implementation of 2014 compliant engines is extremely varied across all OEM's. Although the technologies are all the same – combustion improvement, EGR and SCR – the implementations are highly varied from fuel systems with different characteristics, fixed to variable geometry turbochargers and even the displacement selections of the engines. In such a case, it is difficult to precisely estimate the dis-synergies of a set of technologies without detailed understanding of a given engine's system design. [EPA-HQ-OAR-2014-0827-1919-A2 p.15]

A strong example of dis-synergy is the implementation of WHR as discussed earlier. As the engine becomes more efficient to meet the proposed rule, there will, by definition, be less waste heat available to extract from these systems. Increased cylinder pressure and fuel injection pressures are also counter to friction reduction assumptions and again very specific to the particular design and architecture of a given engine. The dis-synergy factor is an appropriate acknowledgement by the agencies that the technologies are not simply additive. [EPA-HQ-OAR-2014-0827-1919-A2 p.15]

**Response:**

We appreciate Navistar's comments together with other reports, such as the one from four major vehicle OEMs - Daimler Trucks North America, Navistar Inc., Paccar Inc., and the Volvo Group. We largely agree with the assessment on DOE's SuperTruck program. We also appreciate Navistar's comments on many items, including WHR, HCCI, PCCI related combustion, downspeeding, and dis-synergy. This report has helped us to justify why we cannot use the Charlton/Walsh report as the basis to increase the stringency of the standard to the level they recommended. See the response to EDF in Section 3.3.1 above.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Among the technologies listed under Alternative 3, where the agencies believe CO<sub>2</sub> emissions and fuel consumption could be improved, were: [EPA-HQ-OAR-2014-0827-1244-A1 p.11]



- Combustion optimization [EPA-HQ-OAR-2014-0827-1244-A1 p.11]
- Turbocharging system [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Engine friction and other parasitic losses [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Exhaust aftertreatment [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Engine breathing system [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Engine downsizing [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Waste heat recovery [EPA-HQ-OAR-2014-0827-1244-A1 p.12]
- Transient control for vocational engines only [EPA-HQ-OAR-2014-0827-1244-A1 p.12]

#### Waste Heat Recovery

The agencies proposed phase-in standards from 2021 through 2027 for OEMs to gradually introduce various technologies, one of which is waste heat recovery (WHR). EPA assumes that WHR will cost up to \$11,000, but because this technology is not currently available in any production form, the actual costs are unknown and more than likely much higher than EPA has estimated. Though the technology has some promise, its potential benefits are dependent upon many confounding variables. According to the researchers at the Southwest Research Institute, no all duty cycles can expect to benefit from WHR. Again, this speaks to the diversity of the trucking industry, while also demonstrating the unsuitability of forcing technology. It is important for the agencies to remember that while OEMs may utilize WHR to receive credits, the customers will more than likely never actually benefit from this technology. This is especially likely with Alternatives 3, 4, and 5. [EPA-HQ-OAR-2014-0827-1244-A1 p.30]

Ultimately, with multiple fluid pumps, additional hoses, and heat exchangers, the WHR system has a great potential for failure. Until more is known and understood about WHR and until more real-world data is collected, OOIDA suggests that WHR not even be considered as part of Phase II. With an estimated 200 parts, this technology is certain to be expensive to purchase and maintain, and will add a notable amount of weight to the vehicle, thus WHR would be counter-productive to the agencies proposal to reduce weight. This as-yet-developed technology is so far from even being tested to determine if it actually will work in a class 8 truck environment those who are testing it continue to drastically alter the very method in which they propose to capture the waste heat. It is doubtful that any owner-operator would risk purchasing a truck with such a technology, which will once again prime the market for a pre-buy or no-buy situation. [EPA-HQ-OAR-2014-0827-1244-A1 p.30-31]

#### **Response:**

Downtime and cost are two of the key concerns, specifically for an emerging technology that has not been extensively tested in the market. As explained in RIA Chapter 2.3.9, the agencies have outlined a path forward to resolve technical issues within the lead time provided by the final rule. In addition please see our response in RTC Section 3.4.1 below. With respect to issues related to cost of the technology, see RIA Chapter 2.11.2.15.

**Organization:** PACCAR, Inc.

***Meeting Alternative 3 Engine Stringency will Require Use of New Technologies***

EPA and NHTSA set stringency levels for vocational and tractor engines at 4% and 4.2%, respectively. These standards, when viewed against PACCAR's current engine performance and the available existing technologies that can improve the engine's performance, will require the development and implementation of new technologies. Some of the technologies envisioned by the Agencies for meeting the stringency, such as waste heat recovery, turbo compounding, low delta pressure aftertreatment system, and model-based controls, are not at the prototype level for PACCAR and other OEMs. Technologies like waste heat recovery are technically sophisticated and will require a longer lead time for development, OEM testing, field reliability growth to ensure a robust product for the customer. PACCAR anticipates that meeting these standards will be possible, but doing so will be challenging and will require all of the lead-time provided in Alternative 3. As discussed below, meeting the same standards within the more accelerated timeframe of Alternative 4 would be infeasible. [EPA-HQ-OAR-2014-0827-1204-A1 p.3-4]

As a result of this assessment, PACCAR recommends that the Agencies finalize the Alternative 3 engine standards as they are proposed in the NPRM. [EPA-HQ-OAR-2014-0827-1204-A1 p.4]

**Response:**

We have received a large number of comments from the public as well as CBI from individual companies in response to the NPRM. As one can imagine, opinions and recommendations are split in terms of the stringency of engine standards. Taking all factors into consideration, we have made many changes to the engine standards that were proposed. On the vocational side, we changed the baseline engine to reflect the most recent certification data. The detailed vocational engine stringency and its baseline engine standards can be found in Chapter 2.7 of the RIA; see also RTC Section 3.3.3. For tractor engines, new information allowed us to increase the dis-synergy factor from 0.85 to 0.9 in 2027, and increase the market projected penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and included down speed benefits for engines. As a result of this, the 2027 MY tractor engine standards' projected stringency over the baseline increased from 4.2% (proposal) to 5.1% in 2027. We have also identified ways in which greater reductions would be feasible in 2024. Chapters 2.3 and 2.7 of the RIA detail the justification of these increases. Thus, we do not agree with Paccar that meeting the 4.2% standard within the more accelerated timeframe of Alternative 4 would be infeasible, and are adopting 2024 standards that are equivalent to the Alternative 4 engine standards for MY 2024.

**Organization:** Union of Concerned Scientists (UCS)

**TRACTOR ENGINE STRINGENCY**

There are four key issues in the agencies' analysis that lead to an engine standard that is far more conservative than can be achieved in the timeframe of this rule: the use of a dissynergy factor, an underestimate of the effectiveness of technologies applied, discounting the benefit of a revised test cycle, and the exclusion of downspeeding. Accounting for these four factors would raise the effective engine standard in the preferred alternative from 3.7 percent in 2024 up to 9.0 percent compared to the baseline performance given in the NPRM. Using the agencies' assumed technology penetration rates, these factors would raise the engine standard up to 10.3 percent relative to the assumed baseline in 2027; however, the agencies are likely underestimating the potential uptake for waste heat recovery in this timeframe. [EPA-HQ-OAR-2014-0827-1329-A2 p.6]

Dissynergy. Because the agencies cannot model every possible engine configuration for every manufacturer, they have utilized a generic baseline engine map and then applied, via multiplication, the effectiveness of different technologies on this map:  $\%FE_{total} = 1 - 1 - d \times f \times \%FE$ , where  $f_i$  represents the fraction of engines with technology  $i$  and  $d$  is the dissynergy factor. The agencies' dissynergy factor is equal to 25 percent in the earliest years and 15 percent in the later years. [EPA-HQ-OAR-2014-0827-1329-A2 p.6]

The dissynergy factor is meant to discount the effects of combining different separate technologies, since some technologies may be trying to reduce the same type of energy losses and therefore will not simply add. However, it is rarely applied in the technology-independent manner that the agencies have used in assessing the potential for engine reductions, since many technologies may be unaffected by the application of an additional technology—for example, the effectiveness of improving the efficiency of the turbocharger is unlikely to be affected by the effectiveness of reducing engine friction. In fact, in some cases the application of two technologies can even have a synergistic effect, where the complementary fuel reductions result in an overall effectiveness beyond the individual technologies—this is often the case when considering technologies applied to both the engine and vehicle, like cylinder deactivation and load reduction. [EPA-HQ-OAR-2014-0827-1329-A2 p.6]

Because synergy/dissynergy is dependent upon specific technology interactions, it is preferable to consider modeling the technology packages separately. Recent research by the Southwest Research Institute (SwRI), commissioned by NHTSA for the express purpose of informing these regulations, helps shed light on whether the agencies' use of a dissynergy factor is appropriate. In the first report issued by SwRI, the effectiveness of 20 different tractor engine technologies was examined (Reinhart 2015a). In the second report, these different technologies were combined into 11 different engine packages (Reinhart 2015b). By comparing the multiplicative model noted in the formula above and the modeled package results, we can assess what dissynergy is present, if any, in these technologies. [EPA-HQ-OAR-2014-0827-1329-A2 p.6]

It should be noted that not all technologies applied in the packages were analyzed separately in the first report, so we have trimmed the selection to six specific packages: 2019 Baseline DD15, Package #1 (2019 DD15 + friction reduction), Package #2 (2019 DD15 + Downspeeding B + 50% friction reduction), Package #3 (Package #2 + H2O bottoming cycle), Package #3a (Package #2 + R-245 bottoming cycle), Package #4 (2019 DD15 –EGR, – turbo compounding, with fixed geometry high-efficiency turbocharger), and Package #5 (2011 DD15 + optimized turbo compounding + Downspeeding B + 50% friction reduction + optimized combustion + air handling). In the case of the 50% friction reduction, we have modeled the effectiveness of this as  $1 - (1 - \%FEFR)^{1/2}$ , which when applied twice would thus equal  $\%FEFR$ . We have modeled the 1% combustion improvement of the 2019 DD15 engine and Package #5 as a simple 1-percent improvement in fuel consumption. [EPA-HQ-OAR-2014-0827-1329-A2 p.6-7]

[Figure 1, 'Comparison of Package Effectiveness', can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

The results of the multiplicative method compared to the fully simulated packages are shown in Figure 1. Here we have used the results on all five drive cycles modeled (CARB Transient, 55 MPH steady state, 65 MPH steady state, World Harmonized Vehicle Cycle, and the Northeast States Center for a Clean Air Future cycle) under three different load conditions (0-, 50-, and 100-percent load) to assess fifteen different datapoints for each of the six packages. As is evident from the data, the majority of the data falls below the  $x=y$  line—this actually means that, on average, we find evidence for a net synergy, in stark contrast to the agencies' assessment. Fitting to the data, we find that the simplified multiplicative

approach underestimated the fully simulated package model results by 6 percent, on average—this is in direct contrast with the agencies’ use of a blanket dissynergy factor. Furthermore, the few datapoints that show some dissynergy are almost exclusively either the 2019 DD15 baseline or Package #5, run over either the CARB Transient or NESCCAF cycles—this suggests that rather than a dissynergy, it is much more likely that our simplistic assessment of the 1% combustion improvement is invalid under heavy transient operation. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

Based on the data in Figure 1, we find no supporting evidence for the agencies’ use of a dissynergy factor in combining engine technologies. Removing the broad application of the dissynergy factor would raise the value of the proposed engine stringency in 2027 to 4.9 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

Technology effectiveness. In addition to the synergy between technologies, the agencies have not appropriately considered the effectiveness of the technologies themselves. Despite the thorough work by Southwest Research Institute commissioned by NHTSA, the agencies have assumed levels below this work in nearly every technology examined.<sup>1</sup> In many cases, this effectiveness is also inconsistent with public data from the industry. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

Friction reduction was noted as an exceptionally effective technology in the SwRI analysis initially (Reinhart 2015a), and the conventional engine package in the follow-on study yielded an improvement of 3.3 percent over the 2018 baseline engine. This is significantly beyond the agencies’ 1.4-percent improvement. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

Combustion controls are expected to advance considerably over the timeframe of the rule, with industry estimating possible improvements of between 1 and 4 percent, with an industry average of 2.5 percent (Lutsey et al. 2014). The agency’s assessment of 1.1 percent is obviously again at the low end of this scale. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

The effectiveness of turbo compounding varies widely by engine manufacturer, as some companies may be implementing this already in engines today, while others may not see this as part of their product plan; estimates range from 0.5 to 5 percent, with an average of about 2.3 percent. SwRI analysis finds that an optimized turbo compounding engine package could achieve a 5.8 percent improvement over the 2018 baseline, 2.6 percent better than improvements to combustion and friction reduction alone and higher than the agencies’ assumption of 1.8 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.7]

Organic waste heat recovery is challenging to assess because only one manufacturer is currently planning on deploying these engines ahead of the 2021 rule, while others are still at the demonstration stage. However, the SuperTruck program has shown great promise, and industry assessment estimates that it holds the potential for between 2- and 8-percent improvement, with an average of 5-percent improvement (Lutsey et al. 2014). The package that is furthest along in development involves a recuperator and uses a refrigerant as the working fluid— SwRI modeling of this package yields a total improvement of 9.2 percent for the engine package, or 4.4 percent from the waste heat recovery system alone. This again exceeds the 3.6-percent improvement estimated by the agencies. [EPA-HQ-OAR-2014-0827-1329-A2 p.7-8]

Even while maintaining the agencies’ dissynergy factor and penetration rates, these adjusted technology effectiveness values would raise the engine standard from 4.2 percent to 6.1 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.8]

**Downspeeding.** Downspeeding is a strategy used by manufacturers to reduce fuel usage from the engine by operating at a lower speed, which reduces parasitic and friction related losses. This recent trend has been enabled by a move by the industry towards more automated manual transmissions, which can help keep a narrower gear spread at the highest gears without having to worry about issues like driver fatigue. It also requires axles designed to handle a greater torque at low speed. [EPA-HQ-OAR-2014-0827-1329-A2 p.9]

While the agencies acknowledge the benefits of downspeeding on the vehicle side, they have not considered the benefits of downspeeding at the engine level. This is at odds with the actual design process— engines are designed to operate within a specific range of speeds, especially at high load. Downspeeding typically results in an engine that operates with higher torque at low speeds to generate the same power, often operating in a narrower range of speeds at peak power (Figure 2). This changes the torque curve, resulting from the manufacturer’s desire to maintain the level of performance for its users while shifting the cruise speeds lower. Shifting the torque curve would also shift the A, B, and C speeds of the SET cycle, which is used for both greenhouse gas and criteria emissions testing. [EPA-HQ-OAR-2014-0827-1329-A2 p.9]

[Figure 2, 'Comparison of Downspeed Engines', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

The agencies’ engine maps for 2018, 2021, 2024, and 2027 all maintain the same torque curve and therefore the same SET A, B, and C speeds. Despite assuming the engine will be run at lower speeds over time, the agencies have not chosen to adjust the torque curve accordingly— this may be allowable because the power demands of the regulatory cycle are not particularly severe, but it is not reflective of real world engine design. This is problematic because on the vehicle side, they alter the drive axle ratio to shift the cruise speed by 16 percent, down from 1500 rpm to 1300 rpm at 65 mph. For reference, we calculate the SET cycle speeds for the EPA engine to be A = 1233 rpm, B = 1515 rpm, and C = 1797 rpm, with the “not-to-exceed” (NTE) zone thus starting at 1120 rpm. With the 2027 axle ratio and default transmission gearing, the 55mph cruise speed is at 1100 rpm in overdrive—at this speed, the vehicle would actually be operating outside the NTE zone used for criteria emissions. This is true only because of the way in which the agencies have treated downspeeding. [EPA-HQ-OAR-2014-0827-1329-A2 p.9-10]

It should also be noted that the agencies’ 2018 cruise speed of 1500 rpm is exceptionally high compared to the performance of even today’s powertrains (Table 2). The agencies’ torque curve for 2018-2027 matches that of the Detroit Diesel DD15 engine, yet the 2014 model of that engine already is meant to operate today at speeds lower than the agency is targeting in assessing stringency. This is even more drastic when compared to other popular Class 8 engines. [EPA-HQ-OAR-2014-0827-1329-A2 p.10]

[Table 2, 'Comparison of Tractor Engine Speed', can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

Downspeeding ultimately is linked to engine design and must be reflected in engine stringency to ensure that there is no gaming occurring between criteria emissions and greenhouse gas emissions testing. The SwRI modeling identified an additional 1.8-percent improvement in efficiency for the downsped engine package compared to friction and combustion improvements alone (Reinhart 2015b). This would revise the engine standard up to 6.0 percent from 4.2 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.10]

Advanced technology penetration. The agencies have estimated a 15-percent penetration rate for Rankine cycle waste heat recovery and a 10-percent adoption rate for turbo compounding (NPRM p. 40197)— higher adoption rates are feasible by 2027. Both turbo compounding and Rankine cycle waste heat

recovery are designed to capture energy from the exhaust and are most effective in highway operation. However, Cummins has presented data indicating nearly the same levels of performance for a regional-haul cycle as line-haul operation (Salemme 2014), which means this technology could see application beyond the long-haul sleeper cabs assumed in the agencies' analysis. Furthermore, a 25-percent application represents just half of all line-haul trucks, assuming no application in regional haul, yet a significant number of vehicles are already on the road with mechanical turbo compounding offered by both Detroit Diesel and Volvo, and Cummins is expected to roll out small numbers of Rankine cycle-powered vehicles before the rule even begins (Lockwood 2015). Therefore, the agencies' assumed penetration rates do not correspond to a "technology-forcing" standard, and adjusting these to reflect what the market is already primed to do on its own would result in a much more stringent standard, by as much as 3 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.10]

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1 While the SwRI modeling study did not directly model the effects on the SET cycle, we are considering technology effectiveness as represented by a 50/50 split of the regulatory cycles for day and sleeper cabs, since the ARB transient and 55-mph and 65-mph cruise cycles were all modeled by SwRI.

Reinhart, T.E. 2015a. Commercial medium- and heavy-duty truck fuel efficiency technology study - report #1. (Report no. DOT HS 812 146). Washington, DC: National Highway Traffic Safety Administration. Online at <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/812146-CommercialMDHD-TruckFuelEfficiencyTechStudy%E2%80%93Report1.pdf>.

Reinhart, T.E. 2015b. Commercial medium- and heavy-duty truck fuel efficiency technology study - report #2. (Draft report) Washington, DC: National Highway Traffic Safety Administration. Online at [http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/Draft-SwRI-MDHD-FE-TechReport2\\_DocketVersion.pdf](http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/Draft-SwRI-MDHD-FE-TechReport2_DocketVersion.pdf).

Lutsey, N., T. Langer, and S. Khan. 2014. Stakeholder workshop report on tractor-trailer efficiency technology in the 2015-2030 timeframe. Online at <http://www.theicct.org/stakeholder-workshop-report-tractor-trailer-efficiency-technology-2015-2030>.

**Response:**

We appreciated the commenter's constructive comments, specifically on down speeding. However, we do not believe that 10.3% increase in 2027 per commenter's recommendation is feasible. Also, we do not believe that the commenter properly used SwRI's data to deduce the dis-synergy factor, because SwRI made a correction to the 2019 baseline engine results, which changes all of the conclusions the commenter made. First of all, the data quote from the commenter mainly relies on the literature, including DOE SuperTruck programs. The values from the literature are single optimal operating points and not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point. Technology effectiveness is also not additive. Chapter 2.7.5 of the RIA details justifications of dis-synergy used in the rule. These justifications were also supported by many industry comments, such as the reports made by four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar). See response to EDF in Section 3.3.1 above. The technology effectiveness of WHR in Rankine cycle used by the agencies, which is less effective than what commenters (including this commenter) recommended, were directly obtained from credible, but CBI information, based on the recommendation from a leading engine manufacturer. It is critical to derive the standards based on the agencies' weighting factors over 13 modes, vehicle weight,

and three vehicle certification cycles. Thus, the adjusted values for stringency are typically much smaller than the values seen in the literature. Having said that, we have made changes to make the standards more stringent than those proposed. In the final rule, we readjusted the baseline of the engine standards to reflect the reweighting impact. Chapter 2.7.4 of the RIA details the change in the baseline. We made a few key changes on engine standards. For tractor engines, we increased the dis-synergy factor from 0.85 to 0.9 in 2027, and increased the market penetration rate for WHR Rankine cycle technology from 15% to 25% in 2027, and include down speed benefits for engines. As a result of this, the 2027 MY tractor engine standards' projected stringency over the baseline increased from 4.2% to 5.1%. Chapters 2.3 and 2.7 of the RIA detail the justification of this increase. We also increased the stringency of the vocational vehicle standards from those proposed.

**Organization:** United Parcel Service (UPS)

The specific market penetration rates that concern UPS, given our particular fleet, are listed below and UPS strongly recommends reduction of these MPRs: [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

Waste Heat Recovery (projected 15% in 2027)

UPS agrees generally with the comments of the American Trucking Association on this issue. Specifically, UPS favors a successful rulemaking for Phase II, but urges that the technologies offered in compliant trucks are fully tested, verified, and affordable before adoption. UPS keeps its class 8 tractors for 10-12 years, unlike many in our industry, and so durability is a major factor for us. So is maintenance. Our engineers' review of the current state of WHR technology gives us little basis for confidence in the WHR approach at this point, especially given the magnitude of the improvement in efficiency that the proposed rule hopes to achieve relative to other technologies. Note that UPS is very familiar with the SuperTruck program and its prototype usage of WHR. Reliance on WHR in the final rule will necessitate compliance margins that the proposed rule does not contain now. [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

Waste Heat Recovery

UPS agrees with the ATA on their following comments: [EPA-HQ-OAR-2014-0827-1262-A1 p.7]

'The agencies assume that Waste Heat Recovery ('WHR') technology will cost \$10,523 in 2021. The only WHR system of which we are aware is a prototype in the SuperTruck. Because waste heat recovery is not currently in the market, the actual costs remain unknown. Some OEMs state the cost is actually higher than this figure, while another OEM says it is over-inflated. Perhaps these differences reflect varying perceptions as to prospective business opportunities. This wide-ranging pricing uncertainty should raise a cautionary flag to the agencies. WHR is the highest cost menu item under the current heavy-heavy duty engine technology listings. The agencies must be more transparent in how they derived such cost figures given how some OEMs are contesting these projections. As you can imagine, these cost uncertainties have only escalated fleet concerns over future pricing of equipment under Phase 2.' [EPA-HQ-OAR-2014-0827-1262-A1 p.7]

UPS is also concerned about the heavy reliance the agencies place on the penetration of this technology in the market. [EPA-HQ-OAR-2014-0827-1262-A1 p.7]

**Response:**

As already acknowledged, downtime and cost are two important concerns, specifically for an emerging technology that has not been extensively tested in the market. In addition to our response in RTC Section 3.4.1 below, see RIA Chapter 2.3.9 (and especially RIA at p. 2-17) indicating how WHR can be brought to market reliably within the lead time provided by the final rule.

**Organization:** Volvo Group

## Future Technology

If we consider the example of waste heat recovery, full scale development is estimated at \$130 Million from proof of concept to market launch, with an expected development project period of 6 years. Volumes can be determined from Volvo Group's expected Sleeper Tractor production and taking the expected penetration rates of from Table II-6 and fitting a curve to interpolate volume growth between stringency steps and extrapolate to MY2030. Assuming the project costs are spread evenly over the project period and series production starts in engine MY 2021, Volvo Group would need to charge nearly \$21,700 per unit over the ten year regulatory period just to recover the R&D investment and cost of capital. [EPA-HQ-OAR-2014-0827-1290-A1 p.36]

The Agencies' estimate that WHR will provide a 3.6% SET weighted improvement (Table II-6 of the Preamble). In a typical line haul application of 125,000 miles per year and a \$3.98 fuel cost a 3.6% improvement is worth ~\$2,520 per year with a customer expected payback period of no more than 18 months, thus the market price for the 3.6% fuel economy improvement would be no more than \$3,780. Given the estimated \$21,700 per unit cost, Volvo Group would lose \$17,920 per unit on R&D alone, without regard to material costs, sales and administrative expense, production costs, or even considering Volvo Group expects payback and profit within 5 years. [EPA-HQ-OAR-2014-0827-1290-A1 p.36]

The Agencies, however, determined a cost for WHR of \$10,500 in 2012 dollars in MY2021 (Preamble Table II-8), which is inclusive of all direct and indirect costs and markup. [EPA-HQ-OAR-2014-0827-1290-A1 p.36]

**Response:**

Given our adoption rates for WHR and our estimated costs along with projected sales, we estimate total costs of WHR ranging from \$10.3 million in MY2021 up through \$188 million in MY2027 and then \$166 million in MY2030 (the slight reduction in costs being attributable to learning). The cumulative total costs would be roughly \$850 million. Using our ICMs, and the RPEs upon which they are based as a guide, then the cumulative total R&D would be \$30 million to \$40 million. This amount is below the \$130 million suggested by the commenter. This could mean one or more of the following: we have underestimated costs; we have underestimated adoption rates; Volvo should not enter the market with a WHR system. We believe that our WHR cost estimate is sound, and would have preferred that the commenter provide an estimated technology cost for WHR rather than a development estimate since that development estimate, presumably, would pay dividends in other areas not fully attributable to WHR and/or this final rule. If development costs are truly that high, then perhaps other technologies will be chosen to meet the demands of the new standards. Importantly, we have put forward what we believe to be a reasonable path to compliance but do not mean to suggest that it is the only path or that Volvo must choose that path. In 2015, Volvo reported R&D of roughly 15 billion Swedish Krona (SEK, or \$1.8 billion). (15 billion SEK from "The Volvo Group Annual And Sustainability Report 2015, page 80; conversion to USD using factor of 0.12 USD to 1 SEK via google.com on 6/23/2016) If we simply use



that value, we could estimate Volvo's R&D at roughly \$17 billion over the years 2021 through 2030. For WHR, \$130 million would represent less than 1 percent of R&D.

**Organization:** Walsh, Michael and Charlton, Stephen

The standards set for HD tractor engines fall well short of being “technology advancing” – the original stated goals of the rulemaking: [NHTSA-2014-0132-0102-A1 p.6]

*“This technology-advancing program would phase in over the long-term, beginning in the 2018 model year and culminating in standards for model year 2027, responding to the President’s directive on February 18, 2014, to develop new standards that will take us well into the next decade.” [NHTSA-2014-0132-0102-A1 p.6]*

The agencies have underestimated the potential of key technologies when setting the GHG emission and fuel consumption standard for HD tractor engines, in particular: waste heat recovery (WHR), advanced combustion and engine downspeeding. [NHTSA-2014-0132-0102-A1 p.6]

#### **Finding 4**

WHR technology is an important component of the technology package that can deliver a 15% or greater reduction of GHG emissions and fuel consumption by 2027, as recognized by NAS 21CTP Report #3, September 11, 2015 [41]: [NHTSA-2014-0132-0102-A1 p.6]

*“The 21CTP has successfully met Goal 1, to develop and demonstrate an emissions compliant diesel engine system for Class 7 and 8 highway trucks that achieves 50 percent brake thermal efficiency in an over-the-road cruise condition. The engine uses a waste heat recovery system.” [NHTSA-2014-0132-0102-A1 p.7]*

In the Draft RIA WHR was effectively eliminated by the agencies because of assumed adoption rates and outdated and illogical cost assumptions: [NHTSA-2014-0132-0102-A1 p.6]

*“We consider this technology to be on the flat portion of the learning curve (curve 12) because although waste heat recovery is a new technology and in the 2015 to 2017 timeframe remains, perhaps, on the steeper portion of the learning curve, applying such rapid learning effects to the cost estimate we have would result in costs too low in the MY2024 to 2027 timeframe.” Draft RIA section 2.12.2.15 [15] [NHTSA-2014-0132-0102-A1 p.7]*

The agencies used cost data from 2009 developed by TIAX [36] and reported by Tetra Tech. Inc. [44], thereby penalizing the technology with unrealistically high costs. WHR was then effectively eliminated from consideration when the assumed adoption rate was set at only 15% in 2027. [NHTSA-2014-0132-0102-A1 p.7]

The role of ‘adoption rate’ in this rulemaking should be questioned. Since the regulation is intended to drive the introduction of technology beyond that which normal market forces would achieve, the only valid meaning of ‘adoption rate’ is in determining which real world applications should logically be included and excluded on the basis of effectiveness. In the case of WHR there is broad agreement that line-haul tractor trailer applications and heavy-haul applications (at least) will benefit from adoption of

WHR. These applications form a high percentage of the Class 7-8 fleet (greater than 65%). [NHTSA-2014-0132-0102-A1 p.7]

### **Finding 5**

Advanced combustion was eliminated from consideration – “since the agencies do not anticipate these technologies will be commercially available by 2027” [15] Draft RIA section 2.3.2. Given the significant research effort on advanced combustion (Appendix A) and the progress being demonstrated [27,28,31], the agencies should at the very least allow for incremental improvements being transferred from this work into products released in 2021, 2024 and 2027. [NHTSA-2014-0132-0102-A1 p.7]

### **Finding 6**

Downspeeding results from SWRI report #1 [42] shown in section 5.3, Figure 6 of this paper, present results from a GT-Power cycle simulation of a HD tractor. Through overall gearing, the highway cruise speed of the engine was reduced from 1368 rpm to 1209 rpm at 65 mph (Downspeed A) and reduced further to 1051 rpm (Downspeed B). Figure 6 shows that downspeeding can reduce fuel consumption by 2%-4% with engine speeds as low as 1051 r/min at 65 mph. [NHTSA-2014-0132-0102-A1 p.7]

Downspeeding should be seen *primarily* as an engine technology, since the engine has to be significantly redesigned to allow downspeeding to 1000-1050 rpm to deliver fuel savings, while continuing to meet road load demands. The redesign involves increased peak cylinder pressure to allow higher BMEP at low engine speeds, increased wrist pin, journal and main bearing performance to protect oil film thickness, increased air handling performance at low engine speeds and re-optimized combustion. [NHTSA-2014-0132-0102-A1 p.7]

Vehicle design changes include changing the overall gear ratio between engine (rpm) and tires (rev/mile) by selecting an appropriate rear axle ratio and transmission top gear ratio, and adopting either an AMT or DCT transmission integrated with the engine controller. [NHTSA-2014-0132-0102-A1 p.7]

### **Finding 8**

The cost and retail price data used by the agencies in the development of this rule [44] for key engine technologies are outdated, being taken from sources published in 2009. The cost and retail price data took no account of the advances made by the SuperTruck Program which ran from 2010 through 2015 at a cost to the U.S. government and industry of \$375M [30-35]. [NHTSA-2014-0132-0102-A1 p.8]

The agencies should consider developing more accurate and current cost and retail price estimates based on a dialog with the SuperTruck OEMs and tier 1 supply base. Progress has been made between 2010 and 2015 both in simplifying designs for cost and reliability, and in better understanding manufacturing processes. [NHTSA-2014-0132-0102-A1 p.8]

### **Finding 11**

A *synergy* or *dis-synergy* factor is intended to account for the fact that some technologies may positively or negatively impact the performance of other technologies. For some technologies, such as combustion optimization, friction reduction and turbocharger efficiency improvements, one would expect only a positive effect. For some other technologies there can be a minor offsetting effect – for example by adding weight or increasing heat rejection – WHR and EGR are examples of this. Yet in 2021 the

agencies applied a 25% dis-synergy factor with only a 1% adoption of WHR, and knowing that the 2017 baseline engines already contained EGR. [NHTSA-2014-0132-0102-A1 p.9]

Synergistic and dis-synergistic effects need to be accounted for with the specific combinations of technology in mind. The agencies did not do this. Instead, they crudely applied a 25% discount in 2021 and a 15% discount in 2024 and 2027 across all technologies. Furthermore, there is no explanation for the agencies' derivation or justification of its use in the rulemaking record. The agencies' use of a dis-synergy factor is inappropriate and many of the technologies in EPA's preferred package may not have any dis-synergistic effects. This step in the agencies' analysis further contributes to setting weak engine standards. [NHTSA-2014-0132-0102-A1 p.9]

4. The agencies having wrongly included downspeeding as a vehicle technology and allocated the CO2 reduction to the vehicle via the GEM simulation. By so doing they have relaxed the stringency of the engine limit standards, which is a significant oversight by the agencies. This issue can be corrected by including downspeeding in the derivation of the proposed engine standards, Draft RIA section 2.7.4, Table 2-8 [15]. [NHTSA-2014-0132-0102-A1 p.10-11]

### 3.3 Technology Roadmaps

The most accessible and relevant Technology Roadmaps, related to improvements in HD diesel engine efficiency and emissions are the government funded, industry cost-shared initiatives which fall under the 21<sup>st</sup> Century Truck Partnership (21CTP). These initiatives, which culminated in the SuperTruck Program, have been significant in the development of clean and efficient HD diesel engines which meet both the EPA/NHTSA Phase 1 GHG standards and the near-zero EPA on-highway criteria pollutant standards. [NHTSA-2014-0132-0102-A1 p.14]

#### 3.3.1 21<sup>st</sup> Century Truck Partnership [22]

The 21<sup>st</sup> Century Truck Partnership was formally launched on April 21, 2000. The 21CTP is a cooperative research and development (R&D) partnership including four federal agencies—the U.S. Department of Energy (DOE), U.S. Department of Transportation (DOT), U.S. Department of Defense (DOD), and the U.S. Environmental Protection Agency (EPA)—and 15 industrial partners. The management of specific projects under the 21CTP umbrella rests with the individual federal agencies that have funded the work. These agencies use the 21CTP information-sharing infrastructure to coordinate efforts and ensure that valuable research results are communicated and that any overlap of activities is reduced. [NHTSA-2014-0132-0102-A1 p.14]

The purpose of this partnership is to reduce fuel consumption and emissions, increase heavy-duty vehicle safety, and support research, development and demonstration to initiate commercially viable products and systems. DOE released 21CTP Roadmap and Technical White Papers in 2006 [23] and in 2013 [24] which outline the goals and objectives of the partnership. [NHTSA-2014-0132-0102-A1 p.14]

#### 3.3.2 U.S. DOE Programs in Support of HD Diesel Engine Technology Development

In addition to being a member of the 21CTP partnership, DOE has initiated programs in Advanced Combustion R&D, Materials and Vehicle Systems for example, which have engaged the National Laboratories and industry in collaborative cost-shared projects. A listing of these projects from NAS 21CTP Report Phase 3 [41] is provided in Appendix A [see p.36 of docket number NHTSA-2014-0132-0102-A1], Figure 17. These projects have provided enabling technologies and knowledge which has been

integrated into programs such as SuperTruck, a program launched under the 21CTP umbrella with the intention of demonstrating complete truck systems. [NHTSA-2014-0132-0102-A1 p.14]

### 3.3.3 U.S. DOE SuperTruck program [21,26]

The SuperTruck Program was launched on January 11, 2010 when the Department of Energy (DOE) announced the selection of nine projects, totaling more than \$187 million, to improve the fuel efficiency of heavy-duty trucks. The funding included more than \$100 million from the American Recovery and Reinvestment Act of 2009 (ARRA). The projects required that private industry contribute at least 50% of the project cost, and so a total of more than \$375 million was provided for research, development, and demonstration projects. [NHTSA-2014-0132-0102-A1 p.15]

The goal of SuperTruck is to develop and demonstrate by 2015, a 50% improvement in freight efficiency (ton-miles per gallon) for Class 8 long-haul trucks compared with a 2010 base line. At least 20% is expected to be achieved through heavy-duty engine improvements, and the remainder from reductions in aerodynamic losses, rolling resistance, vehicle weight and auxiliary loads, and other approaches such as hybridization. [NHTSA-2014-0132-0102-A1 p.15]

### 3.4 Criteria Pollutant Regulation – Progress through Technology Forcing Standards

The 2010 standards for control of NO<sub>x</sub> and PM from HD engines was published as a final rule in January, 2001 [19]. These standards were introduced over a phase-in period 2007 through 2010, and required the availability of ultra-low sulfur diesel fuel as an enabler for PM and NO<sub>x</sub> aftertreatment. This very successful program is an outstanding example of technology forcing standards combined with adequate lead time, and the commitment of industry. The aggressive limit standards for NO<sub>x</sub> (0.2 g/HP-hr) and PM (0.01 g/HP-hr) were considered to be at the limits, if not beyond the limits of technology understood in 2001. The candidate technologies (DPF, NAC, AMOX and SCR) had existed in research labs for several years prior to the rule. However, component and system level refinement and demonstration had not taken place. Given the research foundation, industry was able to step up to the challenge and develop products that met or exceeded the near-zero standards [58, 59]. Additionally, the DEF infrastructure was also developed to support the launch of SCR systems across the fleet by 2010. [NHTSA-2014-0132-0102-A1 p.15]

By contrast, most of the engine technologies needed for the Phase 2 program, are known and the development is evolutionary in nature. Even in the case of WHR, its development is advanced when compared to some of the criteria pollutant technologies when EPA set the 2007/2010 standards – such as Urea SCR or NO<sub>x</sub> adsorber catalysts. [NHTSA-2014-0132-0102-A1 p.15]

### 5.4 SWRI Report #2 Commissioned by NHTSA, June 2015 [43]

This SWRI report is the second of two reports commissioned by NHTSA. The report evaluates the effectiveness of packages (“Combo Packages”) of the individual technologies studied in Report #1 [42]. [NHTSA-2014-0132-0102-A1 p.18]

**The conclusions reached regarding HD tractor engine fuel savings are shown in Figure 8.** [NHTSA-2014-0132-0102-A1 p.19]

[Figure 8 can be found on p.19 of docket number NHTSA-2014-0132-0102-A1]

Waste heat recovery was modeled separately as a stand-alone Rankine cycle – with water, R245fa, ethanol and methanol working fluid options. The R245 WHR system was claimed to provide benefits of 3 to 3.5% over Combo Package 2, described in Figure 8. Adding a recuperator to the R245 system increased the fuel savings to well over 4%. Comparing the Combo Package 3 systems to the 2019 baseline, the overall benefits at 55 and 65 mph and on the NESCCAF cycle reach and sometimes exceed 10%. The results for all technology combinations included in the study are shown in Appendix G [see p.42]. [NHTSA-2014-0132-0102-A1 p.19]

Given the nature of this second study, where technology packages are created from semi-arbitrary parametric value ranges, it would be difficult if not impossible to make a forecast for the future performance of these technologies. However, the report attempted to draw quantitative conclusions nonetheless: [NHTSA-2014-0132-0102-A1 p.19]

*“One surprise that came out of this project is the relatively large benefit from engine friction reduction in long haul applications”*

*“Assuming a reduction in FMEP ranging from 10% at high speed and load, to 35% at low speed and light load, significant benefits were found”*

*“An aggressive reduction in Cd (25%) and Crr (30%) provides nearly a 20% fuel consumption reduction on the long haul NESCCAF cycle” [NHTSA-2014-0132-0102-A1 p.19]*

The SuperTruck projects [30-35] were nearing completion as this report [43] and its partner report [42] were being written, yet no attempt to obtain data for comparative purposes is reported, and no comparisons are made in order give a point of reference for the conclusions. [NHTSA-2014-0132-0102-A1 p.19]

#### 5.5 Draft RIA [15]

The draft RIA reviews available technologies for HD diesel engines in Section 2-3: [NHTSA-2014-0132-0102-A1 p.19]

- Low Temperature Exhaust Gas Recirculation Reduction
- Model Based Control System
- Combustion System Optimization
- Turbocharging System
- Engine Breathing System
- Engine Parasitic and Friction
- Integrated Aftertreatment
- Engine Downsizing
- Waste Heat Recovery

Relative to WHR, the Draft RIA states that: [NHTSA-2014-0132-0102-A1 p.19]

*“... at a single optimal engine operating point, Cummins reports potential efficiency gains from WHR on the order of 2.8 percent points from the engine without WHR.”*

Important qualifiers are necessary: [NHTSA-2014-0132-0102-A1 p.19]

- This data is over 2 years out of date, having been presented at the 2013 DOE Annual Merit Review [30];
- The 2.8% efficiency gain in question is Brake Thermal Efficiency – which when converted to CO2 or fuel savings is a 4-5% reduction; and
- More recent data from Cummins showed potential for a 3.6% BTE improvement [31], which is a 5-6.5% reduction of CO2 and fuel consumption.

The agencies expressed their concern with WHR technology readiness, citing complexity, reliability, durability, weight, heat rejection and other concerns. However, while the agencies' recognized the challenges that would need to be overcome, they also stated that they – “believe with enough time and development effort, this can be done” [15]. [NHTSA-2014-0132-0102-A1 p.19-20]

The agencies took a similarly conservative view of potential combustion system improvements to reduce CO2 and fuel consumption, Page 2-8 Draft RIA [15]: [NHTSA-2014-0132-0102-A1 p.20]

*“Alternative combustion processes such as homogeneous charge compression ignition (HCCI), premixed charge compression ignition (PCCI), low-temperature combustion (LTC), and reactivity controlled compression ignition (RCCI) technologies were not included in the feasibility analysis for Phase 2”* [NHTSA-2014-0132-0102-A1 p.20]

Given the significant research efforts on advanced combustion (Appendix A, Figure 17) and the progress being demonstrated [27, 28, 31], it is to be expected that some level of improvement in combustion technology will bleed through into product development programs over the next 12 years, providing reductions of GHG emissions and fuel consumption. [NHTSA-2014-0132-0102-A1 p.20]

#### 5.6 Cummins SuperTruck Program [31]

Key engine technologies used by each of the four projects are listed in Appendix H [see p.43], for reference. [NHTSA-2014-0132-0102-A1 p.21]

The Cummins SuperTruck project is a consortium of industry partners, with Peterbilt providing vehicle integration expertise. Other partners include Modine, Oakridge National Lab and Purdue University. Cummins closed out the project in Q2 2015 having met all of the objectives. [NHTSA-2014-0132-0102-A1 p.21]

#### 5.7 Daimler SuperTruck Program [32, 33]

The Daimler SuperTruck program is a consortium of industry partners including: Detroit Diesel, Schneider National, Walmart, National Renewable Energy Lab, Oregon State University, Strick Trailer and Michelin. This project was completed successfully and closed March 2015. [NHTSA-2014-0132-0102-A1 p.21]

[Figure 10 and 11 can be found on p.21 and figure 12 and 13 can be found on p.22 of docket number NHTSA-2014-0132-0102-A1]

#### 5.8 Volvo SuperTruck Program [34]

The Volvo SuperTruck consortium members are: Penn State, Grote, Freight Wing and Ridge Corporation. This project continues and is expected to complete by June 2016. [NHTSA-2014-0132-0102-A1 p.22]

### 5.9 Navistar SuperTruck Program [35]

The Navistar SuperTruck consortium consists of: Bosch, Wabash, ANL and LLNL. This project is expected to close September 2016. [NHTSA-2014-0132-0102-A1 p.22]

### 5.10 NAS Review of the 21CTP: Third Report – September 11, 2015 [41]

This report is the third review of 21CTP by NAS. They found a number of important accomplishments, most notably by the projects that form the DOE SuperTruck Program: [NHTSA-2014-0132-0102-A1 p.22]

- “The engine systems Goal 1 of a 50% BTE for an emissions compliant engine has been achieved. Two of the four SuperTruck teams have successfully demonstrated BTE greater than 50% in on-road tests using commercial, ultra-low-sulfur diesel fuel” NAS [41].
- “It is anticipated that by the end of each of the respective SuperTruck programs, the teams will have developed a technology pathway for achieving 55% BTE” NAS [41].
- “The SuperTruck projects incorporated a number of vehicle power demand technologies that accounted for about 56 to 74 percent of the total fuel consumption reductions, with 26% to 44% coming from engine efficiency improvements” NAS [41]. [NHTSA-2014-0132-0102-A1 p.22]

The NAS committee has moved their focus from attaining HD engine technology for 50% BTE to defining the pathways to a HD engine attaining 55% BTE. While the NAS committee see 55% BTE as extremely challenging, they observed that all of the programs are pursuing improved friction and pumping, more effective air boosting systems, smaller auxiliary and accessory loads, and improvements in WHR, and that all teams are investigating advanced low-temperature combustion (LTC) approaches. [NHTSA-2014-0132-0102-A1 p.22]

### 5.11 Technology Cost Estimates

Tetra Tech, Inc. (TTI) was retained by NHTSA to work in conjunction with SWRI [42, 43] to study the cost of implementation of the key technologies for reducing GHG emissions and fuel consumption [44]. Due to the limited timeframe and funding available for the study, this analysis relied on existing MD/HD literature for price inputs. [NHTSA-2014-0132-0102-A1 p.22]

The TTI study [44] assessed the incremental retail prices for the implementation of the key technologies in constant 2011 U.S. dollars. The list of technologies and configurations identified by SwRI and included in the TTI study are shown in Figure 14. [NHTSA-2014-0132-0102-A1 p.22]

[Figure 14 can be found on p.23 of docket number NHTSA-2014-0132-0102-A1]

#### 5.11.1 WHR Cost / Retail Price Assessment [44]

TTI obtained their cost data from the open literature, and for WHR they relied upon two main sources – the NESCCAF/ICCT 2009 study [48] and TIAX 2009 report [36]. While these studies were the primary sources of the data, they also referenced secondary sources – NAS [37] and NHTSA [18], which in fact had relied upon the primary NESCCAF/ICCT and TIAX sources. Therefore all of the data used to project costs for the Phase 2 rulemaking process, for WHR, have their origins in two studies published in 2009, pre-dating the SuperTruck program. [NHTSA-2014-0132-0102-A1 p.23]

The NESCCAF/ICCT study, supported by TIAX and SWRI, based their WHR cost assessment on a steam cycle, with a multiple-stage turbine expander driving an electric generator with associated battery storage. The study found up to 8% fuel consumption and GHG reduction, at a cost of \$15,100 (\$30,200 retail price equivalent) and payback of 5.2 years. In this study, the WHR was sized for the full rated power of the engine. Later analysis by TIAX [36] found that most of the benefits could be realized using a smaller, lower cost system with fuel consumption savings and retail price equivalents of: [NHTSA-2014-0132-0102-A1 p.23]

- . 32 kW system – 8 percent reduction in fuel use, \$15,100
- . 12 kW system – 6 percent reduction in fuel use, \$8,400

According to TIAX [36], manufacturers could not provide firm costing information on these systems, as they were still in the development stage. However, they expected to be able to achieve payback in 18 to 24 months if development proceeds as projected. For a line-haul truck, this would suggest a low-end system cost of \$7,200 to \$8,400 for a system that gives 6 percent reduction of GHG emissions and fuel consumption [36]. [NHTSA-2014-0132-0102-A1 p.23]

The agencies used the TTI analysis as the basis for the cost / price assessments included in the Draft RIA [15]. In the case of WHR, the source data was created in 2009 for a system that has little in common with the state of the art demonstrated by the SuperTruck Program between 2010 and 2015 [30, 35]. [NHTSA-2014-0132-0102-A1 p.23]

The agencies estimated the cost of WHR at \$12,000 (retail, 2013\$) [15], based on the estimate from TTI [44]. From this data the agencies were able to use their models to estimate a Direct Material Cost of \$8,692. The agencies also attempted to place technologies on a ‘learning curve’ to project costs as experience is gained. This leads to the odd conclusion below, which seems to say that the agencies don’t want to consider a learning curve for WHR, because that would result in the projected costs being “too low.” [NHTSA-2014-0132-0102-A1 p.23]

*“We consider this technology to be on the flat portion of the learning curve (curve 12) because although waste heat recovery is a new technology and in the 2015 to 2017 timeframe remains, perhaps, on the steeper portion of the learning curve, applying such rapid learning effects to the cost estimate we have would result in costs too low in the MY2024 to 2027 timeframe.” Draft RIA section 2.12.2.15 [15].* [NHTSA-2014-0132-0102-A1 p.23]

Other engine technology costs and retail price equivalents used by the agencies as input to the determination of HD tractor engine stringency were also largely based on data that pre-dated the 2010 to 2015 SuperTruck Program – mainly the NESCCAF/ICCT 2009 study [48] and TIAX 2009 report [36]. [NHTSA-2014-0132-0102-A1 p.24]

To achieve these technology forcing standards it will be necessary for the following technologies to be developed: [NHTSA-2014-0132-0102-A1 p.25]

- Waste Heat Recovery / Organic Rankine Cycle
- Engine Design for Downsizing
- Advanced Combustion
- Advanced NOx and PM Aftertreatment
- Reduced Frictional Losses
- Advanced Adaptive Controls
- Reduced Accessory Losses
- Advanced Sensors
- Reduced Open Cycle Losses
- Increased Turbocharger Efficiency



Although the agencies have expressed concern that WHR is costly and complex – they also recognize that industry is capable of resolving these concerns given adequate lead time: [NHTSA-2014-0132-0102-A1 p.25]

*“The agencies believe manufacturers will improve these systems [WHR] over time just as they have for other advanced technologies that initially had high cost and complexity at a comparable stage of development” Draft RIA 2.3.9 [15].*[NHTSA-2014-0132-0102-A1 p.25]

It is important that the agencies elevate their support for WHR, advanced combustion and downspeeding, since these are key enablers for the technology forcing standards proposed above. Furthermore, this study finds that there is a high probability of successfully implementing these technologies by the time the standards are phased in. [NHTSA-2014-0132-0102-A1 p.25]

Given the 12 year lead time to product launch in 2027 and the relaxed engine standards proposed; if this rule moves forward in its current form it will make it impossible for truck and engine OEMs and tier 1 suppliers to continue to make investments in advanced engine technologies at the levels we have seen during the past 5-10 years. R&D funds are a scarce resource that will be withdrawn or reallocated to other priorities. [NHTSA-2014-0132-0102-A1 p.25]

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#### **Response:**

We respectfully disagree with many of arguments that pertain to a more aggressive engine standard stringency. We have reviewed the reports from four major vehicle OEMs (EPA-HQ-OAR-2014-0827-1894) as well as other comments made by individual vehicle OEMs (Daimler Truck North America and Navistar), which rebut the points made by the commenter. Specifically, we disagree with the approach taken by the commenter regarding the technology effectiveness from DOE’s SuperTruck program and NAS’s report. It appears that the commenter took single value out of these literatures, primarily based on peak values, such as their findings 1 and 2 related to 50% and 55% BTE. The values from the literature are single optimal operating points and not operation over the entire engine map. Further, those values were demonstrated in an R/D environment. In contrast, we consider stringency over the 13 modes of the SET, where the reduction over the composite is not as great as the reduction over the single, most efficient, operating point. The technology path for downspeeding proposed by the commenter is not practical, because while the peak torque of the engine moves down to an engine speed of around 800 rpm, the required high boost pressure cannot be maintained due to the engine’s low speed. We disagree with the commenter statements that we did not consider combustion technology. We do consider advanced combustion as one of the technologies as indicated in Chapter 2.7.5 of the RIA. We also disagree with the commenter’s comments on dis-synergy and synergy. We have updated our justification on the dis-synergy we used for our rulemaking, which can be found in Chapter 2.7.5 of the RIA and discussed below in RTC Section 3.4.3. While we disagree with many of the comments, we have responded to some in a positive manner. We have updated the cost tables associated with technologies, such as WHR, as shown in Chapter 2.11.2.15 of the RIA. We have made the standards more stringent. We increase the dis-synergy factor from 0.85 to 0.9, and increase the market penetration for WHR Rankine cycle technology from 15% to 25% in 2027, and included down speed benefits on engines. As a result of that, the tractor engine standards increase from 4.2% to 5.1% in 2027. Chapters 2.3 and 2.7 of the RIA detail the justification for this increase. For vocational engines, we have adjusted the vocational engine baseline CO<sub>2</sub> emission level based on the new certification data, strengthening the standards relative to the NPRM. Chapters 2.3 and 2.7 of the RIA detail the justification for this increase.

#### **3.4.1 Additional Discussion of Rankine Cycle Waste Heat Recovery**

**Response:**

As noted above, the agencies received numerous comments on the proposed engine stringencies and the agencies' assumed application rates of WHR.

More than 40 percent of all energy loss in an engine is lost as heat to the exhaust and engine coolant. For many years, manufacturers have been using turbochargers to convert some of this waste heat in the exhaust into usable mechanical power that is then used to compress the intake air. Manufacturers have also been developing a Rankine cycle-based system to extract additional heat energy from the engine. Such systems are often called waste heat recovery (WHR) systems. The possible sources of waste heat energy include the exhaust, recirculated exhaust gases, compressed charge air, and engine coolant. The basic approach with WHR is to use waste heat from one or more of these sources to evaporate a working fluid, which is passed through a turbine or equivalent expander to create mechanical or electrical power, then re-condensed.

For the proposal, the agencies projected that by 2027, 15 percent of tractor engines would employ WHR systems with an effectiveness of better than three percent. Some of the comments included confidential data related to systems not yet on the market. (As CBI, these comments are not fully addressed above). After carefully considering all of these comments, we have revised our projections to increase the effectiveness, decrease costs, and project higher adoption rates than we proposed.

Prior to the Phase 1 Final Rule, the NAS estimated the potential for WHR to reduce fuel consumption by up to 10 percent.<sup>41</sup> However, the agencies do not believe such levels will be achievable within the Phase 2 time frame. There currently are no commercially available WHR systems for diesel engines, although research prototype systems are being tested by some manufacturers. American Trucking Association, Navistar, DTNA, OOIDA, Volvo, and UPS commented that because WHR is still in the prototype stage, it should not be assumed for setting the stringency of the tractor engine standards. Many of these commenters pointed to the additional design and development efforts that will be needed to reduce cost, improve packaging, reduce weight, develop controls, select an appropriate working fluid, implement expected OBD diagnostics, and achieve the necessary reliability and durability. Some stated that the technology has not been thoroughly tested or asked that more real-world data be collected before setting standards based on WHR. Some of these commenters provided confidential business information pertaining to their analysis of WHR system component costs, failure modes, and projected warranty cost information.

Alternatively, a number of commenters including Cummins, ICCT, CARB, ACEEE, EDF, Honeywell, ARB and others stated that the agencies should increase the assumed application rate of WHR in the final rule and the overall stringency of the engine standards. They argued the agencies' WHR technology assessment was outdated and too conservative, the fuel savings and GHG reduction estimation for WHR were too low, and the agencies' cost estimates were based on older WHR systems where costs were confounded with hybrid component costs and that these have since been improved upon. In addition, the agencies received CBI information supporting the arguments of some of these commenters.

Cummins stated the agencies underestimated the commercial viability of WHR and that we overstated the development challenges and timing in the NPRM. They said WHR can provide a 4 to 5 percent improvement in fuel consumption on tractor drive cycles and that WHR would be commercially viable and available in production as early as 2020 and will exceed the agencies' estimates for market penetration over the period of the rule. According to Cummins, the reliability of their WHR system has

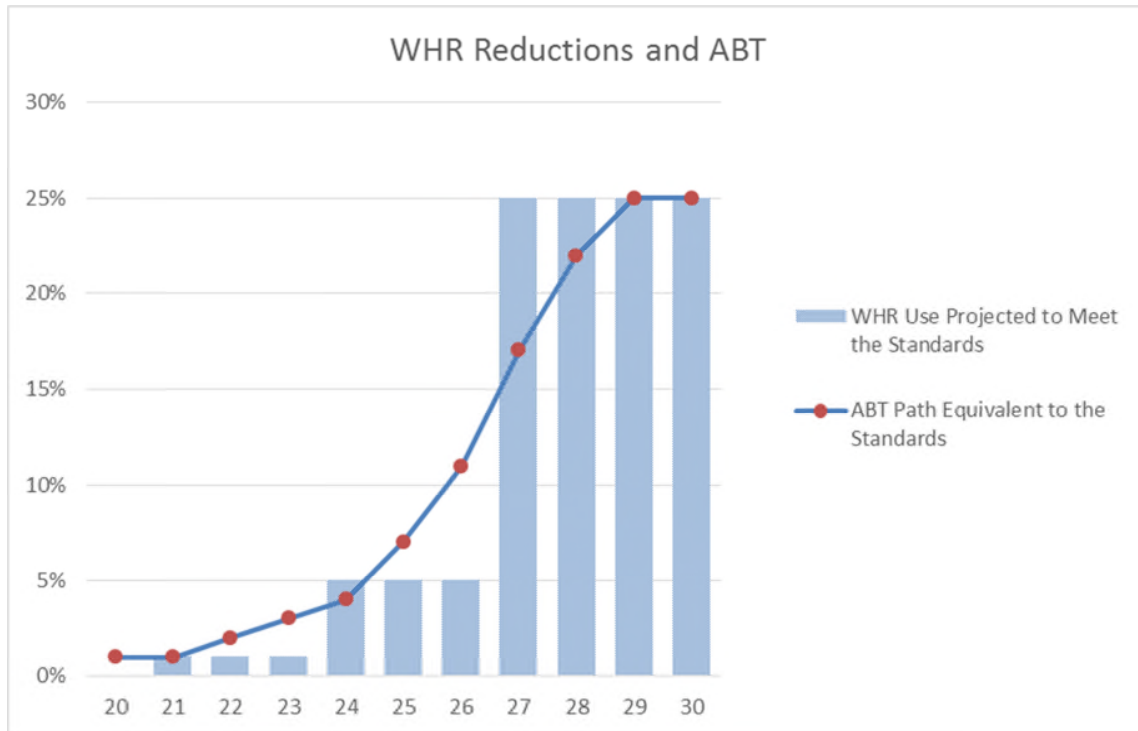
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<sup>41</sup> See 2010 NAS Report, page 57.

improved with each generation of the technology and they have developed a smaller system footprint, improved integration with the engine and vehicle and a low-GWP working fluid, resulting in a much more compact and integrated system. They added that their system would be evaluated in extended customer testing by the end of 2015, and that results of that experience will inform further technology development and product engineering leading to expected commercial product availability in the 2020 timeframe. Furthermore, they said multiple product development cycles over the implementation timeframe of the rule would provide opportunities for further development for reduced cost and improved performance and reliability.

Some commenters, including EDF, said the agencies' assumed design had little in common with the latest designs planned for production. They cited several publications, including the NAS 21<sup>st</sup> Century Truck Program report #3 and stated WHR effectiveness is much higher than the agencies estimated. Gentherm cited an ICCT study saying that up to a 12 percent fuel consumption reduction from a 2010 baseline engine is possible with the application of advanced engine technologies and WHR.

The agencies recognize that much work remains to be done, but we are providing significant lead time to bring WHR to market. Based on our assessment of each manufacturer's work to date, we are confident that a commercially-viable WHR capable of reducing fuel consumption by over three percent will be available in the 2021 to 2024 time frame. Concerns about the system's cost and complexity may remain high enough to limit the use of such systems in this time frame. Moreover, packaging constraints and lower effectiveness under transient conditions will likely limit the application of WHR systems to line-haul tractors. See RIA Chapter 2.3.9 for a detailed description of these systems and their applicability. For our analysis of the engine standards, the agencies project that WHR with the Rankine technology could be used on 1 percent of tractor engines by 2021, on 5 percent by 2024, and 25 percent by 2027, with nearly all being used on sleeper cabs. We project this sharper increase in market adoption in the 2027 timeframe because we have noted that most technology adoption rate curves follow an S-shape: slow initial adoption, then more rapid adoption, and then a leveling off as the market saturates (not always at 100 percent). We assumed an S-shape curve for WHR adoption, where we project a steeper rise in market adoption in and around the 2027 timeframe. Given our averaging, banking and trading program flexibilities and that manufacturers may choose from a range of other technologies, we believe that manufacturers will be able to meet the 2027 standards, which we based on a 25 percent WHR adoption in tractor engines. Although we project these as steps, it is more likely that manufacturers will try to gradually increase the WHR adoption in MY 2025 and MY 2026 from the 5 percent in 2024 to generate emission credits to smooth the transition to the 2027 standards. As shown in the figure below manufacturers that gradually increase the adoption rate after 2021 could achieve the standards with 17 percent adoption of WHR in 2025, and would not need to reach 25 percent adoption until 2029.



Commenters opposing the agencies' WHR projections argued that the real-world GHG and fuel consumption savings will be less than in prototype systems. DTNA said a heat rejection increase of 30 percent to 40 percent with WHR systems will require larger radiators, resulting in more aerodynamic drag and lower fuel savings from WHR systems. DTNA cited a Volvo study showing a 2 percent loss of efficiency with the larger frontal areas needed to accommodate heat rejection from WHR systems. Daimler stated effectiveness may be lower than expected since there is large drop off in fuel savings when the tractor is not operating on a steady state cycle and the real world performance of WHR systems will be hurt by transient response issues. Daimler and ACEEE said the energy available from exhaust and other waste heat sources could diminish as tractor aerodynamics improve, thus lowering the expected fuel savings from WHR. Daimler said because of this, WHR estimated fuel savings was overestimated by the agencies. Navistar said WHR working fluids will have a significant GHG impact based on their high global warming potential. They commented that fuel and GHG reductions will be lower in the real world with the re-weighting of the RMC which results in lower engine load, and thus lower available waste heat. However, none of these commenters have access to the full range of data available to the agencies, which includes CBI.

Daimler said that with increased freight movement by ship, barge, and rail, some steady-state long haul truck VMT would be replaced with more regional truck VMT over time. This Daimler said, would further reduce the effectiveness of WHR as an approach to lower GHG emissions and fuel consumption. However, this is very speculative.

It is important to note that the net cost and effectiveness of future WHR systems depends on the sources of waste heat. Systems that extract heat from EGR gases may provide the side benefit of reducing the size of EGR coolers or eliminating them altogether. To the extent that WHR systems use exhaust heat, they increase the overall cooling system heat rejection requirement and likely require larger radiators. This could have negative impacts on cooling fan power needs and vehicle aerodynamics. Limited engine compartment space under the hood could leave insufficient room for additional radiator size increasing.

Many of these issues disappear if exhaust waste heat is not recovered from the tailpipe and brought under the hood for conversion to mechanical work. In fact, it is projected that if a WHR system only utilizes heat that was originally within the engine compartment (e.g., EGR cooler heat, coolant heat, oil heat, etc.), then any conversion of that heat to mechanical heat actually *reduces* the heat rejection demand under the hood; potentially leading to smaller radiators and lower frontal area, which would actually lead toward improved aerodynamic performance. Refer to RIA Chapter 2.3.9 for more discussion, and in particular RIA at 2-17 describing how these engineering challenges can be successfully addressed.

Several commenters stated that costs are highly uncertain for WHR technology, both for manufacturers and for fleets. OOIDA, Volvo, ATA and UPS stated costs for WHR systems are uncertain yet somehow argued that the agencies' assumption of a \$10,523 cost in 2027 are likely significantly lower than reality. Volvo estimated a cost of \$21,700 for WHR systems. Volvo said that in addition to hardware cost being underestimated, the agencies had not properly accounted for other costs such as the R&D needed to bring the technology into production within a vehicle. Volvo said they would lose \$17,920 per unit R&D alone, excluding other costs such as materials and administrative expenses. Daimler said that costs almost always inflate as the complexity of real world requirements drive up need for more robust designs, sensors, controls, control hardware, and complete vehicle integration. They added that development costs will be large and must be amortized over limited volumes. Furthermore, OOIDA said the industry experience with such complex systems is that maintenance, repair, and down-time cost can be much greater than the initial purchase cost. ATA and OOIDA said that potential downtime associated with an unproven technology is a significant concern for the industry. They said if a truck goes out of service, the fleet must dispatch a tow truck to recover it and this could result in penalties for missed delivery times, added costs for the use of an additional truck, repair parts, and other related expenses. We agree that in-service failures can be costly, but the commenters overstate the risks of such failures. We are providing many years of lead time before WHR system would be widely needed to meet the standards (and potential alternative compliance pathways exist as well). This extended lead time includes the time needed for extensive field testing. See RIA Chapter 2.3.9 at 2-16 and 2-17 and Figure 2-1. Our conversations with manufacturers since they began implementing the 2007/2010 standards indicate that they learned important lessons about how to implement new technologies and have all developed internal processes to ensure that reliability problems are fully addressed before new technologies are widely introduced into the market.

On the other hand, some commenters argued that the agencies had actually overestimated WHR costs in the proposal. These commenters generally argued that engineering improvements to the WHR systems that will go into production in the Phase 2 time frame would lower costs, in particular by reducing components. For example, they cited the possibility of low-GWP working fluids that could result in much more compact and integrated systems. They added such a system would be evaluated in extended customer testing by the end of 2015, and results of that experience will inform further technology development and product engineering leading to expected commercial product availability in the 2020 timeframe.

EDF cited several publications such as Walsh/Charlton and John Wall stating the agencies' effectiveness assessment for WHR was overly conservative and based on outdated assumptions. Wall, EDF, and Walsh/Carlton said the agencies' assumed design had little in common with the latest designs planned for production. Wall, CARB, and others also stated the agencies underestimated the effectiveness of WHR systems.

The costs developed by the agencies were challenged by Cummins, Wall, ACEEE, EDF, and others. Cummins said costs developed in a report from Tetra Tech for NHTSA and referenced in the Draft RIA is based on references that pre-date the SuperTruck program. They added that improvements have

significantly lowered system cost since that study was published. John Wall commented that the agencies' assumption of cost was based in part on the 2009 NESCCAF study which used an electrical system with full hybridization. Wall said the WHR system included a 30 kW system and a full hybrid whereas a 10 kW system is used in more current designs. He added that current systems do not need an exhaust heat exchanger and other components assumed in the TIAX report and that a retail price equivalent of a 10 kW system would be \$4,760, less than half the agencies' cost estimate.

Wall said this substantially lower cost estimate should allow the agencies to consider a more significant penetration of WHR technology with acceptable cost effectiveness and a higher overall engine stringency. Similarly, Walsh/Charlton said the agencies' costs were based in part on a steam system with multiple expanders which is very different from today's designs.

The agencies largely agree with these commenters' estimates of costs (in particular, that the system evaluated at proposal contained certain elements which are unnecessary for the type of system and effectiveness projected for the final rule) and we have revised our analysis to reflect these lower costs. See RIA Chapter 2.11.2.15 for additional discussion.

A number of commenters took issue with the assumption made by the agencies that WHR is on the flat portion of the learning curve with regard to cost reduction potential, saying this overstates the costs of the technology over the long term. Cummins encouraged the agencies to apply a learning curve calculation that is more consistent with the continuing evolution of WHR system design and integration. In the final rule, we estimate that WHR is on the steep portion of the learning curve. See RIA Chapter 2.11.2.15.

The agencies have carefully evaluated comments submitted on the NPRM and information submitted on cost, technology effectiveness, and system design since the publication of the NPRM. As stated above, some of this information was submitted publicly in comments or attachments to comments and other information was provided as confidential business information. Taken together, these comments provide significant technical, cost, and manufacturing information, as well as other information that leads us to believe a higher application rate of WHR is possible in the 2027 timeframe. The agencies are not assuming any changes in the 2021 or 2024 introduction rates for WHR to allow manufacturers adequate research and development and testing time to bring the technology into production. Assuming low application rates of WHR in the early years of the Phase 2 program will allow manufacturers to integrate the technology over normal product development cycles. The agencies are, however, assuming a WHR adoption rate of 25 percent in 2027. As we have explained in RIA Chapter 2.3.9, some technological challenges remain, but we have outlined means of resolving these challenges successfully and provided manufacturers sufficient lead time to do so. We believe the significant information provided to the agencies in the public comments and CBI information after the publication of the NPRM further supports this approach for the 2027 timeframe.

In summary, while we understand the concerns raised by commenters opposing the agencies' assessment of WHR, we believe these concerns arise primarily from a lack of information. None of these commenters have access to the full range of data available to the agencies. In large part, this is because much of the most compelling information supporting the agencies' projection is considered to be CBI, and thus is not widely available. While the projections can be justified based on the public information, the CBI gives the agencies even greater confidence that these projections are reasonable. In addition, by projecting a maximum adoption rate of only 25 percent (with an effectiveness of about 4 percent), we limit the overall impact of this analysis to an average reduction of about one percent. While we project WHR to be an important engine technology, we do not base the standards completely on this one technology. Given the ten years of lead time before manufacturers must meet the 2027 engine standards, it is possible that some other engine technology may arise that would provide this one percent reduction without WHR. For example, manufacturers choosing to not invest in WHR, could potentially invest



instead in expanded use of other technologies such as model-based controls, turbo-compound, and downspeeding.

### **3.4.2 Additional Discussion of Confidential Business Information**

#### **Response:**

Given the competitive nature of the heavy-duty industry, manufacturers of components, engines, and vehicles very often consider information on technologies they are developing to be confidential business information (CBI). It is also true that manufacturer CBI is often the best information available when evaluating technological feasibility. In the interest of transparency and public participation, the agencies have tried to rely as much as possible on publicly available information, including our own research. Nevertheless, in establishing standards that are appropriate and achieve the maximum feasible reductions, we cannot avoid some reliance on CBI.

When using CBI, the agencies have applied the same standards of analysis as we have the publicly available information. We have given more weight to more detailed information that was fully documented; and less weight to less rigorous information. In general, the CBI supported the more public statements of these manufacturers. However, in some rare cases, cases, we found the public statements to be more optimistic and or more pessimistic than the data truly supported.

Overall, CBI played a limited but significant role in our feasibility analysis. The agencies were generally able to find public information to support our conclusions. For these technologies, the CBI was more corroborative than determinative. For example, as discussed in Section 3.4.1 above, CBI was very helpful to corroborate our analysis of WHR. However, even there, the impact on overall program was small. We project WHR to provide a roughly one-percent reduction for the tractor and tractor engine standards, which represents a small part of the overall program.

### **3.4.3 Additional Discussion of Dis-Synergy**

While many effective technologies are considered for this rulemaking, it is important to point out that the benefits of these technologies are not additive. For example, when multiple technologies are applied to an engine, it is incorrect to simply sum the individual technologies' effectiveness to arrive at an overall combined effectiveness of the technologies. We have received a number of public comments regarding this non-additive effect. Most of them focus on the agencies' projections of our so-called "dis-synergy" effect and our use of a dis-synergy factor to account for this effect. This effect could also be called a negative synergy because it is a decrease in technology effectiveness as a result of multiple technologies being applied to an engine. As used here, a factor less than one indicates a net dis-synergy, and a smaller factor indicates more dis-synergy and lower overall effectiveness.

As discussed in RIA Chapter 2.7.4, the agencies applied dis-synergy factors to our effectiveness estimates to reflect the degree to which combining multiple technologies reduces slightly the effectiveness of each individual technology. First, the weighted reductions of individual technologies were combined using the "II-formula," which was then augmented to account for technology dis-synergies that occur when combining multiple technologies. RIA Chapter 2.7.4 provides details on the "II-formula" and an explanation for how the dis-synergy factors were determined. Some commenters recommended that we adopt lower numeric values of our dis-synergy factors, but a few commenters recommended higher dis-synergy factors than what we proposed (i.e., less dis-synergy).

We also note that the degree of dis-synergy is sufficiently small to make the impact of any errors on the resulting standards negligible. For example, even a 0.05 difference in the dis-synergy factor would change the percent reduction of the 2027 engine standard only by about one-quarter of a percent.

#### *Causes of Dis-Synergy*

As background, it is helpful to first review how engine fuel efficiency technologies interact with one another. One example is the interaction between WHR and other technologies, such as combustion, friction reduction, and fuel injection system improvements. WHR effectiveness is directly proportional to the amount of thermodynamic available energy (i.e., energy available for conversion into mechanical work) provided from an engine's sources of waste heat. In a modern internal combustion engine, these sources include exhaust gas energy available from the EGR cooler and tailpipe, and from the coolant and lubricating oil systems. Therefore, decreasing the amount of available energy from these sources reduces the effectiveness of WHR. Some of the fuel efficiency technologies we identify in our stringency analysis decrease the amount of available energy from these sources. For example, advancing fuel injection timing will improve efficiency to a certain point, but it will also decrease available exhaust energy by lowering exhaust temperature, and thus exhaust WHR effectiveness would decrease. To a lesser extent, reducing bearing friction or piston ring-wall friction improves fuel efficiency, but this also leads to less heat transfer to the coolant; and hence lower available energy for WHR. As another example, increasing compression ratio can improve combustion thermal efficiency (until the peak cylinder pressure rises past a given mechanical limit), but this in turn increases friction losses at piston rings and bearings. As another example increasing fuel injection pressure provides more opportunity for fuel injection optimization (e.g., enabling more multiple injection events), which can improve fuel efficiency, but this will in turn increase fuel pump parasitic energy losses. In another example, increasing turbocharger efficiency can improve fuel efficiency, but this will also reduce EGR flow due to lower back pressure, thus potentially increasing NO<sub>x</sub>, and also reducing the exhaust gas energy that can be utilized by waste heat recovery devices, such as turbo-compound and Rankine cycle systems. Increasing NO<sub>x</sub> would also put more demand on the after-treatment system or force less fuel efficient fuel injection timing. There are more examples, but in conclusion, there are numerous complex interactions between fuel efficiency technologies.

### *Use of a Single Dis-Synergy Factor*

Fully evaluating all of the potential engine technology fuel efficiency dis-synergies would likely require a multi-million dollar multi-year effort. Such an analysis was not available to the agencies. However, it would not be appropriate to ignore such dis-synergies. Therefore, the agencies developed a single set of empirical constants to account for these known dis-synergies, based on the best information available.

The agencies' experience dealing with engine technologies strongly supports the likelihood that these interactions between technologies will have a net dis-synergy, and we thus we expect the factor to be less than one. And practically speaking, it is highly unlikely that adding a technology to an engine that leads to a dis-synergy factor on the order of 0.5 would even be considered a fuel efficiency improving technology. Therefore, the agencies focused on determining where within the range of 0.5-1.0 we should project this dis-synergy factor to be. We sought the most probable single dis-synergy factor that matches the diverse set of data that we collected. We determined a range of dis-synergy factors and the value of the factor depended in part on the selection of technology packages. We found that this constant varies in the range of 0.75 - 0.90. Some commenters recommended using a dis-synergy factor of 0.95, however, our analysis shows this would be inappropriately high and likely not achievable.

Based on our analysis, we have reduced our projection of dis-synergy compared to the NPRM analysis, but are still applying a dis-synergy factor that is less than one. More specifically, we applied dis-synergy factors of 0.85 for MY 2021 and 0.90 for MY 2024 and MY 2027. We project these improvements to result from manufacturers increasing their research and development efforts to optimize engine technologies together as a package, in order to comply with the HD Phase 2 engine standards. The agencies have accounted for our projected increased investment in research and design by including respective incremental vehicle cost increases in our cost analysis. In other words, by increasing the dis-synergy factor from 0.85 to 0.90, our MY 2024 and MY 2027 engine standards reflect projections of increased technology package optimization.

### **3.5 Proposed EPA Engine Standards for N<sub>2</sub>O**

**Organization:** Advanced Engine System Institute (AESI)

AESI supports the Agency's efforts to tighten the nitrous oxide (N<sub>2</sub>O) cap to ensure that efficiency enhancements made by engine manufacturers to reduce carbon dioxide pollution do not lead to unintended increases of this other potent greenhouse gas. The changes in engine technology to meet Phase 2 overall, particularly the great likelihood that the new more efficient engines will produce a higher volume of nitrogen oxides, will make meeting that new N<sub>2</sub>O cap challenging. Our members are working now on the cutting edge materials necessary to limit N<sub>2</sub>O formation. [EPA-HQ-OAR-2014-0827-1152-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.292.]]

**Organization:** American Gas Association (AGA) et al.

#### **We Strongly Support Preserving the Compliance Pathway Flexibility**

In the HD Phase 1 Rule,<sup>2</sup> the agencies adopted provisions that allowed original equipment manufacturers (OEMs) to offset any nitrous oxide (N<sub>2</sub>O) and methane emissions above the standard with carbon dioxide (CO<sub>2</sub>) emissions below the standard. Under this approach, an OEM would convert measured N<sub>2</sub>O and methane emissions levels generated on the engine certification test cycle into a CO<sub>2</sub>-equivalent credit.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

We strongly support the maintenance of this provision in the Phase 2 Proposal. Doing so preserves the valuable compliance pathway flexibility for cross-pollutant trading of methane, N<sub>2</sub>O, and CO<sub>2</sub>. We further note that this flexibility is not only beneficial to the OEMs in the natural gas sector that use it to offset methane emissions with CO<sub>2</sub>-equivalent credits, but it is also a necessity for some diesel engine OEMs who use the provision to offset high N<sub>2</sub>O emissions with CO<sub>2</sub>-equivalent credits. [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

### **We Support the Proposed Deterioration Factors for Natural Gas Tailpipe Emissions**

Westport and Cummins Westport Inc. (CWI) have reviewed the proposed deterioration factors (DFs) for natural gas tailpipe emissions and do not have sufficient data or a strong rationale to propose alternate DFs at this time. Accordingly, we support the agencies' proposed DFs of 0.0 g/hp-hr for CO<sub>2</sub>, 0.020 g/hp-hr for N<sub>2</sub>O (0.010 g/hp-hr for model year 2021 engines and later), and 0.020 g/hp-hr for methane.<sup>29</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

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2 "Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rule." Federal Register, September 15, 2011. <http://www.gpo.gov/fdsys/pkg/FR-2011-09-15/pdf/2011-20740.pdf>. (Hereafter cited as the "HD Phase 1 Rule")

3 Phase 2 Proposal, page 40341.

29 Phase 2 Proposal, page 40587.

**Organization:** American Automotive Policy Council

**Deterioration Factors (DFs)** – AAPC suggests that DFs for CH<sub>4</sub>, N<sub>2</sub>O, and CO<sub>2</sub> can be both positive and negative. Testing at 4,000 miles is sometimes worst case and future rules need to allow for negative DFs. [EPA-HQ-OAR-2014-0827-1238-A1 p.12]

**Organization:** American Automotive Policy Council

### **2021 MY N<sub>2</sub>O stringency increase on dyno-tested engines**

AAPC is concerned that the long term costs and benefits attributed to lowering the heavy-duty N<sub>2</sub>O standard to 0.05 g / hp-hr may not be properly reflected in the RIA. We note that EPA included a simple graph of reported N<sub>2</sub>O vs the Phase 1 requirement of 0.100 g / bhp-hr as supporting rationale to lower the standard to 0.05 g/hp-hr. However, the data appears to be incomplete. Furthermore, EPA only recently finalized N<sub>2</sub>O measurement equipment requirements, and AAPC is concerned that the reported data in EPA's database may be underestimating actual N<sub>2</sub>O emissions. Quantum Cascade Laser (QCL) equipment is more sensitive to N<sub>2</sub>O than the historical data which was most likely collected using Fourier Transfer Infrared Spectroscopy (FTIR) type equipment. Merely switching to more sensitive measurement equipment may cause a large fraction of N<sub>2</sub>O measurements to increase beyond the 50 mg/bhp-hr threshold and thus incur an effective increase in stringency of 3 – 6 g/bhp-hr not properly reflected in the RIA. See data on the next page comparing N<sub>2</sub>O results using FTIR and new QCL equipment. [EPA-HQ-OAR-2014-0827-1238-A1 p.27]

[Chart, comparison of N<sub>2</sub>O emissions, can be found on p.28 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

Adjusting for changes in measurement from FTIR to QCL suggest that the standard would be more appropriately set at a value of 0.06 g/hp-hr N2O in lieu of the proposed 0.05 g/hp-hr. [EPA-HQ-OAR-2014-0827-1238-A1 p.28]

**Organization:** American Power Group Inc (APG)

As the Proposed Phase II regulations allow CO2 reported results to be taken from the FTP-HDT HHDD test for vocational vehicle engines and from the RMC13 HHDD test for line haul vehicle engines, but all HHDD vehicle engine CH4 and N2O reported emissions come from the FTP-HDT HHDD tests, would the EPA consider allowing the CH4 and N2O emission reported results for come from the RMC13 HHDD test for line haul vehicle engines? The RMC13 test results are more representative of the line haul vehicle duty cycle.[EPA-HQ-OAR-2014-0827-1197 p.2]

The current GHG regulations have HHDDE reportable CO2 results from the FTP-Heavy Duty Transient test cycle for vocational HHDDE vehicles and Ramped Modal Cycle 13 test for line-haul HHDDE vehicles. All N2O and CH4 reportable HHDDE values come only for the FTP-HDT test results. As the APG Mixed-Fuel system is utilized by line haul HHDDE vehicles we would respectfully request that EPA allow all GHG emission values for HHDDE vehicle line haul applications be taken from the RMC 13 test results as the RMC 13 test more represents our customers duty-cycle. Is there some reason the CH4 and N2O reportable results are only used from the FTP-HDT cycle test? [EPA-HQ-OAR-2014-0827-1197-A1 p.4]

**Organization:** Cummins, Inc.

*Cummins supports use of assigned deterioration factors (DFs) for GHG emissions* [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

For reasons outlined in EMA's comments, Cummins supports the use of assigned DFs for CO2 emissions. Furthermore, it is also appropriate to apply assigned DFs for CH4 and N2O emissions. In the Preamble, the Agencies indicated the same assigned DFs used for diesel engines are appropriate for natural gas engines. Cummins agrees with this assessment. [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

*Cummins opposes reducing the N2O standard to 0.05 g/hp-hr* [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

For reasons outlined in EMA's comments, Cummins opposes reducing the N2O standard to 0.05 g/hp-hr. [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

Additionally, the Agencies are requesting comment on changing the GWP for CH4 and N2O for Phase 2. Changes should only be made if they are Agency-wide, consistent across all GHG programs (for example, light-duty, GHG inventories, reporting rules, etc.). Also, to the extent that Phase 1 credits are carrying over and can be used for CH4 and N2O compliance in Phase 2, maintaining the same Phase 1 GWP values is appropriate. [EPA-HQ-OAR-2014-0827-1298-A1 p.31]]

**Organization:** Daimler Trucks North America LLC

The agencies must revise the N2O proposal, as the agencies improperly analyzed N2O data and failed to take account for the fact the increased stringency of the currently-proposed CO2 standards will result in greater difficulty to meet even existing N2O standards. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

## 6. N<sub>2</sub>O

**EPA proposes to set an N<sub>2</sub>O standard of 0.05 g/bhp-hr which based on their assessment of model year 2015 engines.** (80 FR 40203). EPA's certification data base shows that the N<sub>2</sub>O emissions standard of 0.10 g/bhp-hr is stringent for the majority current diesel fueled heavy-heavy duty engine– ATS technologies (Figures 1 -3). Due to fundamental tradeoffs of SCR and engine technology, the increased stringency of proposed CO<sub>2</sub> standards will result in greater difficulty to meet the existing 0.10 g/bhp-hr N<sub>2</sub>O standards, thereby the standard will maintain its intended purpose of being anti-backsliding at this level. [EPA-HQ-OAR-2014-0827-1164-A1 p.24] We agree with the N<sub>2</sub>O formation and the reduction mechanism (80 FR 40204) as discussed in EPA's literature review of research studies. However, it is also important to note, that there is a tradeoff to consider when lowering the CO<sub>2</sub> standards concurrently with lowering the N<sub>2</sub>O standards. This trade-off does not go hand-in-hand with each other. CO<sub>2</sub> emissions standards that are proposed for Phase 2 demand the most fuel efficient in-cylinder technologies, while keeping the extremely low tailpipe NO<sub>x</sub> emissions. The demand for increasingly efficient in-cylinder combustion technologies will be driven by the proposed decrease in CO<sub>2</sub> emissions standards and will drive manufacturers to develop engines with higher engine-out NO<sub>x</sub> levels. On a given SCR based technology, N<sub>2</sub>O formation over the SCR based catalyst increases proportionally with increased engine out NO<sub>x</sub> levels as has been discussed in the N<sub>2</sub>O formation section by EPA in the literature review. This is true even for the most advanced SCR catalyst technologies in the market today. Consequently engine manufacturers will be extremely challenged to maintain current N<sub>2</sub>O limits while pursuing combustion based fuel efficiency improvements at the same time as maintaining compliant NO<sub>x</sub> levels. CO<sub>2</sub> emissions and tail pipe N<sub>2</sub>O emissions trends for a SCR based catalyst technology are shown in Figures 4,5. As depicted in Figure 5, maximum N<sub>2</sub>O formation occurs in the mid-temperature range. Although in theory, N<sub>2</sub>O formation could be reduced by elevating temperatures above this range, it is not possible to push temperatures upwards by using the engine thermal management without greatly sacrificing fuel economy and CO<sub>2</sub> emissions. [EPA-HQ-OAR-2014-0827- 1164-A1 p.24-25]

We disagree with EPA comment that “We are proposing this change at no additional cost and no additional benefit because manufacturers are generally meeting the proposed standard today.” EPA's data base upon which it determined its proposed N<sub>2</sub>O formation level (Figures 1-3) of 0.05 g/bhp-hr shows that the anti-backsliding standards are not being met by most of the manufacturers today. In fact, only two of fifteen heavy-heavy duty engine families were certified at levels that would suggest the possibility of complying with a 0.05 g/bhp-hr standard for engines that are certified to 2014 model year N<sub>2</sub>O formation levels. As discussed above, pressures to develop to 2017 model year's lower CO<sub>2</sub> levels can be expected to further increase N<sub>2</sub>O emissions, as will any additional increases in Phase 2 CO<sub>2</sub> stringency. [EPA-HQ-OAR-2014-0827-1164-A1 p.25]

Due to increased engine efficiencies demanded of in-cylinder technologies for GHG Phase 2 and the increased upcoming demands from ATS for commensurately increased NO<sub>x</sub> conversion efficiencies, the tailpipe N<sub>2</sub>O emissions must be kept at the current 0.10 g/bhp-hr with the current default deterioration factor of 0.02 g/bhp-hr. DTNA recommends that to meet EPA's intent of setting a standard that allows adequate compliance margin, the N<sub>2</sub>O standard be set no lower than 0.10 g/bhp-hr. [EPA- HQ-OAR-2014-0827-1164-A1 p.25]

Although EPA has stated that it proposes no changes to criteria pollutant emission standards within the Phase 2 regulation, DTNA is aware that the California Air Resources Board has strong interest in lowering heavy duty diesel NO<sub>x</sub> standards to mitigate ambient Ozone concerns in certain regions of their state. As was described above, there is an adverse relationship between improving in cylinder efficiency and the SCR systems ability in reducing engine out NO<sub>x</sub> to meet tailpipe emissions standards while at the same time controlling N<sub>2</sub>O emissions. Any reduction in tailpipe NO<sub>x</sub> standards will commensurately

increase the difficulty of meeting N<sub>2</sub>O standards especially while under simultaneous pressure to meet more stringent CO<sub>2</sub> standards. DTNA therefore recommends that in order to maintain a reasonable balance between these various tradeoffs, and in order to ensure that N<sub>2</sub>O targets remain feasible, the EPA should not tighten the current NO<sub>x</sub> limits. [EPA-HQ-OAR-2014-0827-1164-A1 p.25]

[Figures 1-3, which show that the N<sub>2</sub>O emissions standard of 0.10 g/hp-hr is stringent for the majority of current diesel field heavy-duty engine ATS technologies, and Figures 4 and 5, which show CO<sub>2</sub> emissions and tail pipe N<sub>2</sub>O emissions trends for a SCR based catalyst technology, can be found on p. 26-27 and p.27-28 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **Nitrous Oxide (N<sub>2</sub>O)**

While total N<sub>2</sub>O emissions are much lower than CO<sub>2</sub> emissions, N<sub>2</sub>O is approximately 298 times more powerful than CO<sub>2</sub> at trapping heat in the atmosphere. One of the anthropogenic activities producing N<sub>2</sub>O in the U.S. is fuel combustion in motor vehicles. In 2006, N<sub>2</sub>O emissions from mobile source combustion were approximately 9% of total U.S. N<sub>2</sub>O emissions. N<sub>2</sub>O is emitted directly from motor vehicles and its formation is highly dependent on temperature, NO<sub>2</sub> to NO<sub>x</sub> ratio entering the SCR catalyst, ammonia to NO<sub>x</sub> ratio, the SCR catalyst formulation and the temperature of the catalyst over the test cycle. Temperatures favorable for N<sub>2</sub>O formation (approximately 250o C) are achieved inside catalytic converter systems, especially during cold-start conditions when engine exhaust temperatures are lower. [EPA-HQ-OAR-2014-0827-1210-A3 p.8]

EPA is proposing to tighten the N<sub>2</sub>O cap and deterioration factor by 50% from 100 mg/bhp-hr to 50 mg/bhp-hr and 20 mg/bhp-hr to 10 mg/bhp-hr, respectively. This is to ensure that climate change impacts of this potent greenhouse gas are minimized on future medium- and heavy-duty vehicles. Furthermore because 75% of engine families certified in 2014 already meet a 50 mg/bhp-hr N<sub>2</sub>O level, the agency is concerned that engine manufacturers may emit higher levels in the future as they optimize the overall CO<sub>2</sub> emissions of engines. EPA estimates that a 40 mg/bhp-hr N<sub>2</sub>O emission reduction has the CO<sub>2</sub> equivalent climate impact of a 2.6% improvement in engine efficiency. Although MECA members believe that meeting the proposed N<sub>2</sub>O levels will be achievable, it will be challenging given the types of engine developments that we expect to see in the future. In particular we expect that future engines will have higher engine-out NO<sub>x</sub> levels in the exhaust as a way of achieving lower CO<sub>2</sub> levels. Furthermore, overall cooler exhaust temperatures may be expected as a result of efficiency technologies such as turbo-compounding being deployed upstream of the exhaust emission control system. Furthermore, it is important to consider N<sub>2</sub>O emissions in-light of future regulations such as the 0.02 g/bhp-hr heavy-duty NO<sub>x</sub> standard under consideration by California. Below, we discuss the primary formation mechanisms for N<sub>2</sub>O and some approaches that may be used in the future to achieve lower levels of N<sub>2</sub>O emissions on future diesel engines. [EPA-HQ-OAR-2014-0827-1210-A3 p.8-9] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.211-212.]]

At low temperatures, around 250o C, the predominant mechanism for N<sub>2</sub>O formation is by the decomposition of ammonium nitrate, whereas at high temperatures, above 500o C, the primary mechanism is ammonia oxidation. Nitrous oxide can form at intermediate temperatures (300-3500 C) if the NO<sub>2</sub> to NO<sub>x</sub> ratio exceeds 50%. Excess ammonia injection across the SCR catalyst can also lead to an increase in N<sub>2</sub>O formation if the ammonia to NO<sub>x</sub> ratio exceeds 1.0. A recent study published by the Society of Automotive Engineers (SAE Technical Paper 201301-2463) concluded that the test cycle, cycle exhaust temperature, system design and urea injection calibration all play a role in the formation of

N<sub>2</sub>O on the SCR catalyst. The authors observed that the inlet conditions of the SCR catalyst had the greatest effect on the formation of nitrous oxide. [EPA-HQ-OAR-2014-0827-1210-A3 p.9]

Another SAE technical paper (2015-01-0997) studied the effect of SCR catalyst type on the formation of N<sub>2</sub>O. The authors observed that the lowest N<sub>2</sub>O emissions were observed from a vanadia/titania SCR and Cu-zeolite SCR systems. Furthermore the Cu-zeolite SCR exhibited little deactivation after aging. The authors found that the system design, linear versus muffler, can impact the overall NO<sub>x</sub> performance and N<sub>2</sub>O emissions as a result of the average temperature of the SCR catalyst in each configuration relative to the optimal temperature for N<sub>2</sub>O formation. Upstream components such as the DOC and DPF can also impact the N<sub>2</sub>O levels based on their relative activity to form higher NO<sub>2</sub>/NO<sub>x</sub> ratio feedgas to the SCR. The authors of this paper discuss ways to formulate the precious metal composition and loading on the DOC and DPF to minimize their contribution to N<sub>2</sub>O formation while still maintaining high NO<sub>x</sub> conversion efficiency. For all SCR systems, the N<sub>2</sub>O emissions could be reduced by tighter urea dosing control to limit excess ammonia, by targeting an optimal amount of ammonia storage in the SCR catalyst and reducing engine-out NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1210-A3 p.9]

In another recent paper published at the 2015 SAE Congress (SAE paper Number 201501-1030), the authors looked at ways to design the SCR catalyst architecture to target lower N<sub>2</sub>O emissions from the system. Because the front part of the SCR catalyst is more prone to form N<sub>2</sub>O, the authors looked at coating the front of the SCR substrate with a vanadia-SCR formulation and the rear of the substrate with a standard Cu-zeolite SCR. Further optimization may be possible through the use of modeling tools to identify the SCR formulation and coating volume combinations that minimize N<sub>2</sub>O emissions and maximize NO<sub>x</sub> conversion. [EPA-HQ-OAR-2014-0827-1210-A3 p.9]

Advanced gasoline and diesel powertrains for medium- and heavy-duty vehicles in conjunction with advanced emission control technologies can be optimized to minimize N<sub>2</sub>O emissions. Catalyst manufacturers can utilize a number of approaches to reduce N<sub>2</sub>O emissions from the exhaust emission control components and therefore MECA believes that the proposed N<sub>2</sub>O emission cap is achievable with the use of appropriately designed emission controls on today's medium- and heavy-duty powertrain options. The proposal further provides manufacturers with the flexibility of meeting emission caps or factoring in emissions of N<sub>2</sub>O or CH<sub>4</sub> into the CO<sub>2</sub>-equivalent emissions calculation of the overall vehicle. MECA supports continuing this proposed flexibility introduced under Phase 1 of this regulation. [EPA-HQ-OAR-2014-0827-1210-A3 p.9-10]

**Organization:** Navistar, Inc.

In order to meet the proposed N<sub>2</sub>O standard, manufacturers would have to introduce technologies that will not be available prior to 2020. The alternative would be to trade CO<sub>2</sub> for reduced engine out NO<sub>x</sub> in order to control N<sub>2</sub>O for current aftertreatment technologies, effectively reducing the emission standard. In addition, the expected margin that is to be built into fuel maps actually will result in an additional estimated 3% of stringency to the engine standard, now requiring a 4.5% improvement between 2017 and the first step of Phase 2, which is again a technology forcing step in stringency. On the other hand, with this added margin the final phase will represent a greater than 10% improvement over the engines currently on the road today with less than 10 years for technology development and implementation. [EPA-HQ-OAR-2014-0827-1199-A1 p.21]

The major concerns with the technology projections and penetrations for both vocational and tractor engine standards include: [EPA-HQ-OAR-2014-0827-1199-A1 p.21]



- Insufficient technologies have been identified, particularly considering the proposed changes in N2O [EPA-HQ-OAR-2014-0827-1199-A1 p.22]

Changes to engine breathing systems, such as improved EGR systems, may run counter to the N2O requirement and impact the reliability of the system [EPA-HQ-OAR-2014-0827-1199-A1 p.22]

Navistar has substantial concerns regarding the proposed 50% reduction in the N2O standard. The NPRM and RIA both assume no technology changes are necessary to meet the standard. On the contrary, Navistar believes that some technology will be necessary, likely a redesigned catalyst or catalyst with new materials. [EPA-HQ-OAR-2014-0827-1199-A1 p.23]

The NPRM requested comments based on the assumption that there would be no costs associated with a reduction of the engine N2O standard from 0.10 g/bhp-hr with an assigned DF of 0.02 g/bhp-hr to a proposed standard of 0.05 g/bhp-hr with a DF of 0.01 g/bhp-hr. We believe this is incorrect and that there will be costs associated with this change. [EPA-HQ-OAR-2014-0827-1199-A1 p.23]

As part of the EPA evaluation for the proposed standard EPA presented an evaluation of the Model Year 2014 EPA certification database. Based on a review of the data presented and the current EPA database, here are several observations: [EPA-HQ-OAR-2014-0827-1199-A1 p.23]

- The DF is not included in the data presented by the EPA. Figure 1 (Attachment A) shows the sample of engines used in the NPRM shown with and without the manufacturer declared DF (unless the family has a zero DF in the database). [EPA-HQ-OAR-2014-0827-1199-A1 p.23]
- Two of the 24 families EPA included in their discussion of N2O test data are non-2SCR equipped engine families (blue-green bars in Figure 1). It is not anticipated that any non-SCR diesel engines will be used in the HD on-highway segment by the time the Proposed Regulations are to take effect. Therefore, these families are not relevant to the proposed N2O standard. [EPA-HQ-OAR-2014-0827-1199-A1 p.23]
- Two of the 24 data points EPA included in their analysis are natural gas fueled engines and another is a gasoline engine. These engines are also not SCR equipped engines and therefore are not relevant to the proposed N2O standard. [EPA-HQ-OAR-2014-0827-1199-A1 p.23]
- An evaluation of the remaining 19 engine families shows the following, assuming a 0.01 g/bhp-hr DF (Figure 1): [EPA-HQ-OAR-2014-0827-1199-A1 p.24]
  - 6 families have test data below the 0.05 g/bhp-hr
  - 5 families have test data approximately at 0.05 g/bhp-hr
  - 9 families have test data above 0.05 g/bhp-hr.
- The evaluation of the 2014 engines also shows that these EPA tested engines are not all at the CO2 standard. The range of engines spans both Vocational and Tractor applications and are shown in Figure 2 and 3, respectively, against the Medium Vocational and the Tractor standard. The same engines are separated between Vocational Medium, Vocational Heavy and Tractor based on displacement and shown in a N2O vs CO2 trade-off in Figures 4-6. All tractor engines fall outside the Phase II N2O-CO2 box. Similarly, a large population of heavy and medium vocational vehicles does not fall within the box. A trade-off trend is observed across the population of engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.24]

Based on the certification data at least half of the currently certified engine families would need to make significant reductions in N<sub>2</sub>O emissions in order to meet the proposed standard. Furthermore, bringing these engines into CO<sub>2</sub> compliance could drive increases in N<sub>2</sub>O if not mitigated by system improvements. [EPA-HQ-OAR-2014-0827-1199-A1 p.24]

Some of the projected technologies (see attached Table 2) do not have an impact on N<sub>2</sub>O such as friction reductions, WHR and turbo compound. The other technologies can actually have an adverse effect, for example, reductions in EGR and higher compression ratio combustion systems. Therefore, to meet the proposed N<sub>2</sub>O standard most of the certified engines would require technology development in aftertreatment, such as SCR (SCR combined with DPF in one unit). Hence, an assumption of no additional cost is not accurate. [EPA-HQ-OAR-2014-0827-1199-A1 p.24]

[Table 2 can be found on p.44 of the docket]

As far as the interaction between N<sub>2</sub>O and NO<sub>x</sub> emissions, it is not appropriate or justified to assume any unknown, future new regulations in the analysis of this proposed regulation. The costs and technical feasibility of the proposed regulation is based on existing engines and regulations. Any future rulemaking must account for the technological limitations and regulations in existence at the time of the proposed regulation. [EPA-HQ-OAR-2014-0827-1199-A1 p.24]

**Organization:** Truck & Engine Manufacturers Association (EMA)

Similarly, the Agency should not lower the Phase 1 N<sub>2</sub>O standard. In the NPRM, the Agencies have proposed reducing the N<sub>2</sub>O standard for heavy-duty engines from 0.10 g/hp-hr (with an assigned DF of 0.02 g/hp-hr) to 0.05 g/hp-hr (with a DF of 0.01 g/hp-hr). The Agencies claim that they “are proposing this change at no additional cost and no additional benefit because manufacturers are generally meeting the proposed standard today.” (See 80 FR at 40203). As part of the underlying rationale for the proposed standard, the Agencies have presented an evaluation of the Model Year 2014 EPA certification database. (See 80 FR at 40205). EMA has the following comments based on its review of the data that the Agencies have presented: [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

a. The proposed DF is not included in the N<sub>2</sub>O emissions data that the Agencies have cited in the NPRM. Figure 1 (below) shows the sample of engines referenced in the NPRM with and without the proposed DF of 0.01 (unless the family had a zero DF in the database). [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

b. Two of the 24 engine families that the Agencies included in their discussion of the N<sub>2</sub>O test data are non-SCR equipped engine families (the blue-green bars in Figure 1 below). However, it is not anticipated that any non-SCR diesel engines will be used in the heavy-duty on-highway segment by the start of the proposed Phase 2 program. Therefore, those engine families are not relevant to the proposed N<sub>2</sub>O standard. [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

c. Two of the 24 data points that the Agencies have included in their supporting analysis are natural gas-fueled engines and another is a gasoline engine. Those engines also are not SCR-equipped engines and therefore are not relevant to the proposed N<sub>2</sub>O standard. [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

d. An evaluation of the remaining 19 engine families, assuming the proposed DF of 0.01 g/hp-hr, shows the following (see Figure 1 below): [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

i. 6 engine families have test data below the proposed 0.05 g/hp-hr standard;

ii. 4 engine families have test data approximating the proposed 0.05 g/hp-hr standard; and

iii. 9 engine families (almost half) have test data above the proposed 0.05 g/hp-hr standard.

e. EMA's evaluation of the 2014 engine data shows that not all of those engines meet the applicable CO<sub>2</sub> standards. Some engines are credit-users. The CO<sub>2</sub> emission from the range of engines that the Agencies referenced in the NPRM, which span both Vocational and Tractor applications, are shown in Figure 2 and 3 below, respectively, as compared against the applicable Medium Vocational and the Tractor CO<sub>2</sub> standards. The referenced engines are separated between Vocational Medium, Vocational Heavy, and Tractor, based on displacement, and are shown in N<sub>2</sub>O versus CO<sub>2</sub> trade-off charts in Figures 4 through 6 below. All of the tractor engines fall outside the Phase 2 N<sub>2</sub>O-CO<sub>2</sub> box. Similarly, a large population of heavy and medium vocational vehicles fall outside the box as well. A trade-off trend can be clearly observed across the entire population of engines. [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

Accordingly, based on the Agencies' referenced certification data, roughly half of the currently certified engine families would need to make significant reductions in N<sub>2</sub>O emissions to meet the proposed standard. Furthermore, bringing those engines into CO<sub>2</sub> compliance could drive increases in N<sub>2</sub>O if not mitigated by system improvements. [EPA-HQ-OAR-2014-0827-1269-A1 p.65]

While some of the projected Phase 2 engine technologies (see Figure 7 below) do not have an impact on N<sub>2</sub>O, such as friction reduction, Rankine cycle operation and turbo compounding, other technologies can have an adverse effect, for example, reductions in EGR and higher compression-ratio combustion systems. Therefore, most of the referenced certified engines would need to incorporate technology development in aftertreatment solutions, which to this point have not been identified, in order to meet the proposed N<sub>2</sub>O standard. Consequently, the Agencies' assumption of "no additional cost" is simply not accurate. [EPA-HQ-OAR-2014-0827-1269-A1 p.65-66]

With respect to the Agencies' discussion of the interaction between N<sub>2</sub>O and NO<sub>x</sub> emissions (see 80 FR at 40205), it is not appropriate for the Agencies to assume any future low-NO<sub>x</sub> regulations in the analysis of this proposed regulation. The costs and technical feasibility of the proposed regulation is based on existing engines and regulations. Any future rulemaking must account for the technological limitations and regulations in existence at the time of the proposed regulation. [EPA-HQ-OAR-2014-0827-1269-A1 p.66]

In sum, EMA objects to the Agencies' proposal to reduce N<sub>2</sub>O emissions as a component of the pending rulemaking. The Agencies are simply incorrect in their assumption that the proposed lower N<sub>2</sub>O standard could be implemented "with no additional cost or lead time." [EPA-HQ-OAR-2014-0827-1269-A1 p.66]

[Figures 1-7 can be found on p.66-69 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

### **3. The Proposed N<sub>2</sub>O Standards**

The NODA does not provide any supplemental data regarding N<sub>2</sub>O emissions, and so falls well short of justifying the Agencies' proposed new N<sub>2</sub>O standard of 0.05 g/bhp-hr. To the contrary, the most current relevant emissions data, including those being developed by the Southwest Research Institute ("SwRI") under its pending low-NO<sub>x</sub> research program, establish that prevailing N<sub>2</sub>O emission rates from HDOH engines are higher than the Agencies' assumptions and are likely to trend up as lower NO<sub>x</sub> emissions requirements are phased-in. Thus, the premise for this aspect of the Agencies' proposal – that the proposed reduced N<sub>2</sub>O standard can be met without the need for any additional engine improvements, design changes, or costs – is simply incorrect. [EPA-HQ-OAR-2014-0827-1891-A1 p.3-4]

**Organization:** Volvo Group

### **N2O Emissions Reduction**

Volvo Group supports the comments made by EMA that N<sub>2</sub>O emissions cannot be lowered with existing technology. In addition we note that N<sub>2</sub>O is generated on the diesel oxidation catalyst (DOC) and the diesel particulate filter (DPF) during warm-up and on the selective catalytic reduction catalyst (SCR) and ammonia slip catalyst (ASC). One method to reduce N<sub>2</sub>O is to reduce precious group metal (PGM) loading on the DOC in order to reduce N<sub>2</sub>O production. EPA states that N<sub>2</sub>O should be reduced simply by recalibration, but this is not the case. Although it may be barely possible, at the current NO<sub>x</sub> standard, to meet the proposed 0.04 g/bhp-hr N<sub>2</sub>O standard (plus .01 DF), if NO<sub>x</sub> standards are lowered it will drive higher diesel exhaust fluid (DEF) dosing rates and more than likely require increased DOC PGM loading. Both of these will increase N<sub>2</sub>O production (beyond the proposed standard). In addition, some N<sub>2</sub>O reduction strategies may make some of the OBD monitors difficult (or impossible) to achieve. [EPA-HQ-OAR-2014-0827-1290-A1 p.16]

### **Response:**

EPA has evaluated the deterioration factors for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O. These deterioration factors will not change from the Phase 1 values. We have no intention of allowing negative DFs as that is counter to the purpose of DFs, which is to account for deterioration of the emission control systems over the full useful life of the vehicle. Historically, DFs reflected the trend of increasing emissions, so some manufacturers have come to think of them as a way to predict end-of-life emissions. However, they are actually intended to represent the highest emissions during the useful life, relative to the low-hour test data. That is why EPA has never allowed additive DFs less than zero or multiplicative DFs less than one.

In the NPRM, we proposed reducing both the standard and deterioration factor for N<sub>2</sub>O to 0.05 and 0.01 g/bhp-hr respectively because engines certified in model year 2014 were generally meeting the proposed standard. We also explained the process behind N<sub>2</sub>O formation in urea-SCR aftertreatment systems and how that process could be optimized to elicit additional N<sub>2</sub>O reductions. 80 FR 40203. While we have seen some reductions and a few increases in engine family certified N<sub>2</sub>O levels across the 2014, 2015, and 2016 model years, the majority have remained unchanged.

While we still believe that further optimization of SCR systems is possible to reduce N<sub>2</sub>O emissions, as demonstrated for some engine families, we do not know to what extent further optimization can be achieved given the tradeoffs required to meet the Phase 2 CO<sub>2</sub> standards. These tradeoffs potentially include advancing fuel injection timing to reduce CO<sub>2</sub> emissions resulting in an increase in NO<sub>x</sub> emissions at the engine outlet before the aftertreatment, increasing the needed NO<sub>x</sub> reduction efficiency of the SCR system. We will continue to assess N<sub>2</sub>O emissions as SCR technology evolves and CO<sub>2</sub> emission reductions phase in, and we will revisit the standard at a later date to further control N<sub>2</sub>O emission. This would likely be included in any upcoming rule to consider more stringent NO<sub>x</sub> standards.

Finally, with respect to test cycles, we note that these standards were adopted as anti-backsliding or cap standards. Thus, we believe a simple broad test method is appropriate. The FTP covers a broader range of test conditions than the RMC, including engine starting and low temperature operation, which makes it an appropriate test cycle.

## **3.6 EPA Engine Standards for Methane**

**Organization:** American Power Group Inc (APG)

We believe the proposed CH<sub>4</sub> exhaust emission standard, while not a challenge for gasoline and diesel fueled engines/vehicles, will present a significant challenge for converted HHDD Mixed-Fuel engines even with the option to trade off CO<sub>2</sub> GWP ratio'd 'credits'. These concerns are further explained within the attached document [EPA-HQ-OAR-2014-0827-1197 p.1]

APG also would like to understand how the EPA will credit CO<sub>2</sub> reductions enabled by vehicle efficiency improvements (tires, Aero, drive-train friction reduction, etc) as the reported CO<sub>2</sub> results only come from the FTP or RMC13 engine dynamometer tests. [EPA-HQ-OAR-2014-0827-1197 p.1]

As the Proposed Phase II regulations allow CO<sub>2</sub> reported results to be taken from the FTP-HDT HHDD test for vocational vehicle engines and from the RMC13 HHDD test for line haul vehicle engines, but all HHDD vehicle engine CH<sub>4</sub> and N<sub>2</sub>O reported emissions come from the FTP-HDT HHDD tests, would the EPA consider allowing the CH<sub>4</sub> and N<sub>2</sub>O emission reported results for come from the RMC13 HHDD test for line haul vehicle engines? The RMC13 test results are more representative of the line haul vehicle duty cycle.[EPA-HQ-OAR-2014-0827-1197 p.2]

Challenges to meet the proposed CH<sub>4</sub> exhaust emission standard of 0.1 g/bhp-hr for a Dual Fuel (EPA - Mixed-Fuel, ARB - Bi-Fuel, simultaneous diesel and NG fuel) Small Volume Manufacturer: The HHDD diesel engine system configuration should have little to no challenge meeting the proposed Phase II GHG CH<sub>4</sub> standard of 0.1 g/bhp-h as there is no CH<sub>4</sub> being induced or injected during diesel fueled engine operation. In a Mixed-Fuel conversion, the OEM HHDD engine, engine control systems and after-treatment systems (2010 and newer) are typically unchanged. This can present significant challenges to the Mixed-Fuel system to meet the proposed GHG CH<sub>4</sub> 0.1 g/bhp-h emission standard. The reasons are two-fold: [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

## **2) After-treatment oxidation temperatures during the FTP Heavy Duty Transient Cycle**

**EPA/CARB certification test:** In researching possible after-treatment alternatives to help oxidize the 'quench volume' induced CH<sub>4</sub> exhaust emissions, after-treatment/Diesel Oxidation Catalyst suppliers have investigated significantly higher precious metal loading (Pt) of current DOC configurations, but the exhaust gas temperatures needed to oxidized 80% + of the exhaust CH<sub>4</sub> (585oC) are not realized during the EPA test used to determine CH<sub>4</sub> emissions, the FTP--Heavy Duty Transient cycle emission tests, (Please see Figures 1-2). [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

Conversely, conventional DOC's have a NMHC oxidation effectiveness of 80%+ at 300oC exhaust gas temperature. [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

The cost increase associated with the increased Pt loading would more than double the DOC cost, but would not provide for CH<sub>4</sub> oxidation at a high enough effectiveness to significantly reduce CH<sub>4</sub> emissions during the FTP Heavy Duty Transient cycle test. Furthermore changing the DOC within the OEM DOC/DPF after-treatment system would void the OEM after-treatment system warranty. [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

[Figure 1 can be found on p.2 and figure 2 can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1197-A1]

The current GHG regulations have HHDDE reportable CO<sub>2</sub> results from the FTP-Heavy Duty Transient test cycle for vocational HHDDE vehicles and Ramped Modal Cycle 13 test for line-haul HHDDE vehicles. All N<sub>2</sub>O and CH<sub>4</sub> reportable HHDDE values come only for the FTP-HDT test results. As the APG Mixed-Fuel system is utilized by line haul HHDDE vehicles we would respectfully request that EPA allow all GHG emission values for HHDDE vehicle line haul applications be taken from the RMC

13 test results as the RMC 13 test more represents our customers duty-cycle. Is there some reason the CH4 and N2O reportable results are only used from the FTP-HDT cycle test? [EPA-HQ-OAR-2014-0827-1197-A1 p.4]

**Organization:** Cummins, Inc.

*Cummins supports maintaining the Phase 1 CH4 standard of 0.10 g/hp-hr* [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

Cummins agrees with maintaining the Phase 1 CH4 standard. It is set at an appropriate, fuel neutral level that constrains CH4 emissions while allowing natural gas engines to comply though the use of CO2-equivalent credits if necessary. [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

Additionally, the Agencies are requesting comment on changing the GWP for CH4 and N2O for Phase 2. Changes should only be made if they are Agency-wide, consistent across all GHG programs (for example, light-duty, GHG inventories, reporting rules, etc.). Also, to the extent that Phase 1 credits are carrying over and can be used for CH4 and N2O compliance in Phase 2, maintaining the same Phase 1 GWP values is appropriate. [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

**Organization:** Daimler Trucks North America LLC

**CH4 Standards** - EPA proposed to keep the methane standard at 0.10 g/bhp-hr with a 0.02 DF. We agree that this is [redacted]. Therefore we agree with retaining the Phase 1 CH4 standard. 80 FR 40205. [EPA-HQ-OAR-2014-0827-1164-A1 p.30]

**Organization:** NGVAmerica

#### **I. Methane Emissions Cap & Averaging** [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

The phase 1 heavy-duty vehicle rulemaking, establishing greenhouse gas emission standards, included a compliance alternative allowing heavy-duty manufacturers and conversion companies to comply with the respective methane or nitrous oxide standards by means of over-complying with CO2 standards. For Phase 2, EPA proposes to extend this compliance flexibility. NGVAmerica commends EPA for again extending this compliance option. Given that the ability to offset methane (and also nitrous oxide) emissions with CO2 credits is critical for new natural gas engines and vehicles, we strongly support this provision. With respect to aftermarket conversions, we respectfully request that EPA consider the comments in the previous section. [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

#### **Response:**

EPA will continue to apply the Phase 1 methane engine standards to the Phase 2 program. EPA adopted the cap standards for CH<sub>4</sub> (along with N<sub>2</sub>O standards) as engine-based standards because the agency believes that emissions of this GHG are technologically related solely to the engine, fuel, and emissions after-treatment systems, and the agency is not aware of any influence of vehicle-based technologies on these emissions. We are applying these cap standards against the FTP duty-cycle because the FTP cycle is the most stringent with respect to emissions of these pollutants and we do not believe that a reduction in stringency from the current Phase 1 standards is warranted. We also note that these standards were adopted as anti-backsliding standards. Thus, we believe a simple broad test method is appropriate. The FTP covers a broader range of test conditions than the RMC, including engine starting and low temperature operation, which makes it an appropriate test cycle.

EPA continues to believe that manufacturers of most engine technologies will be able to comply with the Phase 1 CH<sub>4</sub> standard with no technological improvements. We note that we are not aware of any new cost-effective technologies that would have allowed us to adopt more stringent standards at this time. Nevertheless, EPA will continue to monitor both emissions and the development of emission controls, and may revisit these standards in a future action.

### **3.7 Compliance Provisions and Flexibilities for Engine Standards**

**Organization:** Allison Transmission, Inc.

#### **EPA and NHTSA Should Adopt and Improve Alternative Certification Approach**

The agencies have requested comment on an alternative certification approach that would allow both vehicles and engines to use the same drive cycles for certification. Allison supports this concept. One benefit of adopting the alternative certification approach would be to alleviate the concerns of engine manufacturers in providing detailed fuel consumption maps (containing proprietary information) for use in GEM. In addition, it is reasonable to protect that the alternate approach will reduce testing burdens, result in more meaningful and realistic fuel maps, result intransient fuel maps and better protect engine and transmission intellectual property. Finally, the alternative certification approach would allow for and realistically result in additional engine and transmission integration efforts. [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

There are several caveats, however, that are important to consider for adoption of the alternative approach in the final rule: [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

(1) Further testing will be required to determine the accuracy of this approach. [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

(2) The approach will not address several real world fuel-economy improvement features that do not receive credit in the proposed GEM – or in powertrain testing.<sup>62</sup> Specifically, EPA and NHTSA should improve the alternative certification approach to give credits to: [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

(a) Transmission elements that adjust shift points based on mass and grade. [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

(b) Transmission elements that manage vehicle acceleration. [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

(3) EPA has included a preliminary comparison between the primary and alternative approaches, but this comparison lacks cost estimates.<sup>63</sup> While raising several key questions in terms of the credibility and accuracy of the approach, another consideration must be the economic impact of adopting the alternative approach and what entities would likely bear this cost. [EPA-HQ-OAR-2014-0827-1284-A1 p.39]

Transmission elements and features such as those outlined above can make a substantial difference in GHG emissions and fuel efficiency, resulting in a 5 to 15% reduction in GHG emissions and improvement in fuel efficiency. EPA and NHTSA should therefore make efforts prior to finalization of this rule to expand the alternative approach and incorporate additional currently “non-creditable” features.<sup>64</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.39]

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62 See additional comments in Section IV.

63 RIA at 3-101.

64 Depending on the scope of this effort, additional regulatory process may be required.

**Organization:** American Automotive Policy Council

**In-Use Compliance and Useful Life** - AAPC agrees with continuing the 3 percent adjustment factor applied to the full useful-life certification standards for the purpose of determining in-use emissions and fuel consumption standards. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

**Loose engine provision** - AAPC recommends the continued allowance for “loose engine” sales to be counted in the sales of the manufacturer’s complete pickup and van products for greenhouse gases. Our primary market continues to be complete heavy-duty vehicles in the 2b/3 classes with a relatively small number of engines being sold to outside vehicle manufacturers. To continue to support this business model, the AAPC members request the continued use of this provision to allow continuity in our business practice. This continued flexibility will allow the individual manufacturers to accurately report compliance of the “loose engine” sales. AAPC considers the Phase 1 final rule statement of reason to be valid and required to comply with the complex Phase 2 greenhouse gas regulations – “...we are adopting a related special provision involving chassis certification aimed at simplifying compliance for manufacturers of complete heavy-duty pickups and vans that also sell a relatively small number of engines...” (76 Federal Register 57260) [EPA-HQ-OAR-2014-0827-1238-A1 p.11-12]

The Agencies requested comment (80 Federal Register 40206) on the appropriateness of continuing the 3 percent adjustment factor applied to the full useful-life certification standards for the purpose of determining in-use emissions and fuel consumption standards. This adjustment factor was applied in Phase 1 based on the Agencies’ assessment of testing variability inherent in comparing results among different laboratories and different engines. AAPC supports the continuance of this allowance for in-use testing. No material advances have occurred that would result in the variability factors relevant in Phase 2 being significantly different than they were in Phase 1. Furthermore, the appropriateness of the 3% allowance has not yet been assessed against actual in-use data on 2014 MY or later vehicles and engines near their full useful lives. Absent such data, a thorough assessment of the appropriateness of this allowance cannot be made. AAPC further notes that in-use verification program limits in Light-Duty are 10% to account for in-use variations. [EPA-HQ-OAR-2014-0827-1238-A1 p.16]

§ 1036.535 Determining engine fuel maps and fuel consumption at idle. Section 1036.535 requires the OEM measure and record fuel flow and NO<sub>x</sub> emission rates at ~143 points during the GEM fuel mapping process. The NO<sub>x</sub> (g/s) measurement proposed standards potentially implicate and imply new criteria pollutants requirements that were not discussed or evaluated in the RIA. Additionally, the provisions of CAA section 202(a)(3)(C) seem to apply, notably the requirement of four years lead time and three years stability. Given these considerations AAPC recommend removing the NO<sub>x</sub> (g/s) reporting requirement from 1036.535 or making it voluntary until a subsequent heavy-duty on-road emission rule making. [EPA-HQ-OAR-2014-0827-1238-A1 p.33]

**Organization:** California Air Resources Board (CARB)

**Oppose/Requested Change Comment**



### **Comment – Appropriateness of useful life adjustment factor**

The NPRM requests comment on the useful life adjustment factor allowance. [EPA-HQ-OAR-2014-0827-1265-A1 p.158]

Consistent with Section 202(a)(1) and 202(d) of the CAA, for Phase 1, U.S. EPA established in-use standards for heavy-duty engines. Based on their assessment of testing variability and other relevant factors, U.S. EPA established in-use standards by adding a 3 percent adjustment factor to the full useful life emissions and fuel consumption results measured in U.S. EPA certification process to address measurement variability inherent in comparing results among different laboratories and different engines. See 40 CFR part 1036. U.S. EPA and NHTSA are not proposing to change this for Phase 2, but request comment on whether this allowance is still necessary. [EPA-HQ-OAR-2014-0827-1265-A1 p.158]

CARB staff believes that the current 3 percent adjustment factor should be removed. An emission standard inherently already accounts for measurement variability due to different laboratories and engines being tested. While the 3 percent in-use factor was allowed for Phase 1 vehicles since the Phase 1 standards were new, this in-use factor should not be necessary for Phase 2 vehicles. Historically, CARB typically does allow an in-use factor when phasing in new standards that force new technology. Many manufacturers have already implemented the technologies that will be required to meet the proposed Phase 2 standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.159]

In conclusion, CARB staff encourages U.S. EPA and NHTSA to not apply the proposed 3 percent adjustment factor to the in-use emission standard. [EPA-HQ-OAR-2014-0827-1265-A1 p.159]

### **Neutral/Provide Additional Info Comment**

#### **Comment – Not-to-Exceed (NTE) Standards**

There may be opportunities to fold in-use compliance testing for CO<sub>2</sub> and N<sub>2</sub>O into the NTE protocol currently in place for criteria pollutants. This could provide greater assurance of in-use compliance, and provide manufacturers an efficient way to demonstrate in-use compliance for greenhouse gas and criteria pollutants simultaneously. When U.S. EPA and NHTSA next consider changes to the NO<sub>x</sub> standards and NTE requirements, CARB staff recommends considering adding in-use testing of CO<sub>2</sub> and N<sub>2</sub>O. A manufacturer could conduct NTE testing and determine in-use compliance for the entire suite of pollutants (GHG as well as other criteria pollutants). [EPA-HQ-OAR-2014-0827-1265-A1 p.159]

CARB staff also suggests that tracking of vehicle weight and speed with engine CO<sub>2</sub>/N<sub>2</sub>O emissions could be used as a tool to determine overall vehicle performance. This information could be used as a GEM correction/correlation tool going forward. [EPA-HQ-OAR-2014-0827-1265-A1 p.159]

**Organization:** Clean Energy

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 249.]

And, for the record, we are strongly supportive of closed crank systems for spark-ignited engines in our space as they have successfully implemented this strategy in Europe.

**Organization:** Cummins, Inc.

*Cummins opposes the exclusion of curb idle torque from the engine certification cycle work calculation* [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

In 40 CFR 1036.501(g)(1), the Agencies are proposing to exclude work generated during “any portion of the duty cycle that has a zero reference value for normalized torque.” This modification can increase the brake specific CO<sub>2</sub> calculated on the certification cycle by up to 8% for engines being used with automatic transmissions. The Agencies’ belief that this change is insignificant is incorrect. The addition of curb idle torque to a cycle does not always reduce the cycle’s brake specific CO<sub>2</sub> emissions. More fuel is burned to achieve that higher cycle work, so the impact of that extra work on the total cycle performance depends on how efficiently that extra fuel is burned. Engine certification based on the engine work performed is the appropriate measure. How efficiently that engine work is used to propel the vehicle is accounted for in the vehicle regulation and does not need to be considered in the engine regulation. Furthermore, exclusion of curb idle torque work for CO<sub>2</sub> certification yields an inconsistency between criteria emissions and CO<sub>2</sub> evaluation, undermining regulatory integrity. Criteria emission and GHG emission results must be consistently measured and calculated over the same test protocols. For these reasons, 40 CFR 1036.501(g)(1) should not be finalized. [EPA-HQ-OAR-2014-0827-1298-A1 p.19]

*Cummins supports continuation of a 3% compliance margin for engine CO<sub>2</sub> emissions* [EPA-HQ-OAR-2014-0827-1298-A1 p.22]

In Phase 1, a 3% compliance margin was provided for engine CO<sub>2</sub> emissions to be applied during selective enforcement audit (SEA) and in-use testing. This margin accounts for measurement variations between facilities and engines. The Agencies are proposing to maintain the 3% compliance margin for engine standards in Phase 2, and Cummins supports this proposal. A similar 3% compliance margin should be applied to GEM results from the engine fuel map used for the vehicle program for SEA testing, as suggested in EMA’s comments. [EPA-HQ-OAR-2014-0827-1298-A1 p.22]

**Organization:** Daimler Trucks North America LLC

**The FCL to FEL allowance is still necessary** – In Phase 1, the agencies created a 3 percent adjustment factor to the FEL results measured in the certification process thereby accounting for lab to lab and engine to engine variability (i.e., by applying a 1.03 multiplier to the CO<sub>2</sub> FCL to establish the FEL for CO<sub>2</sub> levels established during the engine certification process). The agencies request comment from manufacturers regarding continuation of the Phase 1 approach. 80 FR 40206. DTNA supports the agencies’ proposal to continue to utilize this adjustment factor since one can expect that testing variability and other factors considered by the agencies in establishing this approach will not change significantly in the timeframe of Phase 2. DTNA also believes that a variability allowance is also applicable to a manufacturers certified fuel map to account for the same sources of variability and strongly recommends that EPA address the issue in Phase 2 in a similar manner as in Phase 1, for the same reasons (as discussed in our comments above). [EPA-HQ-OAR-2014-0827-1164-A1 p.12-13]

**DF For Criteria Pollutants, CO<sub>2</sub>, and N<sub>2</sub>O** – The agencies discuss DF test procedures and request comment, particularly for how to apply DFs on low level pollutant emissions for which test-to-test variability may be larger than the actual deterioration rates being measured (e.g., N<sub>2</sub>O). 80 FR 40206. The current dynamometer medium-heavy and heavy-heavy duty diesel DF methodology is overly burdensome and costly while yielding DF results that are driven as much by test-to-test variation as the actual deterioration in emissions that the DF testing is designed to characterize. The cost to the manufacture for a 50% unaccelerated useful life DF test, EPA’s preferred method, is in excess of \$1 M and takes a minimum of 40 weeks to complete. Since DF’s must be complete prior to the finalizing the emissions calibration, DF testing must start, at the latest, 20 months prior to start of production. Since this

leaves no time to start a new DF engine, in the event of a catastrophic failure of engine or aftertreatment system, manufactures typically run multiple DF's in an effort to generate a DF that is driven by measurement capability as much or more than the actual deterioration in emissions characteristics. As an example, a measurement noise level of 0.02 g/hphr extrapolated within the calculation can result in a 20-40% non-aging effect that is enough to influence the final result to be potentially non-representative. Additionally, due to time, resource, and cost constraints, most manufacturers only conduct emissions at 3 points, beginning, middle, and end, and extrapolate the DF to full useful life via a straight line linear regression, as required by EPA. This linear "curve fit" and extrapolation does not necessarily yield a DF that is representative of an actual aged to full useful system. NOx standards below today's level, if adopted, will only serve to exacerbate the influence of test to test variation as well as measurement error on the actual emissions DF. DDC recommends EPA adopt an optional assigned DF for dynamometer certified medium-heavy and heavy-heavy duty diesel engines. [EPA-HQ-OAR-2014-0827-1164-A1 p.17-18]

**DF for Hybrids or Cases with High Measurement Variability** – The agencies request comment on DF procedures where deterioration is nonlinear, for example a saw-tooth as might happen with hybrids if the batteries are replaced during a test. 80 FR 40206. We think that it is unlikely given the duration of hybrid testing that a battery would be replaced for normal maintenance reasons, so a saw-tooth is unlikely. But if it were, the DF paradigm would be incorrect. The Clean Air Act requires regulating emission standards over the useful life, but it does not require the use of a DF. CAA § 202(a)(1). Where the tip of the saw-tooth represents the worst-case emissions over the useful life, that is the emission level that must be lower than the emission standard—not an extrapolation through that point. For this reason, we think that the agencies' focus on saw-tooth patterns and extrapolation is improper. Similarly, the agencies pose questions about basing the DF on the highest value measured. 80 FR 40206. The idea of taking the highest point tested and extrapolating through that point is improper, as the highest point in any test—especially as we get to low emission levels—could be confounded by measurement noise. Rather, the agencies should stick with extrapolation unconstrained by the erroneous requirement to pass through the highest point. [EPA-HQ-OAR-2014-0827-1164-A1 p.18]

**Potential Alternative Certification (Cycle Average Mapping) Approach** - The agencies request comment on an approach that could mitigate certain engine manufacturer concerns by allowing both vehicle and engine to use the same driving cycle for certification. 80 FR 40193. In this proposal, GEM generates engine torque and speed profiles for a subsequent engine dyno test of the engine family parent rating, the results of which are then input back into GEM for vehicle compliance purposes for any engine rating. This is a very complicated procedure, and we have not had time to evaluate it. But we have concerns that testing the parent of a family on a drive cycle that involves gear shifts and high torque operation will not characterize the results of the child ratings to the level of accuracy needed for this regulation, and may in fact provide an easy pass for certain ratings. Further, we are concerned that to resolve the inaccuracy the process will force manufacturers to test most or all child ratings, thereby exacerbating the already increased burden of this process, rather than easing the burden as the agencies suggest will happen. More accurately, we see little benefit in terms of accuracy and no benefit in terms of protecting CBI (as we have stated elsewhere in our comments, the fuel map does not convey CBI), yet we see much increased test burden. We recommend against adopting this alternative certification approach or, at least, we recommend delaying making regulations on this procedure until there has been adequate time to resolve the many outstanding issues. [EPA-HQ-OAR-2014-0827-1164-A1 p.43]

**Dual rating engines, remote changes to fuel map, etc** - The EPA proposes that, for vehicles that have multi-torque ratings or vehicles whose engine ratings might be reflashed, the vehicle manufacturer certifies the vehicle using in GEM the worst-case rating that the vehicle might see in its lifetime. (This was based on oral discussions with the agency and is not written in the NPRM. Nonetheless, we feel it

important to respond). As a preface to our comments, it is important to explain certain aspects of our industry just to make sure the agencies are aware. Heavy-duty vehicle manufacturers and their dealers need the ability to reflash engine ratings, e.g., because many vehicles are sold as stock vehicles with a generic rating that will be reflashed when the vehicle is configured to its particular customer and job application, and because many vehicles change jobs during their lifetime such that they need power curve changes to perform the new task. However, we do not know a priori which vehicles will need to be reflashed. If the EPA required that we take a penalty—using the worst-case rating is a penalty—for a practice inherent in the industry, then the EPA would need to factor such penalty into its standard setting process and in turn loosen the emission standards. If the EPA is unwilling to do so, then the agency needs to provide flexibility so as to avoid stifling an important industry practice. We propose that the EPA allow us to reflash an engine’s rating to another rating selected from the ratings certified within the subject certified engine family and whose emissions control and fuel consumption characteristics are of common design. We understand the EPA’s concern that manufacturers might sell a vehicle with a “best-case” rating (meaning the rating that gives the lowest fuel consumption in GEM) but, immediately upon sale of the vehicle, reflash the rating to a higher emission one. We would not do that, however, because it is prohibited tampering, prohibited under the CAA. But to give the EPA even more certainty that we are not trying to game the system, we would agree to track the vehicles and report their actual rating at the end of the 270 day reporting period after the close of the model year. (Note that we are using the 270 day number because, as we mention elsewhere in our comments, the 90 day number is too short for the EPA to get valuable information). Similarly, if in the future we have software that reflashes a rating on the fly, then we propose that the EPA accept that the heavy-duty industry does so to facilitate vehicle operators’ business and thus treats this not as prohibited tampering but as an allowable act. This would be similar to the allowance to change vehicle configurations currently in 1037.655, except that we should not be hamstrung by the limitation on doing this before the regulatory useful life expires; optimizing fuel efficiency should not wait until the end of the useful life. And this would not limit us to modifications that only result in a decrease of fuel consumption, as it may be necessary for a vehicle to have higher torque and higher fuel consumption than when it was built so that it can complete a task. In short, we recommend that the EPA exercise its regulatory discretion to allow multi-torque ratings or reflashing without penalizing manufacturers. (Concurrent with this change, the EPA should amend 1037.655 to reflect the agency’s intent to allow modifications that are necessary for vehicle owners to complete their jobs). [EPA-HQ-OAR-2014-0827-1164-A1 p.47-48]

**Organization:** International Council on Clean Transportation (ICCT)

### **Engine mapping procedure**

Regarding the agencies’ consideration of an alternative mapping procedure, we offer several comments. In principle, we support the agencies seeking to better estimate real-world transient effect of engines in full-vehicle operational settings. We believe this alternative mapping approach does offer the potential for improved fidelity regarding transient effects, to better promote transient operation efficiency and better reflect real-world effects. However, such a dramatic change engine certification and the GEM process -- without substantial data, and without a public understanding of the data comparing the methods for multiple high volume engines by various companies, and without detailed assessment of the pros and cons of the alternative approach -- would be premature. We do not believe that the agencies have put forward sufficient information to validate a shift to the alternative mapping method at this time. We also believe that it is critical that the agencies’ require engine manufacturers to submit all engine maps that will be utilized in real-world driving to ensure the regulators can understand how the regulation connects to the real world operation of the engines and vehicles. Especially for a regulation such as this that is based fundamentally on the simulation of engines and based on limited data from a select few parent engines, for regulators to not have detailed maps (e.g., 100 engine torque and speed points) would

essentially provide no ability to monitor and ensure compliance and troubleshoot on any potential in-use issues. [EPA-HQ-OAR-2014-0827-1180-A4 p.14]

**Organization:** Isuzu Motors Limited

Isuzu also would like to the have the agencies extend the loose engine provision from the Phase I Rule. Currently the loose engine provision is scheduled to end in 2020MY. Isuzu would like to see the rule extended to at least through 2024MY. This provision allows us to continue to provide Class 3, 4 and above Spark Ignited products in limited quantities and also still allows us to produce alternative gaseous fueled vehicles. [EPA-HQ-OAR-2014-0827-1263-A1 p.3]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Ensure Technology-Neutral, Performance-Based Standards** [EPA-HQ-OAR-2014-0827-1274-A1 p.3]

Beginning with regulations for Class 7 and 8 engines and vehicles, we agree with classification of vehicle technologies based on end-user expectations for useful life and emissions warranty. Although certain criteria outlined in Table II-17 do not logically apply to Heavy Duty SI engines, we agree with classification of vehicle technologies based on end-user expectations for useful life and emissions warranty. If left as proposed, it does not provide sufficient clarity for criteria emission requirements. The agencies should take a technology-neutral, performance-based approach in order to provide a predictable, consistent and level playing field for technologies and energy sources. [EPA-HQ-OAR-2014-0827-1274-A1 p.3-4]

**Organization:** National Propane Gas Association (NPGA)

#### **Classification of Alternative Fuel Engines**

We disagree with the agencies' classification of spark-ignited alternative fuel engines under the same emissions standards as diesel fuel engines for vehicles at and above 19,500 lbs GVWR.<sup>25</sup> We find the classification adverse to the overall objectives of the NPRM as well as an inaccurate assessment of alternative fuel engines for heavier vehicles. The agencies determine that similar treatment of spark-ignited alternative fuel engines to diesel for this weight range is logical because, in part, the likely competition to alternative fuels in this weight range are diesel engines.<sup>26</sup> Firstly, it is inaccurate to assume that diesel fuel engines are the principle vehicle type at and above 19,500 lbs GVWR.<sup>27</sup> There are many vehicles at that weight that are fueled by gasoline. Moreover, autogas is an increasingly popular alternative fuel for school buses, among other medium- and heavy-duty vehicles. Therefore, the existence of alternative and gasoline fueled vehicles above 19,500 lbs GVWR renders application of the standards for diesel engines incongruous with the actual demographics of such weight range. [EPA-HQ-OAR-2014-0827-1272-A1 p.3]

Secondly, the agencies' decision to apply the standards for diesel engines to alternative fuel engines creates a disincentive for the expansion of alternative fuel. Over the years, diesel engines have been subject to increasingly technical, discerning regulations implemented over a timeframe that facilitates research, development and disbursement throughout the marketplace for gradual improvement. Unlike the tactful, timely evolution of standards for diesel engines, the analogous approach in the NPRM proposes immediate application of such evolved standards to alternative fuels that are in various stages of development; to some degree, less advanced than diesel engines. If required to meet the same standards as diesel engines, it is our concern that dissemination of alternative fuels, like autogas, to the public would be delayed or precluded due to additional time in research and development, higher cost, etc. Therefore,

the result of the proposed analogous treatment of diesel fuel engines and alternative fuel engines for vehicles at and above 19,500 lbs GVWR may be a general disincentive for autogas, among other alternative fuels. [EPA-HQ-OAR-2014-0827-1272-A1 p.4]

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25 Id. at 40208.

26 Id.

27 Id.

**Organization:** PACCAR, Inc.

### **Engine Family/Subfamily Certification**

Manufacturers need flexibility for engine GHG subfamilies within NO<sub>x</sub> certification families. A requirement to certify with a new NO<sub>x</sub> family when differences in technologies only affect GHG/fuel efficiency of the engine will add to certification burdens, costs, OBD demonstrations, certification fees, etc. PACCAR requests the Agencies work with manufacturers to develop a reasonable resolution of this issue. The subfamily approach used for vehicles may be a viable concept. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Organization:** Truck & Engine Manufacturers Association (EMA)

### Parent-Child Engine Ratings

One open question that the Agencies have raised is whether they should set additional Phase 2 CO<sub>2</sub> and fuel consumption standards for the other engine ratings (often called the “child ratings”) within an engine family. EPA has requested comment from manufacturers regarding the continuation of the Phase 1 approach to GHG certification of an engine family, pursuant to which the certification of the parent and child ratings is based on emissions results from testing the parent rating. (See 80 FR at 40206). EMA supports the continuation of this Phase 1 approach for the certification of parent and child ratings, and also supports the Phase 1 requirement that parent rating sales volumes achieve a minimum level. EMA further agrees that by including the actual fuel map and rating-specific full load curve in the GEM simulation, the range of engine ratings are appropriately represented in the vehicle certification. [EPA-HQ-OAR-2014-0827-1269-A1 p.32]

### Powertrain Compliance Responsibility

Proposed 1036.630 allows an engine manufacturer to choose to include engines used in powertrain families in their engine families. However, under proposed section 1036.630(b), even if an engine manufacturer chooses not to certify any engines in the family over the powertrain test cycles, EPA may still require the engine manufacturer to participate in recalls associated with a powertrain-associated GHG emissions exceedance when the powertrain has presumably been certified by some other manufacturer. [EPA-HQ-OAR-2014-0827-1269-A1 p.43]

An engine manufacturer should not be held responsible for powertrain test results certified by a different manufacturer, since the engine manufacturer may not have knowledge of the engine test cycles or the

compliance margin used by the manufacturer certifying the powertrain test. In such a case, the engine manufacturer should only be liable for the FTP/SET-based and the engine fuel map-based GHG emissions for which the engine is certified. In that regard, EPA already has other means of ensuring engine compliance, such as through engine SEAs and in-use testing of the engine family. [EPA-HQ-OAR-2014-0827-1269-A1 p.43]

#### Alternative-Fuel Engines

As in Phase 1, alternative-fuel engines are included within the scope of the Phase 2 GHG/FE program. EMA has no objection to that aspect of the Phase 2 program, nor to the Agencies' proposal for how alternative-fuel engines are to be classified as either compression-ignition ("CI") or spark-ignited ("SI") engines in the context of the proposed GHG emission standards. (See Proposed section 1036.140). However, the Agencies should clarify that the proposal also applies to the manner in which engine manufacturers categorize their alternative-fuel engines with respect to compliance with the emission standards for criteria pollutants, as well as with respect to the categorization of vocational vehicles for GHG/FE purposes. (See, e.g., Proposed §1037.105 (Table 3).) [EPA-HQ-OAR-2014-0827-1269-A1 p.45]

#### Measuring NO<sub>x</sub> During Fuel-Mapping

EMA objects to the Agencies' proposed requirement that manufacturers also measure NO<sub>x</sub> emissions during the proposed engine and powertrain fuel-mapping processes. There is no need or reasonable justification for that added testing burden on top of processes that already require the development of a 143-point engine map (plus 4 idle test points) and a 24-to-27 point powertrain map. Moreover, since manufacturers still remain subject to NTE and SEA requirements, other regulatory mechanisms are already in place to guard against any discernible backsliding with respect to the control of NO<sub>x</sub> emissions. In sum, there is no basis for imposing an additional NO<sub>x</sub>-testing burden. [EPA-HQ-OAR-2014-0827-1269-A1 p.48]

#### Deterioration Factor for CO<sub>2</sub> Emissions

EMA agrees with the Agencies that the Phase 2 deterioration factor for CO<sub>2</sub> emissions should remain at 0.0 g/hp-hr. Engine manufacturers do not foresee utilizing engine technologies that would increase CO<sub>2</sub> emissions as the engines age. [EPA-HQ-OAR-2014-0827-1269-A1 p.63]

In the NPRM, the Agencies request comment on how to apply DFs to low-level emission measurements where test-to-test variability may be larger than the actual deterioration rates measured. (See 80 FR at 40206). That challenging question arises when regulated emissions levels are approaching zero, as they are now. EMA believes that the best way to address the Agencies' question is to analyze the emissions data from the EMA DF Test Program that industry is currently conducting with oversight from both EPA and CARB. Under the DF Test Program, a number of engines are being operated for thousands of hours and are generating emissions data throughout that extensive testing. At the conclusion of that test program, EMA will be in a much better position to address the Agencies' question regarding how best to apply a DF to low-level emissions measurements. When the DF Test Program concludes next year, EMA will analyze the available data together with EPA and CARB, and at that time will be able to provide more informed input. Additionally, at that time, EMA, EPA and CARB can assess whether any potential changes to the application of DFs to low-level emissions should be carried over to criteria pollutant emissions to maintain consistency. [EPA-HQ-OAR-2014-0827-1269-A1 p.63-64]

**Organization:** Volvo Group

## **Engine Families**

Volvo Group also notes that there is an opportunity to simplify the certification burden by making modifications to the definition of the engine family. As has been discussed in the past, there is a marked difference in the engine family definition for On-Highway engines versus Non-Road engines. The method utilized for On-Highway is based more on traditional convention where the defining parameters were centered on the base engine (e.g. bore center-to-center dimensions). However, the Non-Road regulations are more flexible and allow engines of the same architecture, but differing displacements to be grouped into the same engine families. [EPA-HQ-OAR-2014-0827-1290-A1 p.41]

The intention of the definition is to group engines of similar emissions characteristics. The current definition has not been updated since the advent of modern aftertreatment systems and unduly segregates engines of like nature based on parameters that no longer have a bearing on emissions. [EPA-HQ-OAR-2014-0827-1290-A1 p.41]

Volvo Group recommends a revision of the Engine Family definition, which would better align it with modern emissions related families (e.g. Engine Families, Powertrain Families) that an OEM (and the EPA) have to manage. [EPA-HQ-OAR-2014-0827-1290-A1 p.41]

**Organization:** Cummins, Inc.

(a) Cummins agrees the reweighted Ramped-Modal Cycle Supplemental Emissions Test (RMCSET) reflects the engine downspeeding trend of HD engines. However, the current criteria emissions protocol has a different NO<sub>x</sub> weighting than the proposed CO<sub>2</sub> RMCSET. Different weighting factors may allow CO<sub>2</sub> improvement at the expense of increased NO<sub>x</sub> emissions. Any future rulemaking on criteria emissions should reestablish the link between NO<sub>x</sub> and CO<sub>2</sub> emission test cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.7]

(b) Separate credit for engine downspeeding at the vehicle level conveys CO<sub>2</sub> benefit in the vehicle program which is not reflected in the engine standard and may be accomplished at the expense of in-use NO<sub>x</sub> emissions, especially when downspeeding leads to operation outside the NO<sub>x</sub> NTE zone. Figure 1 shows a copy of Figure 2-14 from the Draft Regulatory Impact Analysis (RIA). Overlaid on this figure is the NTE zone for the criteria emissions regulation and the engine operating speeds for the vehicle on the 55 and 65 MPH GEM cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.8]

*Cummins opposes engine manufacturers being held liable for powertrain results submitted by another manufacturer* [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

In 40 CFR 1036.630(b), the Agencies are proposing to require that engine manufacturers participate in recalls associated with a powertrain GHG exceedance, even if the engine manufacturer did not generate the powertrain results. For reasons outlined in EMA's comments, Cummins opposes engine manufacturers being liable for powertrain results submitted by other manufacturers. [EPA-HQ-OAR-2014-0827-1298-A1 p.40]

**Organization:** Navistar, Inc.

The requirement for NO<sub>x</sub> measurement during the 143 point fuel mapping exercise is unnecessary, burdensome and redundant to the existing certification (FTP and RMC, AECD qualification) and compliance testing (confirmatory, SEA and NTE). We believe there is no development, certification or compliance value in collecting this data. Furthermore, for the purposes of modeling, manufacturers have



sufficient second-by-second emissions data that can be designated as CBI and provided to the EPA upon request. We agree with EMA comments on this topic as well. [EPA-HQ-OAR-2014-0827-1199-A1 p.23]

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10 42 U.S.C. §7521(a)(3)(C). Navistar believes this provision applies to this rulemaking since this rule addresses heavy duty vehicles and engines. Even if it didn't, however, as the NPRM notes, EPA acknowledges that four years of lead time is necessary and the four year lead time of EISA does apply. NPRM at 40150.

**Organization:** Eaton Vehicle Group Eaton

### **Data acquired with powertrain testing**

We do question the implications of the proposed retaining of NOx measured data. While we do understand the concern that the engine and transmission controller might adversely impact the NOx emissions, we believe that is an issue of all advanced powertrains certified through the powertrain test or just through GEM simulation. Therefore, we do not see the added value of recording emission data on select powertrains (not those certified under GEM only). Additionally, such data collection is an added burden to the testing entity and it raises questions on the accuracy and cell calibration requirements. Indeed, if the data is recorded for archival purposes only, the testing entity would have to maintain full criteria emissions capabilities similar to an engine emissions certification test cell. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

**Recommendation:** the EPA should not require certification-grade NOx data, as there is no standard to compare it to and it puts the burden on non-engine manufacturers to implement advanced engine measurements. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

We expect the data provided from the powertrain test be treated as business confidential and competitive intellectual property. We believe the amount of data should be limited to the minimum necessary for certification, especially as powertrain manufacturers are both suppliers and competitors of the OEMs. [EPA-HQ-OAR-2014-0827-1194-A1 p.10]

### **Response:**

#### *Engine Classification*

EPA emission standards have always applied differently for gasoline-fueled and diesel-fueled engines. The regulations in 40 CFR part 86 implement these distinctions by dividing engines into Otto-cycle and Diesel-cycle technologies. This approach led EPA to categorize highway natural gas engines according to their design history. A diesel engine converted to run on natural gas was classified as a diesel-cycle engine; a gasoline engine converted to run on natural gas was classified as an Otto-cycle engine.

Under the existing EPA regulatory definitions of "compression-ignition" and "spark-ignition," a natural gas engine would generally be considered compression-ignition if it operates with lean air-fuel mixtures and uses a pilot injection of diesel fuel to initiate combustion, and would generally be considered spark-ignition if it operates with stoichiometric air-fuel mixtures and uses a spark plug to initiate combustion. As described in Section II.D.(5)(e), EPA proposed a change because we now believe this approach does not fully reflect the reality that engines used in Class 8 vehicles compete directly with diesel engines.

EPA's basic premise for the proposed change is that natural gas engines performing similar in-use functions as diesel engines should be subject to similar regulatory requirements. The compression-ignition emission standards and testing requirements reflect the operating characteristics for the full range of heavy-duty vehicles, including substantial operation in long-haul service characteristic of tractors. The spark-ignition emission standards and testing requirements do not include some of those provisions related to use in long-haul service or other applications where diesel engines predominate, such as steady-state testing, Not-to-Exceed standards, and extended useful life. We believe it would be inappropriate to apply the spark-ignition standards and requirements to natural gas engines that are being used in applications mostly served by diesel engines today. We therefore proposed to adopt a differentiated approach to certification of natural gas engines across all of the EPA standards – for both GHGs and criteria pollutants. 80 FR 40207.

We are finalizing this provision with modifications. We will require manufacturers to divide all their natural gas engines into primary intended service classes, as we already require for compression-ignition engines, whether or not the engine has features that otherwise could (in theory) result in classification as SI under the current rules. We proposed that any natural gas engine qualifying as a medium heavy-duty engine (19,500 to 33,000 lbs. GVWR) or a heavy heavy-duty engine (over 33,000 lbs. GVWR) would be subject to all the emission standards and other requirements that apply to compression-ignition engines. However, based on these comments, we are finalizing this change only for heavy heavy-duty engines. Commenters identified medium heavy-duty applications in which SI alternative fuel engines compete significantly with gasoline engines, which is not consistent with the premise of the proposal. Thus, we are not finalizing the proposed change for medium heavy-duty engines.

We are not aware of any currently certified engines that will change from compression-ignition to spark-ignition under this approach. Nonetheless, because these proposed changes could result in a change in standards for engines currently under development, we believe it is appropriate to provide additional lead time. We will therefore continue to apply the existing interim provision through model year 2020.<sup>42</sup> Starting in model year 2021, all the provisions will apply as described above for heavy heavy-duty engines. Manufacturers will not be permitted to certify any engine families using carryover emission data if a particular engine model switched from compression-ignition to spark-ignition, or vice versa. However, as noted above, in practice these vehicles are already being certified as CI engines, so we view these changes as clarifications ratifying the current status quo.

These provisions will apply equally to engines fueled by any fuel other than gasoline or ethanol, should such engines be produced in the future. Given the current and historic market for vehicles above 33,000 lbs. GVWR, the agencies believe any alternative-fueled vehicles in this weight range will be competing primarily with diesel vehicles and should be subject to the same requirements as them.

Finally, beginning in 2021, we will limit the ability of these medium heavy-duty engines operating on alternate fuels to generate credits relative to the SI standards. However, should we identify a more precise way to differentiate between SI engines that compete primarily with gasoline engines from those that compete significantly with diesel engines, we may reconsider this restriction.

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<sup>42</sup> Section 202 (a)(2), applicable to emissions of greenhouse gases, does not mandate a specific period of lead time, but EPA sees no reason for a different compliance date here for GHGs and criteria pollutants. This is also true with respect to the closed crankcase emissions discussed in the following subsection. Also, as explained in section I.E.i.e, EPA interprets the phrase “classes or categories of heavy duty vehicles or engines” in CAA 202(a)(3)(C) to refer to categories of vehicles established according to features such as their engine cycle (spark-ignition or compression-ignition).l.

### *In-Use FEL Adjustment*

In Phase 1, the agencies adopted a compliance structure using two related compliance levels: the “family certification level” (FCL); and the “family emission limit” (FEL), which is specified in the regulations to be equal to 1.03 times the FCL. This structure, which was adopted to address several areas of uncertainty, applied the FCL for certification testing and the FEL for production-line and in-use testing. The agencies proposed to continue this approach for Phase 2.

Manufacturers supported continuation of this approach while CARB opposed it, arguing that it is inconsistent with past practices for other standards. The agencies understand CARB’s goal of eliminating the 3% in-use adjustment, but do not have enough information to do so at this time. Thus we will continue to evaluate the need for this adjustment as we gather data from production-line and in-use engines.

It is important to emphasize that, although we are including this in the final Phase 2 regulations, we do not expect manufacturers to design their engines to have higher fuel consumption in-use than they have during certification. Rather, we expect most engine families to meet their FCLs in actual use. Thus, if we collect sufficient data in the future that allows us to determine the 3% is too large or even unnecessary, we could revise or eliminate it without impacting the intended stringency of the standards.

Manufacturers argued that we should extend this approach to fuel maps. We did not propose this because we believe the broader nature of the fuel maps further reduces the need for any in-use adjustments. This is even more appropriate under the final regulations, which has revised the SEA test provisions to further reduce variability.

In a related matter, CARB supported applying the not-to-exceed (NTE) approach to GHG emissions. However, we have not determined how this could be applied, or if it would be appropriate to do so. Nevertheless, we will continue to evaluate this and may reconsider such action in the future.

### *CITT*

In an attempt to simplify the test procedures, the agencies proposed to exclude work generated during any portion of the duty cycle that has a zero reference value for normalized torque. However, manufacturers objected noting that the change would make the engine standards more stringent. Because this was not our intent, we are not finalizing this change.

### *Deterioration Factors*

The agencies are finalizing the deterioration factor provisions essentially as proposed, which manufacturers generally supported. However, DDC objected to what it appears to believe to be the agencies proposed approach for engines and vehicles with nonlinear deterioration patterns. DDC appears to believe the agencies proposed or were considering an approach where deterioration would be extrapolated in a way to overestimate emissions. This is not correct. The proposed deterioration factor approach (which is being finalized) requires only that the final deteriorated emission level reflect the highest level projected to occur within the useful life – whether it occurs at the beginning, the end, or somewhere in between.

EPA also requested comment on how to apply DFs on low level pollutant emissions for which test-to-test variability may be larger than the actual deterioration rates being measured. EPA generally agrees with the type of approach suggested in EMA’s comments. EMA believes that the best way to address the

Agencies' question is to analyze the emissions data from the EMA DF Test Program that industry is currently conducting with oversight from both EPA and CARB.

#### *Reflashing Engine Controls*

DDC objected to requirements/prohibitions related to reflashing engine controls in-use. Viewed from the perspective of certification, this is a requirements for manufacturers to certify based on the worst case ratings. Viewed from an in-use perspective, it is a prohibition against configuring the engine in a manner that is inconsistent with the certificate. It is unclear to what aspect of this approach DDC is objecting because it acknowledges and accepts the prohibition of tampering. Therefore, the agencies will continue to work with manufacturers to clarify what is and is not permissible.

#### *Alternative Cycle-Average Fuel Mapping*

The agencies requested comment on an alternative mapping procedure based on engine testing over the GEM duty cycles over a range of simulated vehicle configurations. This approach would use GEM to generate engine duty cycles by simulating a range of transmissions and other vehicle variations. See 80 FR 40179. Comments received on this issue during the formal comment period that ended on September 11, 2015 were mixed. However, since then the agencies have met with manufacturers and other interested stakeholders to improve this approach, which have led some who initially opposed this approach to become more supportive.<sup>43</sup> For additional discussion on the development of the cycle average mapping procedure see RIA Chapter 3.1.2.6.

#### *Engine Manufacturer Liability*

EMA commented that engine manufacturers “should not be held responsible for powertrain test results certified by a different manufacturer, since the engine manufacturer may not have knowledge of the engine test cycles or the compliance margin used by the manufacturer certifying the powertrain test.” It added that “the engine manufacturer should only be liable for the FTP/SET-based and the engine fuel map-based GHG emissions for which the engine is certified.” We largely agree with these statements, with an important clarification. Should we determine from powertrain testing that the engines are causing vehicle noncompliance because the engines do not conform to their certificates of conformity, we may require the engine manufacturer to participate in a recall to remedy the noncompliance.

#### *Engine Families*

The agencies did not propose to significantly change the engine family provisions. However, PACCAR commented on engine families, apparently in reference to the provision in §1036.230 (d), which states:

*Engine configurations within an engine family must use equivalent greenhouse gas emission controls. Unless we approve it, you may not produce nontested configurations without the same emission control hardware included on the tested configuration. We will only approve it if you demonstrate that the exclusion of the hardware does not increase greenhouse gas emissions.*

PACCAR suggested the agencies work with manufacturers to consider flexibility in applying this provision, which is allowed under the existing language.

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<sup>43</sup> Memos to Docket, “Test Procedure Review with Cummins, Volvo, Navistar, Paccar, Daimler Eaton and Allison.”

Volvo suggested more fundamental changes. Given the broad nature of their suggestion, we believe it would be more appropriate to consider it in a separate rulemaking with additional notice and comment.

### *Loose Engines*

The agencies proposed to not continue beyond Phase 1 the interim "loose engine" allowance for engines equivalent to engines in chassis-certified HD pickups and vans. AAPC and Isuzu both commented in support of extending it into Phase 2. However, this provision was originally intended only as a transitional provision as the agencies began regulating GHGs and fuel consumption for heavy-duty engines. Thus, we do not believe it would be appropriate to continue it indefinitely. Nevertheless, we see some value in extending it for an additional three years (through MY 2023), subject to a lower production of 10,000 engines per engine manufacturer, per model year.

### *Measuring NOx Emissions*

AAPC commented that NOx measurement could "imply new criteria pollutants requirements that [were] not discussed or evaluated in the RIA." This is not the case. Rather, the NOx information would be evaluated for compliance only in the context of existing requirements. EMA objects to the requirement to measure NOx emissions during the engine fuel-mapping processes, based on their concerns about test burden. EMA argues that "there is no basis for imposing an additional NOx-testing burden." However, this ignores EPA's previously stated interest in ensuring NOx and CO2 emissions are controlled simultaneously. Nevertheless, we are finalizing some provisions to address the concerns about test burden. In particular, we note that we will allow manufacturers to use field-grade NOx instruments, which can be less expensive and easier to use. We also will not require manufacturers to invalidate fuel maps if the NOx measurement fails during the mapping.

In addition, we believe requiring NOx measurements will address concerns such as those raised by Cummins.

### *Crankcase Emissions*

Spark-ignition engines are already required to have closed crankcases. See Section 12.7 of this RTC for a discussion of crankcase emissions from natural gas-fueled engines and vehicles.

## **3.8 Engine Test Procedures**

**Organization:** American Automotive Policy Council

**Vocational Engines** - AAPC details multiple concerns associated with idle work, infrequent regeneration adjustment factors (IRAF), and test fuel changes and recommends approaches for addressing these concerns. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

### **Heavy Duty Diesel Urea Decomposition Adjustment**

AAPC believes it is inappropriate to downward adjust Heavy-Duty diesel CO2 requirements by 2 g CO2 / bhp-hr to reflect urea decomposition without supporting data. To perform an accurate analysis, AAPC recommends that the Agencies collect, analyze and report on feedgas NOx emission rates, urea dosing rates, and resulting tailpipe NOx levels for a wide variety of diesel engines, power ratings, and aftertreatment system configurations used today and in future years. The test program should collect data

on the cold and hot Heavy-Duty FTP and RMC test cycles. [EPA-HQ-OAR-2014-0827-1238-A1 p.29-30]

### **§ 1036.530 fuel adjustment impacts on CO2**

The planned change from Tier 2 to Tier 3 gasoline certification fuel by the end of 2022MY significantly changes baseline 2017MY HDGE and GEM starting assumptions. Furthermore, the impact of test fuel change was not discussed, documented, or analyzed in the draft RIA and or proposed rule. [EPA-HQ-OAR-2014-0827-1238-A1 p.28]

AAPC members conducted heavy-duty gasoline engine transient testing with four different fuels. The results indicated that a change to Tier 3 E10 regular grade test fuel amounts to an additional 3% increase in stringency relative to baseline assumptions for over 14,000lb GVWR gasoline products. AAPC recommends that the specific Tier 3 E10 regular gasoline factor (BTU/lbm C) be developed for Tier 3 E10 certification fuels. [EPA-HQ-OAR-2014-0827-1238-A1 p.28-29]

[Table of fuel type testing results can be found on p.29 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

### **Changes to Engine Test Calculation Methods**

Proposed changes in 1036.501(g)(1) would require manufacturers to exclude work during any portion of the duty cycle with a zero reference value for normalized torque (i.e. idle work) from the total engine work calculation. While not discussed in the initial RIA, subsequent materials submitted to the docket indicate that the rationale for this change was to eliminate the effect of procedural differences between engines intended to be equipped with manual and automatic transmissions. AAPC is not aware of any heavy-duty spark ignition engines equipped with manual transmissions in the US market. [EPA-HQ-OAR-2014-0827-1238-A1 p.26]

AAPC estimates that this calculation method change results in an effective stringency increase of 3-4% for spark ignition engines and 5-8% for compression ignition engines intended to be equipped with automatic transmissions (See table below and graph on next page for details). The technology needed to make up for this difference is not incorporated into the existing RIA. [EPA-HQ-OAR-2014-0827-1238-A1 p.26]

[Table of engine and gasoline/diesel types can be found on p.26 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

Curb idle torque varies widely by application consistent with good engineering judgment which dictates that applications requiring high curb idle torque will be worst case for emissions. [EPA-HQ-OAR-2014-0827-1238-A1 p.26]

[Chart, curb idle torque vs torque converter K-factor, can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

AAPC recommends that the Agencies withdraw this proposed change to the total work calculation method, keeping the existing method unchanged and harmonized between CO2 and criteria emissions calculations. Idle emission reductions are already being driven by GEM model idle inputs. [EPA-HQ-OAR-2014-0827-1238-A1 p.27]

Proposed changes in 1036.501(g)(3) require that manufacturers use continuous sampling and prohibit batch sampling to measure CO<sub>2</sub> emissions over the ramped modal cycle. To avoid potential facility impacts to engine manufacturers, AAPC requests that manufactures be allowed to propose alternative methods to collect emissions via batch sampling that are equivalent or more conservative compared to the mode-weighted continuous sampling methodology. [EPA-HQ-OAR-2014-0827-1238-A1 p.27]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Reweighting operating points for tractor truck engine certification to reflect today's lower real-world operating speeds is another positive step. [EPA-HQ-OAR-2014-0827-1280-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.55-56.]]

Cycle-average approach to engine performance

For purposes of representing the engine in GEM, i.e. for certifying tractor and vocational vehicle fuel consumption levels, manufacturers must provide a 140-point steady-state engine map showing fueling rates. However, the agencies request comment on an alternative procedure for representing engine performance, both for input to GEM and for engine certification, using "cycle average maps" (RIA p.3-80). The agencies note that this alternative could be the procedure finalized in the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

The rationale for this alternative is two-fold. First, some engine manufacturers believe that the engine fueling map constitutes confidential business information and would prefer not to divulge it to the OEMs, as the proposal would require. Second, the alternative procedure can capture transient performance of the engine, which is an important factor in engine fuel consumption. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

Given that some OEMs have indicated their willingness to provide engine maps, we are not sympathetic to the concern regarding engine CBI. However, we strongly support the agencies' efforts to capture engines' transient performance in testing, which will both improve the agreement between certified and real-world performance and enable the standard to promote technologies that reduce fuel consumption in transient operation. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

Agency test data indicates that, when tested over a cycle that includes transient operation, engines consume from 3 to 7% more fuel than would be calculated from modeling the engine based on a steady-state fuel map. Cycle-based engine testing would create an incentive for the adoption of transient controls that minimize this fuel consumption, especially if the standards were tightened to reflect this opportunity for additional fuel consumption reduction. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

*Recommendation: Cycle-average approach to engine performance* [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

- Continue to develop and refine the proposed cycle-average approach to engine testing. Should this approach be adopted, greater efficiency should be required of engines to drive the adoption of transient controls. [EPA-HQ-OAR-2014-0827-1280-A1 p.8]

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<sup>2</sup> 2013 Diesel Truck Index

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment - Proposed reweighting of SET modes**

The NPRM requests comment on the reweighting of SET modes. CARB staff agrees with U.S. EPA and NHTSA that the current 23 percent weighting of “C Speed” in the SET Cycle will not adequately represent typically real world driving conditions seen in future heavy-duty applications. Therefore, CARB staff supports the reweighting of the SET cycle as proposed to increase the importance of the A Speed engine applications, while decreasing the application of C Speed engine modes. [EPA-HQ-OAR-2014-0827-1265-A1 p.41]

### **Neutral/Provide Additional Information Comment**

#### **Comment – Engine-only testing over the GEM duty cycle approach**

CARB staff generally supports the NPRM’s proposal for vehicle simulation and engine testing and is interested in the extent to which engine-only testing can help capture the transient behavior that is lost in a steady state fueling map simulation approach. This capture of transient behavior could yield more robust results for vocational applications that are characterized by hard acceleration and by stop-and-go driving patterns. [EPA-HQ-OAR-2014-0827-1265-A1 p.114]

As has been noted, the simulation burden for correctly capturing transmission behavior is non-trivial even with access to the proprietary control algorithms. CARB staff anticipates that engine/transmission interactions will continue to develop in both sophistication and prevalence as powertrain development groups seek to maximize efficiency and minimize GHG emissions. This increased complexity is likely to make high fidelity transmission modelling increasingly difficult over time. The advantages of engine-only testing to augment the GEM model inputs could be viewed as a partial step toward eventual use of powertrain and powerpack testing inputs in the GEM model. [EPA-HQ-OAR-2014-0827-1265-A1 p.114]

**Organization:** Daimler Trucks North America, Navistar Inc., Paccar Inc., and the Volvo Group

EPA has recognized that fixed engine test cycles are not as reflective of real world operation as vehicle-based duty cycles. There is nothing new about optimization of engines and vehicles for on-road performance while optimizing for criteria emissions on fixed test cycles. This has always occurred since the dawn of emissions control. EPA has added significant and onerous in-use test and OBD requirements that, in fact, largely dictate emissions control design more so than the fixed engine tests. The advent of GHG emissions control has changed this only to the extent that it forces recognition that vehicle-engine interactions must be recognized to optimize efficiency. EPA should propose to bring the criteria and GHG control process into alignment, not by forcing an ineffective engine regulatory scheme, but by looking to develop criteria emissions controls that account for the vehicle-engine interactions as a long-term objective. Clearly this is not easy and will take quite some, but acknowledging this goal as a key objective for future rulemakings could diffuse some of the pressure to adopt ineffective engine regulations just to align with old criteria emissions processes. In fact, EPA has intimated that “cycle average” engine testing as discussed as an alternative in the Phase 2 Regulatory Impact Analysis is attractive because it may have potential to better align efficiency and criteria regulations. [EPA-HQ-OAR-2014-0827-1894-A1 p.5]

**Organization:** Environmental Defense Fund (EDF)

#### **C. Agencies should restore the linkage between the GHG and criteria pollutant test cycles**



The Supplemental Engine Test (SET) steady-state cycle is one of two test cycles that EPA uses to determine compliance with existing criteria pollutant emission standards. The SET was also adopted as the sole test cycle for GHG compliance determinations in EPA's medium- and heavy-duty Phase 1 GHG rule finalized in September 2011. By using the same SET cycle for both programs, manufacturers are prevented from trading off criteria pollutant control for CO<sub>2</sub> control. [EPA-HQ-OAR-2014-0827-1312-A1 p.35]

As explained above, however, the Agencies are proposing to revise the cycle weighting for CO<sub>2</sub> compliance testing purposes only, based on the belief that the revised weighting would make the SET more representative. But by proposing the SET re-weighting for CO<sub>2</sub> only, EPA breaks the linkage between criteria pollutants and CO<sub>2</sub>, because PM and NO<sub>x</sub> would continue to be measured on the existing SET cycle. Setting aside the merits of the revisions, this de-linkage is of serious concern because it creates a loophole in the regulations that could lead to increases in criteria pollutants. We strongly recommend that EPA maintain the same test cycle for CO<sub>2</sub> and criteria pollutants in order to prevent these unintended consequences. One possible way to do this, if EPA decides to finalize the CO<sub>2</sub> cycle re-weighting, is to apply the same revisions to the criteria pollutant program. [EPA-HQ-OAR-2014-0827-1312-A1 p.35]

**Organization:** Navistar, Inc.

The proposed reweighting of the RMC appears to be appropriate and Navistar believes that it will improve the functioning of that test. The re-weighting allows for technology developments to be aligned with the usage of tractor applied engines. [EPA-HQ-OAR-2014-0827-1199-A1 p.22]

**Organization:** Walsh, Michael and Charlton, Stephen

There is a large amount of information available in the published literature related to HD tractor engine fuel consumption and BTE measurement. The metrics used vary widely – with the common goal of representing the real-world fuel consumption of HD tractor-trailers in tests or in simulations. In the Phase 1 rule [17], EPA and NHTSA adopted the SET steady-state cycle with the weighting factors used in the original European ESC cycle. These same weighting factors are used by EPA in the SET test for criteria pollutants (NO<sub>x</sub> and PM) for HD on-highway engines. In the proposed Phase 2 rule [14], the agencies have adjusted the weighting factors to favor lower engine operating speeds. The current and proposed SET cycles with weighting factors are shown in Figure 4. [NHTSA-2014-0132-0102-A1 p.11]

[Figure 4 can be found on p.12 of docket number NHTSA-2014-0132-0102-A1]

In addition, by proposing a new cycle for GHG regulation, the linkage between criteria pollutants and GHGs has been broken, since NO<sub>x</sub> and PM would continue to be measured on the current cycle. The loss of direct linkage between NO<sub>x</sub>, PM and GHG emissions could lead to unintended consequences, for example with regard to in-use emissions. This misalignment should be remedied by either reverting back to the SET test cycle used for NO<sub>x</sub> and PM for GHG certification, or by adopting the new test cycle for NO<sub>x</sub> and PM certification. [NHTSA-2014-0132-0102-A1 p.12]

A further engine test of importance here is the SuperTruck 65mph cruise test cell test point. This test point will vary between SuperTruck projects depending on the engine speed at 65 mph cruise (i.e. overall gearing and tires assumed), and on the vehicle road load at 65mph. With reasonable assumptions, the test point will likely fall between the A and B speeds at 50% to 75% load, see Figure 5. [NHTSA-2014-0132-0102-A1 p.12]

[Figure 5 can be found on p.14 of docket number NHTSA-2014-0132-0102-A1]

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17 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rule. Federal Register Vol. 76 Thursday, No. 179 September 15, 2011, Pages 57106– 57513. 49 CFR Parts 523, 534, and 535.

**Response:**

The agencies are not finalizing an allowance to adjust CO<sub>2</sub> emissions for FTP or SET testing to eliminate CO<sub>2</sub> from urea (although we are finalizing a similar allowance for fuel maps). Thus, we will not adjust heavy-duty FTP or SET CO<sub>2</sub> emission standards downward to account for CO<sub>2</sub> derived from urea decomposition. As noted in the NPRM, we estimate that current engines produce about 2 g/hp-hr of CO<sub>2</sub> from urea. However, this is based on very limited data.

Regarding gasoline test fuels containing ethanol, the agencies have performed heavy-duty engine testing at Southwest Research Institute utilizing both Tier 2 and Tier 3 certification test fuels. These results in g CO<sub>2</sub>/bhp-hr show that with post-test correction of the  $e_{CO_2}$  results back to the reference fuel as required in 40 CFR 1036.530, there does not appear to be a statistically significant difference between the Tier 2 and Tier 3 fuel results. In other words, the specified correction adequately accounts for test fuel effects. In addition, the agencies disagree with the commenter's conclusion based on their test data that the change to Tier 3 cert fuel increases stringency. The change to Tier 3 certification fuel should not include an engine's change in behavior due to octane. The correct comparison for regular-octane fueled engines is low octane Tier 2 fuel to low octane Tier 3. The results of this comparison from the manufacturers' test data show that there is not an increase in stringency due to the certification fuel change. Thus there is no effect on the stringency of the heavy-duty SI engine standards and the agencies will not be developing a Tier 3 E10 gasoline factor for Tier 3 certification fuels for heavy-duty engines.

The agencies have removed the proposed requirement to exclude work with zero reference value normalized torque from the total engine work calculation, keeping the existing method unchanged.

The agencies have provided an optional alternate RMC cycle with different weightings for CO<sub>2</sub> measurement in 40 CFR 1036.505. This alternate cycle affords the use of bag CO<sub>2</sub> measurement in place of the continuous measurement that would be required if using the current RMC in 40 CFR part 86.1362. We believe this will provide equivalent results to the continuous measurement technique.

The agencies are finalizing the use of cycle average fuel mapping for transient operation and making it optional for highway cruise cycles. Steady-state fuel mapping remains the default/reference method for cruise and idle cycles. . The agencies will further consider the use of cycle average fuel mapping in the future when it undertakes further criteria pollutant reductions.

The agencies appreciate the support for the reweighting of the SET cycle, and we agree that it should largely reflect operation at 65 mph. At this time we are not in a position to align GHG and criteria pollutants with respect to the use of this reweighted duty-cycle due to the effect of the reweighting on criteria pollutant emission results. However, we do not agree that this causes a misalignment with NO<sub>x</sub> because CO<sub>2</sub> and NO<sub>x</sub> will be measured at the same test points.

## 4 Class 7 and 8 Combination Tractors

### 4.1 General Comments

All of the tractor comments are included in subsections 4.2 through 4.6.

### 4.2 Proposed Tractor Standards for CO<sub>2</sub> and Fuel Consumption

**Organization:** California Air Resources Board (CARB)

#### **Comment – Approved low-GWP refrigerants for heavy-duty vehicles**

The NPRM states that currently, there are no low-GWP refrigerants approved for the heavy-duty vehicle sector. This appears to be a misstatement. Two low-GWP refrigerants, R-744 (CO<sub>2</sub>) and HFC-152a have been approved for motor vehicle air conditioning systems, including those for heavy-duty vehicles. (In addition, HFO-1234yf is SNAP approved for light-duty use and Chemours is applying for SNAP approval for this low-GWP refrigerant for heavy-duty use). [EPA-HQ-OAR-2014-0827-1265-A1 p.141]

#### **Response:**

Section III of the FRM Preamble has been corrected. Additional discussion regarding alternative refrigerants is included in Section I.F of the FRM Preamble.

**Organization:** Climate 911

Several independent analyses by transportation energy experts concur that diesel consumption by heavy duty trucks could be reduced to 40% of 2010 levels as early as 2025 using technology which is, for the most part, commercially available. Economic analysis showed this could be accomplished at a reasonable cost (payback from fuel savings within 12-24 months) with substantial long term savings. (NRC, 2010. ACEEE, 2013). [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

The proposed Phase 2 standards fall far short of what is possible, increasing the fuel economy of tractor trailers from the current 5-6 mpg to 8-9 mpg in 2027. The Department of Energy's Super Truck Program has already surmounted this low bar with a Cummins-Peterbilt Class 8 tractor trailer which gets 10.7 mpg and another built by Daimler which gets 12.2 mpg. (USOEERE, 2015) [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

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National Research Council; Transportation Research Board Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles. Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles; National Academies Press 2010

American Council for an Energy-Efficient Economy (ACEEE), "Further Fuel Efficiency Gains for Heavy-Duty Vehicles," September 25, 2013. <http://aceee.org/fact-sheet/heavy-duty-fuel-efficiency>.

US Office of Energy Efficiency and Renewable Energy. SuperTruck Team Achieves 115% Freight Efficiency Improvement in Class 8 Long-Haul Truck April 2015. <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

**Response:**

The agencies considered all of the general comments associated with the 40 percent reduction and the SuperTruck program. We believe there is merit in many of the detailed technology comments received and these are discussed in detail in Section III of the FRM Preamble. DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway. This type of tractor represents only one of the ten subcategories of tractors where the agencies have set new stringencies for Phase 2. In addition, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to damage from potholes or other road hazards. Thus, simply applying SuperTruck efficiencies would lead to infeasible standards, since the SuperTruck program does not account for the range of operating conditions likely to be experienced in use. Nor does the SuperTruck program account for cost of technology, or lead time needed to reliably deploy the technology. Nevertheless, the SuperTruck program has led to significant advancements in the efficiency of combination tractor-trailers. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the purpose of SuperTruck and the plenary applicability of regulations with the force of law, it is helpful (although not determinative) to assess the achievements and evaluate how the technologies could be applied into mass production into a variety of real world applications and maintaining performance throughout the full useful life of the vehicle.

**Organization:** Edison Solar Inc.

Finally, we know that improving truck fuel efficiency can be achievable and can be done affordably: [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

- Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies. [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

**Response:**

The agencies considered all of the general comments associated with the 40 percent reduction and the SuperTruck program. We believe there is merit in many of the detailed technology comments received and these are discussed in detail in Section III of the FRM Preamble. DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway. This type of tractor represents only one of the ten subcategories of tractors where the agencies have set new stringencies for Phase 2. In addition, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to damage from potholes or other road hazards. Thus, simply applying SuperTruck efficiencies would lead to infeasible standards, since the SuperTruck program does not account for the range of operating conditions likely to be experienced in use. Nor does the SuperTruck program account for cost of technology, or lead time needed to reliably deploy the technology. Nevertheless, the SuperTruck program has led to significant advancements in the efficiency of combination tractor-trailers. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the purpose of SuperTruck and the plenary applicability of regulations with the force of law, it is helpful (although not determinative) to assess the achievements and evaluate how the

technologies could be applied into mass production into a variety of real world applications and maintaining performance throughout the full useful life of the vehicle.

**Organization:** International Council on Clean Transportation (ICCT)

*Tractor-trailers* – Overall for tractors, the technologies included in the stringency determination are far short of the full technology potential. Applying the available incremental technologies for engines, transmissions, and aerodynamics can achieve technology potential far greater than agencies' proposed 8 miles-per-gallon tractor-trailer standards before 2025 (See Delgado and Lutsey, 2015). SuperTruck teams are achieving 10.7 mpg (Peterbilt) and 12.2 mpg (Daimler/Freightliner) in real-world testing (Buchholz, 2014; Daimler, 2015) with combinations of engine, tractor, and trailer technologies that greatly surpass the proposed 2027 standard analysis. After correcting for test cycle differences, the SuperTruck technologies demonstrated by manufacturers would achieve up to 10 miles per gallon (Lutsey, 2015b); because the proposed 2027 stringency levels do not approach these stringency levels, the standards can be advanced by at least several years. [EPA-HQ-OAR-2014-0827-1180-A4 p.5]

**Response:**

The agencies considered all of the general comments associated with the 40 percent reduction and the SuperTruck program. We believe there is merit in many of the detailed technology comments received and these are discussed in detail in Section III.D of the FRM Preamble. For example, the agencies included the technology assessments in the ICCT tractor-trailer technology reports that were cited in the ICCT comments.

DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway. This type of tractor represents only one of the ten subcategories of tractors where the agencies have set new stringencies for Phase 2. In addition, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to damage from potholes or other road hazards. Thus, simply applying SuperTruck efficiencies would lead to infeasible standards, since the SuperTruck program does not account for the range of operating conditions likely to be experienced in use. Nor does the SuperTruck program account for cost of technology, or lead time needed to reliably deploy the technology. Nevertheless, the SuperTruck program has led to significant advancements in the efficiency of combination tractor-trailers. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the purpose of SuperTruck and the plenary applicability of regulations with the force of law, it is helpful (although not determinative) to assess the achievements and evaluate how the technologies could be applied into mass production into a variety of real world applications and maintaining performance throughout the full useful life of the vehicle..

**Organization:** Quasar Energy Group

Finally, we know that improving truck fuel efficiency can be achievable and can be done affordably: [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

**Response:**

The agencies considered all of the general comments associated with the 40 percent reduction and the SuperTruck program. We believe there is merit in many of the detailed technology comments received and these are discussed in detail in Section III of the FRM Preamble. DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway. This type of tractor represents only one of the ten subcategories of tractors where the agencies have set new stringencies for Phase 2. In addition, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to damage from potholes or other road hazards. Thus, simply applying SuperTruck efficiencies would lead to infeasible standards, since the SuperTruck program does not account for the range of operating conditions likely to be experienced in use. Nor does the SuperTruck program account for cost of technology, or lead time needed to reliably deploy the technology. Nevertheless, the SuperTruck program has led to significant advancements in the efficiency of combination tractor-trailers. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the purpose of SuperTruck and the plenary applicability of regulations with the force of law, it is helpful (although not determinative) to assess the achievements and evaluate how the technologies could be applied into mass production into a variety of real world applications and maintaining performance throughout the full useful life of the vehicle.

**Organization:** Union of Concerned Scientists (UCS)

The agencies' proposal must be 'technology-forcing' and achieve the 'maximum feasible' reductions in the timeframe of the rule. To do this, the agencies must strengthen Alternative 4 by: [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

- Increasing the stringency for tractors by 6 percent in 2024 to reflect the full range of improvements to the powertrain; [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

**Response:**

First, UCS is mistaken that section 202 (a)(2) of the Clean Air Act mandates technology-forcing standards, although it allows them. See generally 74 FR 49464-465 (Sept. 28, 2009). Second, the agencies acknowledge UCS's comment about increasing the stringency of the tractor program due to the opportunity to further improve powertrain optimization through powertrain testing. For the Phase 2 final rule, we have made several changes since proposal that capture much of the improvement potential highlighted by UCS. First, the agencies have used additional engine technologies in the technology package used to determine the tractor standards for the final rule, as described in Section III.D.1 of the Preamble. In addition, the final rule requires the use of a cycle average fuel map in lieu of a steady state fuel map for evaluating the transient cycle in GEM will recognize improvements to transient fuel control of the engine. The agencies are including the impact of improved transient fuel control in the engine fuel maps used to derive the final standards. Second, the optional transmission efficiency test will recognize the benefits of improved gear efficiencies. Therefore, the agencies have built some improvements in transmission gear efficiency into the technology package used to derive the final standards. This leaves only the optimization of the transmission shift strategy, which would need to be captured on a powertrain test. The agencies believe that the opportunity of shift strategy optimization is less for tractors than for other types of vocational vehicles because a significant portion of the tractor drive cycles are at highway speeds with limited transmission shifting. Therefore, we have not included the powertrain optimization portion only recognized through powertrain testing into the standard setting for the final rule.

### 4.3 Projected Tractor Technologies, Effectiveness, and Cost

**Organization:** A de F Limited

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 167-168, 171.]

And I want to applaud EPA on incentivizing small, incremental, innovative technologies that ultimately add value in the big picture.

A lot of times, we underestimate the incremental. And when that incremental is scalable, we may very well miss meaningful opportunities that move us to our ultimate goal, in this case CO2 mitigation.

The market opportunities of aerodynamic wheel covers have gained momentum with many new entrants salivating at the commercial prospects. An aerodynamic wheel cover is the only aerodynamic component that is functional on both tractor and trailer. And, yet, because of this regulatory process that splits tractor from trailer in testing, it is lost in the noise.

The addition of a single sentence to this regulation that would embrace testing of tractor-trailer combinations for aerodynamic components found on both would be helpful to permit aerodynamic wheel covers to scale in a marketplace that is worldwide.

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 169, 171.]

We applaud EPA's focus on vigilantly bumping efficiency of long-haul tractor-trailer combinations through this new phase 2 as it will bring further fuel savings through trailer efficiency.

When measuring the increases in efficiency of wheel covers on trailers and tractors independent of each other, the fuel savings get lost in the margin of error of the test methodology. With no enmity suggested, it is our belief that a hugely scalable opportunity is being missed. We suggest a remedy that would permit testing of both tractor and trailer in combination for the purposes of aerodynamic components that can be fitted to both.

We believe current testing methodology is sufficient, albeit misapplied to either tractor or trailer and not the combination.

**Response:**

The agencies considered technologies, including wheel covers, in establishing the more aerodynamic bins, such as Bin V, in Phase 2.

**Organization:** Alliance of Idle Mitigation Technologies

The Alliance of Idle Mitigation Technologies was formed out of concern that Phase 2 will drastically and unintentionally limit the options available for idle reduction. [EPA-HQ-OAR-2014-0827-1311-A1 p.1]

The Alliance consists of best in class companies, including Idle Smart, IdleAir, and Shorepower Technologies, who offer high impact solutions to extended main engine idling of class 8 trucks. Common

among member companies is the threat that a radical increase in adoption of Automatic Engine Shutdown (AES) will have on member companies' viability. The threat varies from complete incompatibility, as in the case of adjustable automatic shutdown, to frustration of relevance, as in the case of electrified parking space providers. [EPA-HQ-OAR-2014-0827-1311-A1 p.1]

Unlike the transition away from tire pressure monitoring systems towards a system that both monitors and inflates the tires, the transition to AES is not a straightforward progression to greater efficiency. AES will necessarily result in APU adoption. The costs and environmental effects of APU's are not fully considered within the proposed rule. [EPA-HQ-OAR-2014-0827-1311-A1 p.1]

The Alliance recognizes that the AES scoring scheme is not new. However, in light of the ambitious increase in the efficiency threshold, even after accounting for the inclusion of technologies that are arguably not commercially feasible today, the effect of this scoring scheme is as different between Phase 1 and Phase 2 as the meaning of the word "lightening" after appending the word "bug." [EPA-HQ-OAR-2014-0827-1311-A1 p.1]

**Response:**

The agencies received a number of comments regarding "mandating APU" or "mandating AESS." There is a misconception of the proposed Phase 2 program where stakeholders thought that the agencies were mandating APUs (or mandating any technology for tractors, for that matter). This is incorrect. The tractor standards are performance standards to be met by any means an OEM chooses. The agencies merely *projected* an adoption rate of up to 90 percent for tamper-proof AESS in our analysis as one part of one technology package for determining the stringency of the proposed standard. We did not propose to differentiate between the various idle reduction technologies in terms of effectiveness and only used the diesel powered APU in terms of estimating the cost and effectiveness of the proposed, or final standard. For each standard, we developed one potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths and combinations of technologies. They will not be required to apply all technologies to every tractor; nor will they be required to apply any specific technology to any tractor.

The agencies have assessed the environmental impact of APUs in the NPRM and FRM. As noted in Section III.C of the Preamble, EPA is adopting a new PM standard of 0.02 g/kW-hr that applies exclusively to APUs installed in MY 2024 and later new tractors. EPA is also amending the Phase 1 GHG standards to provide that as of January 1, 2018 and through MY 2020, a tractor can receive credit for use of an AESS with an APU installed only if the APU engine is certified under 40 CFR part 1039 with a deteriorated emission level for PM that is at or below 0.15 g/kW-hr.

**Organization:** Allison Transmission, Inc.

Several key projections with regard to technology penetration rates and cost estimates in the Proposed Rule are flawed. The agencies are too optimistic with regard to the ability to incorporate hybrids into the MD/HD sector; cost estimates with respect to different transmission architectures are understated; cost estimates for Neutral-Idle and Stop-Start technology are below costs that have been reported. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

EPA and NHTSA lack a rational basis to provide more credits to automated manual ("AMT") and dual clutch transmissions ("DCTs") than fully automatic transmissions. Allison's real world studies indicate that automatic transmissions ("ATs") are as good as or better than AMT or DCTs in terms of greenhouse



gas emissions and impact on fuel efficiency in most vocational applications and many tractor applications. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

### **EPA and NHTSA's 2 Percent Credit for Advanced Transmissions is Reasonable**

EPA and NHTSA have requested comment on "all aspects" of the feasibility analysis that underlies the regulatory alternatives presented in the Proposed Rule. With respect to the projections of the relative emission impact of various transmission technologies, the agencies are proposing a 2% technology input for ATs, AMTs and DCTs for Class 7 and 8 vehicles. While Allison ATs can exceed this level (versus the baseline contained in the Proposed Rule) we believe it is a reasonable level to apply based on the record for this rulemaking for ATs and AMTs. Moreover, we do not believe that EPA and NHTSA have articulated any basis in the Proposed Rule to differentiate between the technology inputs that should be available to ATs and AMTs.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.16]

### **DCTs in Tractors**

Mesilla Valley Transportation ("MVT") operates a fleet of 1345 trucks and over 5000 trailers and is known as one of the largest locally owned, full service truck load carrier companies in the southwest. In October 2014, EPA recognized MVT with the SmartWay® Excellence Award for their progress on environmental performance and energy efficiency. As part of their on-going efforts to find more energy efficient vehicles, MVT has done extensive evaluation of transmissions during 2015. 50 production-built fully automatic TC10™ equipped trucks have been operating in normal fleet operations as a comparison to the Eaton Fuller Advantage® Automated Transmission. The latest data from August 2015 shows the TC10 having 4.6% higher MPG than the fleet average with the AMT. Based on this significant level of improvement, MVT plans to have over 400 AT's in their fleet of sleeper cab tractors by the end of 2016. It is also notable that when combined with all of the other vehicle efficiency improvements, the TC10 equipped vehicles demonstrated 9.25 MPG in August 2015. [EPA-HQ-OAR-2014-0827-1284-A1 p.17-18]

With respect to the Phase 2 proposal, the MVT experience is evidence of the following: [EPA-HQ-OAR-2014-0827-1284-A1 p.18]

- AT's can be more fuel efficient than AMTs in real-world tractor duty cycles [EPA-HQ-OAR-2014-0827-1284-A1 p.18]
- ATs penetration into tractors is feasible per EPA's assumptions [EPA-HQ-OAR-2014-0827-1284-A1 p.18]
- ATs are viable in sleeper cabs (in addition to day cabs) [EPA-HQ-OAR-2014-0827-1284-A1 p.18]
- Neutral at stop capability, 1st lockup operation, load-based and grade-based shift algorithms and Acceleration Rate Management contribute to the overall fuel efficiency of ATs in tractors [EPA-HQ-OAR-2014-0827-1284-A1 p.18]

EPA and NHTSA must therefore apply the same or greater emission reduction factor to the AT. Not doing so would create an unfair and unsupported disadvantage for ATs relative to the AMTs. This same disadvantage would occur with respect to DCTs; however, as noted above, Allison believes that the agencies lack technical information in the record for this rulemaking to support any credit for DCTs and therefore also lack a rational basis to grant any emission reduction credit in the Final Rule. While DCTs should logically perform better than the MT baseline, EPA and NHTSA must base crediting on adequate

information placed into the docket; this does not currently exist. Indeed, Volvo has indicated that fuel consumption with the I-Shift Dual Clutch is the same as the I-Shift AMT.<sup>31</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.18]

In addition, AMTs receive a 1.8% credit in GEM for heavy-haul tractors, yet there is no similar credit for ATs. Although Allison is unaware of statements in the Proposed Rule with regard to the source of the AMT credit, presumably it is for the GHG and fuel efficiency benefits of automation. Since ATs offer similar, if not greater, benefits, they should also receive credit. In addition, neutral-idle recognition should be available as previously discussed in Section III.E. [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

### **EPA and NHTSA Must Include Automatic Neutral At Stop Into GEM for Tractors**

The Proposed Rule expands the incorporation of idle emission systems in GEM, such as Stop-Start systems and AT Neutral-Idle systems. Allison generally supports the agencies' proposal to expand incorporation of such systems in GEM; our own experience with such systems indicates that they result in significant improvement in fuel efficiency and reduced emissions. The Proposed Rule, however, does not include an idle cycle for tractors, but rather solicits comments as to whether idle systems should be incorporated within GEM for certain tractor types. [EPA-HQ-OAR-2014-0827-1284-A1 p.25]

There is no rational reason not to include automatic neutral in only vocational tractors, but all tractors. Automatic neutral is standard with the Allison TC10 and is available with the Allison 3000 and 4000 Series transmissions; we believe that usage of the technology will be high by 2021. Thus, including Neutral-Idle as a selectable option in GEM is fully justified; allowing its use as a selectable option would both ensure that real world emission benefits would be recognized in GEM and that use of such technology is incentivized. [EPA-HQ-OAR-2014-0827-1284-A1 p.25]

Conversely, there would not appear to be a basis for excluding such technology as a selectable option in GEM, whether or not it is currently utilized in a tractor type of vehicle. Given the long timeframe of this rulemaking, affecting vehicles through at least MY 2027, EPA and NHTSA must recognize and allow for the broader incorporation of Neutral-Idle across many different fleets and vehicle types. There is no technical reason why Neutral-Idle could not be implemented in all tractors and the agencies should allow for its adoption by vehicle manufacturers where it makes commercial sense based on the vehicles' intended uses. [EPA-HQ-OAR-2014-0827-1284-A1 p.25]

Allison has developed the TC10 transmission that was purpose-designed for the tractor market. The TC10 combines FuelSense® technologies with a blended architecture that combines a traditional AT planetary with a countershaft that results in a very efficient 10-speed powershift automatic transmission. Fleets have reported improvements in excess of 5% higher average fuel economy over their current fleet average with the TC10 and Allison believes that the penetration of the TC10 will grow in tractors based on its performance, reliability and fuel efficiency. [EPA-HQ-OAR-2014-0827-1284-A1 p.25]

Similar to the Allison transmissions for vocational vehicles, the TC10 includes the automatic neutral at stop functionality. This capability must be recognized in all tractor sub-categories. While this benefit would be expected primarily in vocational tractors and day cabs, Allison believes it is significant that over 40% of TC10 sales to date have been into sleeper cabs. This demonstrates market acceptance of the technology due, at least in part, to features of the TC10 that reduce fuel use. [EPA-HQ-OAR-2014-0827-1284-A1 p.25-26]

Although at a much lower penetration rate in tractors than vocational vehicles, Allison's 3000 and 4000 Series transmissions with automatic neutral at stop technology are also sold into tractors with annual

volume of up to approximately 5000 units. EPA has predicted that the automatic transmission penetration in tractors will grow to 30% in 2027. (RIA Table 2-28). Given this projected adoption – along with the current volume of sales – automatic neutral at stop must be incorporated into GEM in order to ensure the accuracy of the Final Rule, i.e., the ability of the certified emission levels to reflect actual, real world operational emissions. The agencies cannot ignore the emissions and fuel efficiency benefits of a technology which is projected to have sizeable market penetration within the regulatory timeframe of this rulemaking. [EPA-HQ-OAR-2014-0827-1284-A1 p.26]

### **EPA and NHTSA Are Correct Concerning Assessment of Hybrids in Tractor Categories**

The agencies have cited to the high costs and “limited utility of hybrids” with regard to tractors for their decision not to include hybrids as part of the standards that are applicable to such vehicles. We share in this overall assessment. In many tractor categories, there is a preponderance of highway driving; incorporating hybrids into most tractors would provide little incremental benefit in terms of reduced emissions and fuel use – while having offsetting effects through the additional weight of hybrid systems. Thus, based on the record before the agency, it is proper for EPA and NHTSA to conclude that hybrids should not factor into the stringency of tractor categories. Investment dollars will yield greater GHG reductions through implementation of other technologies. [EPA-HQ-OAR-2014-0827-1284-A1 p.51]

### **EPA and NHTSA Must Account For Weight of Different Transmission Architectures**

The baseline technology for MD/HD automatic transmissions is a planetary gearset. Planetary architectures typically weigh less than countershaft architectures. For vocational vehicles, Allison recommends that a weight penalty be assessed for MT/AMT transmissions with countershaft architectures. For this assessment, the clutch, clutch housing and transmission/clutch shift lever all need to be considered to be part of the transmission to have a relevant comparison to a torque converter automatic transmission. [EPA-HQ-OAR-2014-0827-1284-A1 p.63]

Table III-35 Proposed Phase 2 Weight Reduction Technologies for Tractors includes weight reduction for transmission case, clutch housing and transmission/clutch shift lever. As discussed above for vocational vehicles, a planetary torque converter automatic will weigh less than a comparable manual transmission. Allison recommends that a weight reduction be assigned for planetary automatic transmissions such as the Allison 3000 and 4000 Series in tractors. Our data would suggest a 50 lb savings in Class 8 and much more for Class 7 would be appropriate. Allison expects sales up to approximately 5000 transmissions in tractors this year so there is volume associated with this technology. [EPA-HQ-OAR-2014-0827-1284-A1 p.63]

Allison also suggests a 200 lb penalty for a HHD DCT should be applied given the architecture of this system.<sup>99</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.64]

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28 This is not the position we take with respect to DCTs, however. EPA and NHTSA lack technical information in the record to support crediting DCTs within GEM. See Sections II-A, III-B, *infra*.

31 See “Unique gearbox for heavy vehicles on the Volvo FH.” Attachment 2

82 See comments above in Section I.C.

99 See Attachment 1.

**Response:**

The agencies' assessment of the comments is that Allison and Volvo support the proposed two percent effectiveness as an input to GEM for AT and AMT transmission types. The agencies have refined the treatment of transmissions in GEM in the final standards. Using the default transmission input files for AMT and MT, the GEM results for manual transmissions are 2 percent worse than those for an equivalently spec'd automated manual transmission. The agencies have conducted powertrain testing comparing an AMT to Allison's TC10 automatic transmission (see RIA Chapter 2.8.2.5). Overall, the CO<sub>2</sub> emissions and fuel consumption are equivalent between the two transmissions. However, the agencies have selected default losses for automatic transmissions that are higher than the losses in a TC10 because its efficiency is significantly greater than the average heavy-duty automatic transmission in the market today. Therefore, vehicles that utilize the TC10 transmission will achieve similar CO<sub>2</sub> emissions and fuel consumption as an AMT, and approximately 2 percent better than a manual transmission, by either using the results of either the optional powertrain test (40 CFR 1037.550) or the optional transmission efficiency test (40 CFR 1037.565).

For a vehicle that uses a DCT, the agencies treat it as an AMT in GEM because of the inherent design similarities to AMTs. This is a conservative assumption because in addition to a DCT having mechanical efficiencies similar to an AMT, it also could have lower emissions and fuel consumption due to power shifting capabilities.

The agencies considered the comments, both supporting and raising concerns over idle reduction in day cabs. The agencies determined that neutral idle for automatic transmissions is an appropriate technology for use in tractors. Therefore, the agencies are adopting provisions in Phase 2 to recognize neutral-idle in automatic transmissions as an input to GEM. Our analysis shows that neutral idle effectiveness is approximately 0.8 to 1 percent over the composite day cab tractor cycles. The agencies will also include neutral idle as a GEM input for sleeper cabs, though the effectiveness is very low, as shown in RIA Chapter 2.4.8.3. The agencies are predicating the standards for day cabs based on a technology package that includes neutral idle.

After considering the comments, the agencies are continuing the Phase 1 approach of not including hybrid powertrains in our feasibility analysis for Phase 2. Because the technology is still under development for tractors we cannot confidently assess the effectiveness of this technology at this point in time. In addition, due to the high cost, limited benefit during highway driving, and lacking any existing systems or manufacturing base, we cannot conclude with certainty that hybrid powertrains will be available for tractors in the 2021-2027 timeframe. However, manufacturers will be able to use powertrain testing to capture the performance of a hybrid system in GEM if systems are developed in the Phase 2 timeframe.

The agencies are not finalizing a weight penalty for any components since this would require detailed information on conventional and light-weight tractor components to establish a baseline and the weight reduction potential for each component.

The agencies also are not providing a default weight reduction value to transmission type due to the variety of transmissions in the tractor market today. In addition, a 50 pound weight reduction leads to only a 0.06% reduction in CO<sub>2</sub> emissions in sleeper cabs. The manufacturers have the option of requesting off-cycle credits for weight reductions that are not included in 40 CFR 1037.520.

**Organization:** Aluminum Association

The Aluminum Association is committed to producing high quality, accurate information for OEMs as well as the EPA and other regulatory agencies on the benefits of aluminum lightweighting in the transportation sector. Mass reduction using aluminum has emerged as a proven and cost effective technology for achieving improved road vehicle fuel economy and CO<sub>2</sub> emissions performance and in the past 40 years aluminum use in light and heavy-duty vehicles has increased steadily. In the truck and trailer market specifically, aluminum use has nearly doubled since the recession of 2009 and is trending back toward record levels last seen in the late 1990s and early 2000s. Growth in the use of aluminum in the truck and trailer market has been accommodated utilizing existing production capacity, and where needed, with the addition of new capacity, and the aluminum industry has consistently demonstrated the ability to match supply with demand, including the previous growth of aluminum demand in the aerospace, packaging, and auto transportation sectors. In the auto transportation sector for example, the aluminum industry has publicly announced over 1.5 billion pounds of capacity expansion to come on line by 2018 to support that industry's growth. The long lead times in the proposed rule that require ultimate compliance in the 2027 model year also provide ample opportunity for the alignment of aluminum product supply with any potential for increased demand due to the implementation of lightweighting opportunities in the truck and trailer market. [EPA-HQ-OAR-2014-0827-1260-A1 p.1-2]

The weight and emission benefits that result from using aluminum in heavy-duty trucks are significant. Research conducted by Ricardo Consulting Engineers has shown that an "aluminum-intensive" Class 8 commercial tractor trailer combination can reduce vehicle weight by 3,300 pounds and that for every 10 percent of weight reduction, up to a 5.5 percent improvement in fuel economy is possible. The study also found that substituting the nation's fleet of Class 8 tractor-trailers with aluminum-intensive models would save 9.3 million tons of CO<sub>2</sub> emissions annually. [EPA-HQ-OAR-2014-0827-1260-A1 p.2]

The aluminum industry is also continuously improving its product offering to the heavy truck and trailer transportation market to maximize the benefits of using aluminum in lightweighting applications. Recently, these have included – [EPA-HQ-OAR-2014-0827-1260-A1 p.2]

- Alcoa's introduction of the 'ULTRAx Ultra-ONE' forged aluminum wheel – This wheel is 47% lighter than a comparably sized steel wheel and weighs in at only 40 pounds, thus enabling its potential to save over 1400 pounds in Class 8 service. [EPA-HQ-OAR-2014-0827-1260-A1 p.2]
- Alcoa's introduction of a new aluminum alloy, 'Magna-Force' which is up to 17% stronger than the 6061 alloy it replaces in transportation applications. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Novelis' introduction of the 'Advanz' 7000 series next generation high strength aluminum alloy designed to enhance vehicle lightweighting and safety. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Sapa's development and introduction of new aluminum extrusion applications in a variety of tractor componentry including sleeper cabs, seat frames, entry steps/deck plates, and aerodynamic fairings. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Rio Tinto's commissioning of their enhanced state-of-the-art aluminum smelting facility in Kitimat, BC operating solely on clean, renewable, hydropower and using efficient AP40 pot technology to supply aluminum to transportation and other markets in North America and around the world. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

The industry is also pursuing new aluminum joining methods that will enable increased integration of aluminum and non-aluminum components into next generation vocational and heavy-duty vehicles. All the activities noted above continue the aluminum industry's long history of working with transportation market manufacturers throughout the supply chain to develop vehicle efficiency improvement solutions and that work will continue and become ever more important under the recently proposed Phase 2 standards. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

Lightweighting is well-recognized in the proposed rule as a means to increase trucking efficiency and there are three primary ways that this occurs – [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

1) It lowers rolling resistance, which means it takes less energy to start the vehicle moving and then overcome the friction of its contact with the road, [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

2) It allows carriers to add more cargo to each truck, which reduces the number of trucks on the road and/or trips that need to be made, and, [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

3) It facilitates the adoption of other efficiency technologies, such as trailer tails and side skirting, as it can negate the concerns about the added weight of those technologies. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

### Tractor Cab Assemblies

Table 8 of 1037.520 provides weight reduction credits for different individual cab components such as the door, roof, rear wall, and floor. This is appropriate when these components are considered for substitution on an individual basis. However, the Association is aware that in many instances the entire tractor cab is substituted with aluminum and a typical weight reduction associated with this substitution is 500 lbs. Therefore, the Association requests that an additional line item be added to Table 8 reflecting that the “Entire Tractor Cab” be credited with a 500 lb weight reduction if it is switched from steel to aluminum componentry. [EPA-HQ-OAR-2014-0827-1260-A1 p. 7-8]

### **Response:**

The agencies agree with the commenter that there are three primary ways that lightweighting improves efficiency. Weight reductions in GEM are recognized in two ways. The first reduces the mass of the overall vehicle, which in turn reduces the rolling resistance. The second increases the payload of the vehicle in the certification process. In addition, as the commenter notes, lightweighting is a means to offset added weight of other technologies for operators in weight-sensitive operations.

The agencies are not adopting the Aluminum Association’s suggestion to include a weight reduction value for the “Entire Tractor Cab” as an automatic GEM input because cabs come in a variety of sizes and weights. This makes it difficult to assess whether 500 pounds is an appropriate value for both day and sleeper cabs, which have significantly different roof, floor, and side panel areas. We think that the replacement of the entire tractor cab with aluminum can be handled through either the individual components listed in 40 CFR 1037.520 or requested through Off-Cycle credits.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

The single most important shortcoming of the proposal is the weakness of the tractor truck engine standard. However, standards for all engine and vehicle classes have room for improvement. [EPA-HQ-OAR-2014-0827-1280-A1 p.6]

Tractor aerodynamics

In the agencies’ compliance package for the 2027 tractor standard, the average CdA value for a high roof sleeper cab (CdA=5.3) is 14.5% lower than the 2017 baseline value, a reduction of 1.6% per year from

the 2017 baseline. This value falls between Bins IV and V, as shown below in figure 1. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

[Figure 1 can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

The agencies note: “Since the development of the Phase 1 rules, the manufacturers have continued to invest in aerodynamic improvements for tractors. This continued evolution of aerodynamic performance, both in production and in the research stage as part of the SuperTruck program, has consequently led the agencies to propose two additional aerodynamic technology bins (Bins VI and VII) for high roof tractors. These two new bins would further segment the Phase 1 aerodynamic Bin V to recognize the difference in advanced aerodynamic technologies and designs” (p.40246). It is therefore important that the standards promote these advances by moving tractor aerodynamics well into the new bins. The 2027 compliance package for a high roof sleeper cab assumes a 25% penetration of these higher aerodynamic bins, but an average that falls short of achieving Bin V. This suggests that the aerodynamic package for the standards is well within reach of the manufacturers over the next decade. [EPA-HQ-OAR-2014-0827-1280-A1 p.15]

### **Tractor-trailers**

Since the close of the public comment period, numerous new data on tractor-trailers have been submitted to the docket, including a revised report on fuel efficiency technologies<sup>1</sup> and additional information on tractor aerodynamics.<sup>2,3</sup> These data continue to show that the agencies have underestimated the technology potential of tractor-trailers and, particularly, tractor engines. Based on this new data, the agencies should tighten the fuel consumption and emissions targets for tractor-trailers and tractor engines. Furthermore, the agencies should improve the aerodynamic testing procedures for tractors to ensure that benefits of the rule are not eroded. [EPA-HQ-OAR-2014-0827-1896-A1 p.1]

#### *Tractor aerodynamic performance*

Some comments on the proposed rule stated that tractor aerodynamic drag levels assumed in the agencies’ 2027 compliance package were not achievable, at least without a more aerodynamic standard trailer for testing.<sup>9</sup> We are not aware of new information referenced in the NODA that relates directly to this matter; but given comments on the proposed rule, we note here that substantial, additional reductions in drag could be achieved by 2027 through co-optimization and integration of tractor and trailer. These additional drag reductions could be verified by using a more advanced trailer for testing and then correcting for the benefits of the trailer alone, as discussed in greater detail in Appendix 2. [Appendix 2 can be found on p.12 of this docket][EPA-HQ-OAR-2014-0827-1896-A1 p.2]

#### Impact on proposal

There is no evidence provided in the NODA to support weakening of the 2027 aerodynamic targets for tractors. In fact, increased stringency could be achieved by redefining the standard trailer in later years to reflect future improvements to the average trailer and taking advantage of tractor/trailer co-optimization in the compliance package. [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

### **Appendix 2: Additional Savings from Tractor-Trailer Co-optimization and Integration**

The agencies’ compliance package for high roof sleeper cabs in the Phase 2 proposal includes aerodynamic improvements that reduce drag by 14% and fuel consumption by 6% in 2027. Manufacturers raised concerns about these levels of drag reductions in their comments, claiming that the expected tractor

drag levels are not achievable using the prescribed “standard” trailer. We do not believe that this concern provides a basis for weakening the aerodynamic performance of high-roof sleeper cabs assumed in the agencies’ compliance scenario. In fact, SuperTruck results indicate that greater aerodynamic improvements than those assumed in the Phase 2 proposal are achievable. [EPA-HQ-OAR-2014-0827-1896-A1 p.12]

Aerodynamic drag (CdA) values and bin levels are shown below for reference. [EPA-HQ-OAR-2014-0827-1896-A1 p.12]

[Figure, 'CdA values and bin levels', can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

#### *Certainty of savings from matching tractor and trailer*

The fuel savings benefits of co-optimization and integration of tractor and trailer will not be realized if the equipment is not appropriately paired in real-world operation. Because tractors may tow a variety of trailers, ensuring such pairings would be difficult. This raises a question of whether it is prudent to provide credit for the benefits of tractor-trailer co-optimization and integration as recommended above. [EPA-HQ-OAR-2014-0827-1896-A1 p.14]

Manufacturers and purchasers of co-optimized or integrated tractors and trailers presumably would seek to ensure that the correct pairings were made as a matter of course. The agencies note (p.40245) that “tractor-trailer pairings are almost always optimized.” While this observation was made in the context of roof height and trailer type, the same considerations should apply here. In the case of integration, manufacturers and researchers are clearly working towards designs that would necessitate, or strongly favor, appropriate pairings. Furthermore, it is important to weigh the potential for unearned credits for tractor-trailer pairing against the value of the incentive to accelerate the aerodynamic integration of tractors and trailers. [EPA-HQ-OAR-2014-0827-1896-A1 p.14]

In any case, the likelihood of reasonable agreement between compliance credit for tractor-trailer pairings and the real-world benefits could be increased for example by: [EPA-HQ-OAR-2014-0827-1896-A1 p.15]

- Giving manufacturers credit only for vehicles sold to fleets with well-documented estimates of the percentage of miles traveled with matched set. (Credit computed case by case) [EPA-HQ-OAR-2014-0827-1896-A1 p.15]
- Giving a fixed, partial credit to provide an incentive for co-optimization while recognizing the possibility of mismatches. (Partial credit across the board, e.g. 50%) [EPA-HQ-OAR-2014-0827-1896-A1 p.15]
- Certifying tractors to be used only with certain trailers; this requirement would be shown on the tractor label. (100% credit) [EPA-HQ-OAR-2014-0827-1896-A1 p.15]
- Awarding full credit to tractors having hardware to ensure pairing with appropriate trailers. (100% credit) [EPA-HQ-OAR-2014-0827-1896-A1 p.15]

The agencies could adopt a combination of these approaches. Most fleets at present may be unwilling to accept the loss of flexibility required by the 3rd and 4th approaches, especially given the constraint this may impose on resale of the tractor. However, acceptance should increase over time, as integrated designs



demonstrate major fuel savings, and trailer fleets are managed and optimized in real time. [EPA-HQ-OAR-2014-0827-1896-A1 p.15]

#### *Tractor Engine Technology Effectiveness*

The Southwest Research Institute (SwRI) completed a comprehensive analysis of fuel consumption reduction technologies applicable to commercial medium- and heavy-duty trucks.<sup>1</sup> Despite downward revisions in technology potential between the draft version of the report available in the proposal and the final report included in the NODA, this research indicates that tractor engines can improve their fuel consumption by at least 8 percent in 2027, nearly double the agencies' proposed target. [EPA-HQ-OAR-2014-0827-1896-A1 p.1-2]

#### **Tractor-trailers**

Since the close of the public comment period, numerous new data on tractor-trailers have been submitted to the docket, including a revised report on fuel efficiency technologies<sup>1</sup> and additional information on tractor aerodynamics.<sup>2,3</sup> These data continue to show that the agencies have underestimated the technology potential of tractor-trailers and, particularly, tractor engines. Based on this new data, the agencies should tighten the fuel consumption and emissions targets for tractor-trailers and tractor engines. Furthermore, the agencies should improve the aerodynamic testing procedures for tractors to ensure that benefits of the rule are not eroded. [EPA-HQ-OAR-2014-0827-1896-A1 p.1]

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1 EPA-HQ-OAR-2014-0827-1623/NHTSA-2014-0132-0185.

2 EPA-HQ-OAR-2014-0827-1624/NHTSA-2014-0132-0186

3 EPA-HQ-OAR-2014-0827-1625/NHTSA-2014-0132-0188.

9 EPA-HQ-OAR-2014-0827-1215.

#### **Response:**

The agencies disagree with the commenter's assessment on aerodynamic potential. The aerodynamic data provided in the NODA demonstrates that the high roof tractors tested fall into Bins III and IV. This data does not support increasing the stringency of the aerodynamic technology packages because the majority of this test data was considered in the proposal and all of the tractors tested fell within the range of performance of the vehicles tested prior to proposal. The agencies' assessment is that only Bins I through V are achievable with known aerodynamic technologies, but that Bins VI and VII have less known technology paths. Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . See RIA Chapter 2.8.2.2. These aerodynamic improvements have been demonstrated within the program on two vehicles in 2015. In the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing these aerodynamic technologies as early as 2021 MY on a limited scale. We adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2

program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so.

With respect to ACEEE's recommendation for the agencies to facilitate the transition to more integrated tractor-trailers, such as those demonstrated with SuperTruck, the agencies believe this would require a significant change in tractor-trailer logistics to encourage more matching of specific tractors to specific trailers in operation. We believe that this would be most appropriately handled through the Off-Cycle Credit program.

#### *Engines*

The Phase 2 *engine* standards will lead each manufacturer to achieve reductions of 5.1 percent in 2027 MY. For the final Phase 2 rule, we recognize that it could be possible to achieve greater reductions than those included in the engine standard by designing entirely new engine platforms. Unlike existing platforms, which are limited with respect to peak cylinder pressures (precluding certain efficiency improvements), new platforms can be designed to have higher cylinder pressure than today's engines. New designs are also better able to incorporate recent improvements in materials and manufacturing, as well as other technological developments. Considered together, it is possible that a new engine platform could be 6 percent more efficient without WHR than Phase 1 engines and 8 percent more efficient than Phase 1 if 50 percent of these engines have WHR. We project that 50 percent of tractor engines in 2027 MY will be redesigned engines (i.e. engines reflecting redesigned engine platforms, again based on existing engine platform redesign schedules within the industry) achieving a 6 percent reduction for day cabs and an 8 percent reduction in fuel consumption in sleeper cabs beyond Phase 1. This means the average 2027 MY tractor engine would be 5.4 and 6.4 percent better than Phase 1 for day and sleeper cabs respectively. We have factored these levels into our analysis of the *vehicle* efficiency levels that will be achievable in MY 2027. These additional engine improvements make more stringent vehicle standards feasible, and the final standards are structured so that these improved engines are not able to generate windfall credits, but rather that their projected performance is reflected in the stringency of the final tractor *vehicle* standard. We project all vehicle manufacturers will be able to use new platform engines for some of their vehicles. Nevertheless, some may choose not to for business reasons, even though it may be the most cost-effective path. We project that manufacturers that do not achieve this level of engine reduction would be able to make up the difference by applying one of the many other available and cost-effective tractor technologies to a greater extent or more effectively, so that there are multiple technology paths for meeting the final standards. In other words, a manufacturer that does not invest in updating engine platforms in the Phase 2 time frame is likely to be able to invest in improving other *vehicle* technologies. These reductions will show up in the fuel maps used in GEM to set the Phase 2 tractor stringencies.

**Organization:** American Iron and Steel Institute

In the Proposed Rule, EPA and NHTSA did not assume adoption rates for weight reduction measures and did not consider it 'appropriate or fair across the industry to apply overall weight reductions for compliance.' For different types of vehicles, however, EPA proposes to allow for the crediting of certain identified weight reduction options. [EPA-HQ-OAR-2014-0827-1275-A1 p.15]

Regarding tractors, EPA proposes to continue the GEM Phase 1 weight reduction criteria for using certain lightweight materials. [EPA-HQ-OAR-2014-0827-1275-A1 p.15-16]

All of these values serve a regulatory purpose by allowing a credit for different vehicle components, based on the type of vehicle involved. They also implicitly apply a deficit to any materials or components that are not listed, or listed incorrectly. Therefore, like the weight reduction options for trailers, EPA must

supply a basis for these values in the record for this rulemaking or it cannot incorporate them within a final rule. [EPA-HQ-OAR-2014-0827-1275-A1 p.16]

If the agencies intend to pursue identification of specific weight reduction materials and components in a final rule, such a system must be supported by adequate, verifiable data. To this end, we attach to our comments several documents: [EPA-HQ-OAR-2014-0827-1275-A1 p.16]

(1) A/SP Lightweight Suspension, Hannes Fuchs. This report describes the development of lightweight steel suspension front control arms. When contrasted to a baseline forged aluminum component, the study showed that the lightweight steel arms were equivalent in mass.<sup>49</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.16](2) Lightweight Sealed Steel Fuel Tanks (ASP-400), United States Automotive Partnership. This study examined carbon canisters used for fuel evaporative emissions control and compared steel-based alternatives to a plastic tank used in current vehicles. A carbon steel tank for a Lexus vehicle achieved a mass reduction of between 34 to 41%. A stainless steel tank for a Mercedes achieved mass reductions from 25% to 38%.<sup>50</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.16]

(3) Lightweight Steel Wheel, Steel Market Development Institute Final Report. This project developed a generic wheel design that was equivalent in style, structural performance and mass with an aluminum baseline wheel.<sup>51</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.16]

(4) SMDI Lightweight Twist Beam Development, Scott Keefer, Multimatic Engineering, This study developed a proof of concept steel twist beam that achieved a 30% mass reduction relative to an OEM baseline assembly while meeting all structural and elastokinematic requirements.<sup>52</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.16-17]

(5) Abstract: Study Demonstrates Forged Steel Crankshafts are Stronger and More Durable than Cast Iron Crankshafts. Description of a University of Toledo study to develop a forged steel crankshaft where the redesigned shaft achieved an 18% weight reduction without any degradation in performance.<sup>53</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.17]

(6) Steel Intensive Engine Report, Steel Market Development Institute. Report concluded that there was large potential for lighter weight optimized steel connecting rods, steel camshafts and steel pistons.<sup>54</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.17]

(7) Fatigue Performance Evaluation of Forged versus Competing Manufacturing Process Technologies, Prepared for Forging Industry Educational and Research Foundation and AISI by University of Toledo. Determined that forged steel provided a factor of 3 to 5 longer lives compared with cast aluminum and iron in addition to overall weight reduction of 12%. On a life cycle basis, the longer lifetime of a component provides a substantial benefit.<sup>55</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.17]

(8) WorldAutoSteel FutureSteelVehicle project showed 39% weight reduction in a steel-intensive design for electrified vehicles over the benchmarked vehicle and reduced total life cycle emissions by nearly 70 percent. This was accomplished while meeting a broad list of global crash and durability requirements, enabling five-star safety ratings and avoiding high-cost penalties for mass reduction.<sup>56</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.17]

In sum, EPA's currently proposed weight reduction values cannot be finalized given the lack of supporting technical analysis regarding their calculation. In addition, EPA should review the research material we have submitted for the docket with respect to the weight and performance benefits of lightweight steel components. While much of this analysis involves components utilized in the LDV

sector, we believe that comparable components and parts in medium- and heavy-duty vehicles would demonstrate similar results. EPA should therefore utilize this information to substantially adjust upward its estimates of the benefits of lightweight steel components in Table V-29 of the draft proposed regulations. [EPA-HQ-OAR-2014-0827-1275-A1 p.17-18]

In the alternative, AISI would recommend that EPA and NHTSA eliminate all weight reduction technology crediting for component parts. As described above, the component parts for which it is proposed that GEM assign a weight reduction benefit lack a sufficient technical basis in the record for this rulemaking. Values contained in Table V-29 are not representative of realistic mass reductions. Among other deficiencies, the table values do not scale weight reduction to the actual size of the part making them inherently arbitrary in a rulemaking that covers a wide range of truck sizes, uses and GVWR. Thus, while we first believe that EPA and NHTSA should incorporate life cycle analysis and adjust weighting accordingly, if this path is not taken by the agencies, the only reasonable result should be to eliminate the weight reduction inputs in their entirety. [EPA-HQ-OAR-2014-0827-1275-A1 p.18]

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49 Attachment C; see docket number EPA-HQ-OAR-2014-0827-1275-A4

50 Attachment D; see docket number EPA-HQ-OAR-2014-0827-1275-A5

51 Attachment E; see docket number EPA-HQ-OAR-2014-0827-1275-A6

52 Attachment F; see docket number EPA-HQ-OAR-2014-0827-1275-A7 & A8

53 Attachment G; see docket number EPA-HQ-OAR-2014-0827-1275-A9

54 Attachment H; see docket number EPA-HQ-OAR-2014-0827-1275-A10

55 Attachment I; see docket number EPA-HQ-OAR-2014-0827-1275-A11

56 Attachment J.

**Response:**

The agencies are adopting revised weight reduction tables for Phase 2. The basis for the majority of these technologies was documented in the HD Phase 1 rulemaking (Docket EPA-HQ-OAR-2010-0162). The changes made between Phase 2 NPRM and the final rule were based on comments received. The agencies appreciate the light-duty weight reduction attachments included in AISI's comments, but most are not directly applicable to heavy-duty, especially when trying to extrapolate from light-duty vehicles to heavy-duty tractors. In certain cases, the agencies did increase the weight reduction level of steel components, such as brake drums and single piece drivelines, when additional reliable information was provided by commenters. Manufacturers have the ability to request approval for lightweight components not included in the Weight Reduction tables through the off-cycle credit program, as specifically stated in 40 CFR 1037.520 (although please note again that improvements in light duty performance cannot be automatically extrapolated to heavy duty vehicles). Please see Chapter 1.4.1 of the RTC for responses to the lifecycle comments.

**Organization:** American Trucking Associations (ATA)

Specific technology MPRs under the Phase 2 Rule appear to be overly aggressive and must be adjusted downward for fleets to afford flexibility in spec'ing equipment, avoid excessive downtime due to unforeseen maintenance requirements, and maintain equipment affordability. The specific market penetration rates of concern are as follows: [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

### **6x2 Axle Configurations (60% in 2024)**

Single axle 6x2 drive tractors are widely used in European trucking operations and have been for some time. For U.S. regional fleets that make a lot of deliveries, it is often not the best technology choice because of curb cuts and other uneven terrain features that can expose the truck to traction issues. [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

ATA member fleets have not universally endorsed such technology. Recent surveys indicate current market penetration rates of new line-haul 6x2 tractor sales are only in the range of 2%.<sup>3</sup> According to ATA member fleets, reasons for the current low level of adoption include limitations to highway applications, less flexibility, lower residual rates when switching to vocational applications, traction issues, driver dissatisfaction, tire wear and spec'ing, legality of their use, and driver acceptance. While recent improvements in traction control systems can automatically shift weight for short periods of time from the non-driving axle to the driving axle during low-traction events, concerns remain over the impacts to highways caused by such shifting of weight between axles. [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

“Non-liftable” 6x2 axles in the states of North Dakota, Kansas, Indiana, Pennsylvania, Connecticut, Massachusetts, and New Hampshire are currently prohibited. “Liftable” 6x2 axles are legal across the country with the possible exception of Utah. Utah had required that lift axles be steerable. However, it is our understanding that state officials have agreed to revise their language to ensure their legality. Many carriers also conduct cross-border operations with Canada. 6x2 axle configurations are illegal in the province of British Columbia and face regulatory restrictions in other provinces as well. Fleet owners must remain vigilant to deploying 6x2 technologies only to jurisdictions that permit their use. [EPA-HQ-OAR-2014-0827-1243-A1 p.6]

6x2 axle configurations can restrict future resale markets by limiting the types of applications where these types of configurations can be used. Residual values of equipment are critical for fleets in making their purchasing decisions. Since resale values are not calculated into the overall estimated costs under Phase 2, constricting after-market resale opportunities for initial purchasers of equipment will extend the payback periods on 6x2s, making them less cost-effective in many applications. EPA and NHTSA should not assume an overly optimistic 60% market penetration rate for 6x2s in the 2024-2027 timeframe nor, in our opinion, will a 20% adoption rate in 2021 likely be recognized. EPA and NHTSA need to gather further information and modify the anticipated purchase rates accordingly. In addition, both agencies should jointly engage in additional study of any safety and regulatory challenges associated with 6x2 technology applications. [EPA-HQ-OAR-2014-0827-1243-A1 p.6-7]

The agencies should include in its cost calculations the additional tire wear and negative residual values associated with 6x2's. [EPA-HQ-OAR-2014-0827-1243-A1 p.11]

**Auxiliary Power Units and Automatic Engine Shutdown Devices (90% in 2024)** The baseline assumes 30%, and up to 90%, of high-roof sleeper cabs will be equipped with non-programmable 5-minute automatic engine shutdown devices when, in fact, very few fleets selected this option under Phase 1. This

5% efficiency allocation is not likely to come to fruition when fleets are unwilling to spec' out equipment with this option.

Fleets are aware that reduced engine idling results in fuel-savings, reduced engine-wear, and environmental improvements. Fleets have a variety of choices available in providing driver power and comfort in-lieu of idling including use of auxiliary power units ("APUs"), fuel-fired heaters, shore power, battery stand-by, stand-alone anti-idling infrastructure establishments, and hotel accommodations, to name a few. Not all operations require the use of APUs yet the agencies assume that 90% of tractors with sleeper cabs will purchase APUs if an automatic engine shutdown device ("AESs") is installed. [EPA-HQ-OAR-2014-0827-1243-A1 p.7]

Fleets that already limit idling either via slip-seat operations (where drivers take turns driving on a rotational basis) or use fuel-fired heaters will not get adequate payback from installation of an APU. Fleets may also see reduced load capacity due to the additional weight of an APU and possibly worse aerodynamics from a larger trailer gap if the space for an APU requires a longer wheelbase. [EPA-HQ-OAR-2014-0827-1243-A1 p.7]

Most fleets already purchase "programmable" idle shutdown timers to limit idling due to the national patchwork of anti-idling laws currently in place. These timers are typically set for a given period of time throughout the initial fleet's ownership period. As witnessed under Phase I, fleets are unwilling to purchase hard-programmed, tamper-proof AESs given their need for flexibility regarding their resale of used equipment on the secondary market. [EPA-HQ-OAR-2014-0827-1243-A1 p.7]

If forced into using AESs and APUs as the agencies propose, fleets will likely pre-purchase vehicles in advance of such requirement. Mandatory AES use should not be considered part of the stringency requirements under Phase 2. ATA supports efficiency credits for idling reduction options installed by fleets (i.e., APUs, direct-fired heaters, etc.) either at the OEM point-of-sale or installed in the after-market. For idling devices installed in the after-market, the agencies should allow OEMs appropriate credit upon receipt of certified proof from fleets of such installations. The agencies' over-riding assumption should be that a fleet expending capital on an anti-idling device has every intention to utilize such equipment. Such fuel savings and carbon reductions must be recognized and accounted for. [EPA-HQ-OAR-2014-0827-1243-A1 p.7]

The assumption under the rule is that installation of an AES will result in the companion installation of an APU. There are, however, numerous anti-idling alternatives to diesel-powered APUs specific to fleet needs including direct-fueled heaters, electric APUs, shore power, battery power, and certain stationary providers of power and driver comforts. Each of these technologies should be afforded recognition under the rule and recognized in terms of their costs, efficiency attributes, and MPRs [EPA-HQ-OAR-2014-0827-1243-A1 p.11-12]

EPA estimates the cost of APU's in 2021 and 2027 as \$4,899 and \$4,327 respectively. APU costs are substantially higher than this figure; being somewhere in the range of two to three times this estimate. EPA needs to use actual APU costs in its calculations. Of further note, the California Air Resources Board ("CARB") requires particulate filters on diesel APUs. According to suppliers, filtering an APU increases the cost of such a device by up to 20%. Electric APUs are an alternative but such devices will put a strain on deep-cell batteries and will likely require back-up battery power sources, adding additional weight and cost to the tractor. [EPA-HQ-OAR-2014-0827-1243-A1 p.11]

#### **Automatic Tire Inflation Systems (40% in 2024)**

Phase 2 provides credit only for the use of automatic tire inflation systems (“ATISs”). Tire pressure monitoring systems (“TPMSs”) provide similar benefits but at a lower cost. To the extent efficiency credit is provided for tire pressure maintenance devices, TPMSs should be afforded the same amount of efficiency credit as ATISs. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

A recent study on truck and tire inflation systems indicates that both ATISs and TPMSs are being utilized in fleet operations. As of 2012, approximately 33% and 10% of surveyed fleets utilize ATISs and TPMSs respectively on their trailers.<sup>4</sup> Roughly 1% of tractors used ATISs. Operators are well aware of the increased fuel consumption, maintenance costs, downtime, and safety concerns associated with operating heavy-duty vehicle with under-inflated tires. These concerns over time have been significant given the historic volatility of diesel prices, the competitive nature of the industry, shipper pressures to reduce costs, and the rising costs of liability. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

The agencies do not acknowledge TPMSs as a viable menu option since they require user interaction to inflate tires to appropriate pressures. A misguided assumption is that drivers “may” continue to operate a vehicle with underinflated tires. However, in light of continual pressures on fleets to reduce total costs of operation in order to remain competitive and profitable, the agencies should reconsider their rejection of TPMSs as a viable technology option under the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

Given the ability of fleets to monitor fuel consumption remotely, including the ability to identify causes for increased fuel consumption, drivers are routinely held responsible for proper tire pressure levels on TPMS-equipped vehicles. ATA therefore believes that the agencies should provide efficiency credit for TPMS use under the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

The cost estimates for tire inflation systems (and TPMS, where applicable) must include warranty limitations, useful life, maintenance and replacement costs, as well as costs of false warnings. [EPA-HQ-OAR-2014-0827-1243-A1 p.12]

### **Low Rolling-Resistance Tires**

The tire market penetration rates projected in the outlying years are indeed technology-forcing. If tire composite advancements and designs do not keep pace with the target years, OEMs will not be able to hit their overall efficiency targets. In addition, since anti-tampering rules require retention of all original features, fleets may likely choose tires with higher rolling resistance (less efficiency) to maintain more flexibility in replacing tires in the field when needed. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

The agencies err in their tire analysis by using the same rolling resistance for all types of day and sleeper cabs. The need for and benefit of low rolling resistance tires (“LRRTs”) on a high roof sleeper cab is very different from the other tractor categories. The agencies should continue to examine fleet tire data and adjust tire stringency levels to account for fleet and Class variations and different duty-cycle needs. [EPA-HQ-OAR-2014-0827-1243-A1 p.8]

Instead of using current cost data, EPA appears to have based the cost calculations for LRRTs on 1999 data indexed for inflation. Moreover, EPA’s cost figures for LRRTs do not account for increases in lifetime replacement costs due to reduced tire life resulting in fewer retreads. [EPA-HQ-OAR-2014-0827-1243-A1 p.12]

### **Research Must Confirm Safety of New-Generation LRRTs Before Market Entry**

The safety effects of LRRTs are not totally understood. While the “. . . agencies analysis indicate that this proposal should have no adverse impact on vehicle or engine safety,” ATA remains leery of potential unintended consequences resulting from new generation tires that have yet to be developed. This especially holds true in terms of overall truck braking distances. [EPA-HQ-OAR-2014-0827-1243-A1 p.16]

The trucking industry takes safety very seriously. With projected application rates for widely varied LRRTs for Class 7 and 8 trucks ranging from 10% to 60%, new truck purchasers will need to understand which applications may, or may not, be appropriate for these tires. We support all efforts to help maintain and advance our safety agenda. ATA is aware of Transport Canada’s November 2012 study on the winter traction performance of LRRTs on heavy-duty trucks. The analysis involved performance on packed snow as opposed to non-packed snow or ice. The conclusion of that preliminary study indicated that the then-current generation of SmartWay-verified LRRTs offered a similar level of snow traction performance as non-SmartWay-verified tires. Our concern rests in the fact that both Phase 1 and Phase 2 are pushing the limits of rolling resistance to new heights. To our knowledge there has not been any subsequent and comprehensive climatic testing on each new generation of LRRTs. Neither ATA nor your agencies wish to create any unforeseen safety consequences resulting from implementation under either Phase 1 or Phase 2. ATA requests testing and documentation of LRRTs under all weather conditions, including snow and ice, in advance of their entry into the marketplace. ATA asks both agencies, and NHTSA in particular, to ensure that each new generation of LRRTs and retreads not increase braking distances under all weather conditions. [EPA-HQ-OAR-2014-0827-1243-A1 p.16]

### **Useful Life of LRRTs Must be Considered**

LRRTs need to have improved wear rates such that our industry is not adversely impacting the environment by putting more casings into landfills and increasing natural resource use in manufacturing their replacements. The industry commonly sees a 40% reduction in useful life and a 20% reduction in casing life resulting from LRRTs. For example, wide-base single tires have shown poor tread wear in the tighter turning conditions of urban operations.<sup>11</sup> This may result in higher wear-out rates if the rule encourages the use of wide-base single tires in these types of operations. When measuring efficiency improvements, it must be done with consideration of cradle-to-grave costs and consequences. [EPA-HQ-OAR-2014-0827-1243-A1 p.16]

Few disciplines are as unforgiving as tire design. Engineer a tire for maximum grip and it may wear too rapidly; specify rubber that will deliver the best fuel economy and it may impact traction. With about 25 million new truck tires sold in the U.S. every year, extending the useful life of LRRTs not only represents a substantial savings of natural and synthetic rubber, but also reduces the fuel consumption and GHG emissions associated with production of their replacements. Lost in the Phase 2 discussions is the fact that it takes 23 gallons of oil to manufacture a new tire and only 8 gallons of oil to retread a tire. [EPA-HQ-OAR-2014-0827-1243-A1 p.16]

### **Aerodynamic Devices**

The actual stringency in the proposed rule is much greater than what EPA has indicated due to errors in EPA’s baselines and testing protocols, such as: [EPA-HQ-OAR-2014-0827-1243-A1 p.13]

- The assumed 2017 aero baseline uses the best aero trucks available, not the average.
- Cab aerodynamic expectations (Bins V, VI, and VII) likely cannot be achieved with the specified test trailer.



- Compliance margins for aerodynamic audits have been removed. OEMs therefore must over-design (if plausible) to offset this margin omission and pass routine audits.

In summary, these issues create impossible hurdles that could not be met within the framework of the rule and the agencies must work with OEMs to rectify these matters. [EPA-HQ-OAR-2014-0827-1243-A1 p.13]

Estimated costs of future aerodynamic devices appear low given the historical nature of the proposed changes. The agencies should describe in detail the component packages they expect to satisfy each bin level, cost breakdowns of these individual components, and how this technology will be modified over time to maintain compliance with increasingly stringency levels. [EPA-HQ-OAR-2014-0827-1243-A1 p.12]

### **Credit for Use of Vehicle Speed Limiters Needs to be Expanded**

In addition to safety benefits, reducing speed is a proven way to decrease GHG emissions and fuel consumption. To this end, ATA filed a petition with NHTSA and the Federal Motor Carrier Safety Administration (“FMCSA”) in October 2006 requesting a rulemaking to require vehicle manufacturers to limit the speed of trucks with a gross vehicle weight rating greater than 26,000 pounds to no more than 68 mph. In response to this petition, a joint rulemaking has been initiated which will require the installation of speed limiting devices on heavy trucks. This rulemaking is currently undergoing review at the Office of Management and Budget. [EPA-HQ-OAR-2014-0827-1243-A1 p.19]

While the details of this rulemaking have not been released, it appears that vehicle speed limiters (“VSLs”) will be mandatory equipment on new trucks within the timeframe of the Phase 2 standards. This rulemaking will likely establish new parameters for VSLs which should be accounted for in the final rule. For example, the rulemaking is expected to establish a maximum limited speed. This speed should serve as the baseline and may be different than the current baseline Greenhouse Gas Model (“GEM”) input of 65 mph. Depending upon where the maximum is set, credits should be reflective of speed adjustments below this level. [EPA-HQ-OAR-2014-0827-1243-A1 p.19]

The fact that VSLs are not being used as a compliance strategy despite being widely used among trucking companies is concerning. It appears purchasers are not willing to accept the tamper-proof requirement associated with this technology and instead opt to use them on their own terms. The agencies should explore ways of incorporating the in-use benefits being derived from VSLs. To this end, a more workable solution which provides credit for ordering a new tractor with VSL should be pursued. Possible approaches could include: [EPA-HQ-OAR-2014-0827-1243-A1 p.20]

Allowing manufacturers to accept a purchaser’s commitment to establish a maximum limited speed, as opposed to the tamper-proof option, when acknowledged and affirmed on a vehicle’s purchase agreement. Allowing manufacturers to adjust VSLs at the end of a vehicle’s lease or trade-in and allow the creation of deficits or credits if such adjustments affect the initial credits which were generated. Allowing trucking companies to adjust maximum speeds if company policies change during the ownership cycle with corresponding adjustment to manufacturer credits. [EPA-HQ-OAR-2014-0827-1243-A1 p.20] The agencies should work with truck manufacturers and their customers to identify potential mechanism which will allow the practice of using VSLs be more accurately quantified under the final rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.20]

3 North American Council for Freight Efficiency, Confidence Findings on the Potential of 6x2 Axles (January 13, 2014).

4 North American Council for Freight Efficiency, Tire Pressure Systems Confidence Report (August 2013).

11 Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles, National Research Council, Transportation Research Board, Technologies and Approaches to Reducing Fuel Consumption of Medium- and Heavy-Duty Vehicles, p. 137 (2010).

**Response:**

*6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by the commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>44</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>45</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.<sup>46</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

The agencies considered the maintenance impact of 6x2 axles. As noted in the NACFE Confidence Report on 6x2 axles, the industry expects an overall reduction in maintenance costs and labor for vehicles with a 6x2 configuration as compared to a 6x4 configuration.<sup>47</sup> Among other savings, the reduction in number of parts, such as the interaxle drive shaft, will reduce the number of lubrication procedures needed and reduce the overall quantity of differential fluid needed at change intervals. The agencies have

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<sup>44</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>45</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>46</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." January 2014. Page 19.

<sup>47</sup> Ibid. Page 30.

taken a conservative approach to the maintenance costs for the 6x2 technology where we believe that the overall impact will be zero.

#### *Idle Reduction Technologies*

With respect to the baseline comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had APUs and 96 percent were equipped with an adjustable AESS.<sup>48</sup> Therefore, the agencies have significantly reduced the number of APUs assumed in the baseline in the final rule. The agencies are projecting for the baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will have tamper-proof AESS.

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. See RIA Chapter 2.4.8.1. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

EPA considered the comments and more closely evaluated NHTSA's contracted TetraTech cost report found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). See Preamble Section III.D.1.b.iv. This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS, however, we set the effectiveness value of TPMS lower than ATIS to reflect the need for operator intervention.

With respect to costs, all of the agencies' technology cost analyses include both direct and indirect costs. Indirect costs include items such as warranty. In terms of maintenance, the presence of tire inflation management systems should serve to improve tire maintenance intervals and perhaps reduce vehicle downtime due to tire issues; they may also carry with them some increased maintenance costs to ensure that the tire inflation systems themselves remain in proper operation. For the analysis, we have considered these two competing factors to cancel each other out.

#### *Low Rolling Resistance Tires*

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<sup>48</sup> North American Council for Freight Efficiency. Confidence Report: Idle Reduction Solutions. 2014. Page 13.

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data.<sup>49</sup> We found that high roof sleeper cabs are certified today with steer tire rolling resistance levels that ranged between 4.9 and 7.6 kg/ton and with drive tires ranging between 5.1 and 9.8 kg/ton. In the same analysis, we found that high roof day cabs are certified with rolling resistance levels ranging between 4.9 and 9.0 kg/ton for steer tires and between 5.1 and 9.8 kg/ton for drive tires. This range spans the baseline through Level 3 rolling resistance performance levels. Therefore, for the final rule we took an approach similar to the one taken in Phase 1 and proposed in Phase 2 that considers adoption rates across a wide range of tire rolling resistance levels to recognize that operators may have different needs. 76 FR 57211 and 80 FR 40227.

In our analysis of the Phase 1 certification data, we found that the drive tires on low and mid roof sleeper cab tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found only a minor difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. This is also consistent with the approach that we took in setting the Phase 1 tractor standards. 76 FR 57211. In addition, the final rule reflects a reduction in Level 3 adoption rates for low and mid roof tractors from 25 percent in MY 2027 used at proposal (80 FR 40227) to zero percent adoption rate. The technology packages developed for the low and mid roof tractors used to determine the stringency of the MY 2027 standards in the final rule do not include any adoption rate of Level 3 drive tires to recognize the special needs of these applications, consistent with the comments noted above raising concerns about applications that limit the use of low rolling resistance tires. We have estimated the cost of lower rolling resistance tires based on an estimate from TetraTech of \$30 (retail, 2013\$). We also have applied a “medium” complexity markup value for the more advanced low rolling resistance tires. We expect that, when replaced, the lower rolling resistance tires would be replaced by equivalent performing tires throughout the vehicle lifetime. As such, the incremental increases in costs for lower rolling resistance tires would be incurred throughout the vehicle lifetime at intervals consistent with current tire replacement intervals. A recent study conducted by ATA’s Technology and Maintenance Council found through surveys of 51 fleets that low rolling resistance tires and wide base single tires lasted longer than standard tractor tires.<sup>50</sup> Due to the uncertainty regarding the life expectancy of the LRR tires, we maintained the current tire replacement intervals in our cost analysis.

ATA stated it is concerned about the safety consequences of next generation low rolling resistance tires at the adoption rates the agencies assume in the proposal. ATA noted that the agencies have not tested next generation low rolling resistance tires for safety purposes.

Federal Motor Vehicle Safety Standard (FMVSS) No. 121, Air brake systems, sets forth performance and equipment requirements for trucks, buses, and trailers with GVWRs greater than 10,000 lb. and establishes stopping distances for vehicles equipped with air brake systems.<sup>51</sup> Although tires are not specifically regulated as part of FMVSS No. 121, tires are part of the system that must meet the performance requirements outlined in that standard. This ensures that new tractors with air brakes compliant with FMVSS No. 121 are meeting safe stopping distances, regardless of tire configuration. In addition, under Federal Motor Carrier Safety Administration regulations, commercial vehicles are to have

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<sup>49</sup> Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. Docket EPA-HQ-OAR-2014-0827.

<sup>50</sup> Truckinginfo. TMC Survey Reveals Misinformed View of Fuel-Efficient Tires. March 2015.

<sup>51</sup> 49 CFR 571.121.

a service brake system that meets the requirements of FMVSS No. 121 in effect on the date of manufacture.<sup>52</sup> These two regulations taken together ensure that new and in-use trucks meet safe stopping distance requirements.

Additionally, in 2015, NHTSA and FMCSA conducted a safety study to evaluate stopping distances for low rolling resistance tires.<sup>53</sup> NHTSA and FMCSA chose representative tires to evaluate in that study, and found that there was a negligible correlation between the coefficient of rolling resistance and the stopping distance of the tires it tested. Moreover, the results showed that the low rolling resistance tires tested in the study performed well within the stopping distances required by FMVSS No. 121. The agencies believe that taken together, the above described research and the stopping distance requirements FMVSS No. 121 and 49 CFR 393.40 will ensure next generation low rolling resistance meet safe stopping distances for tractors.

### *Aerodynamics*

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The baseline was not determined by or declared to be the average results of the vehicles tested, as some commenters maintained. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

The agencies' assessment is that only Bins I through V are achievable with known aerodynamic technologies, but that Bins VI and VII have less known technology paths. Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . See RIA Chapter 2.8.2.2. These aerodynamic improvements have been demonstrated within the program on two vehicles in 2015. In the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing these aerodynamic technologies as early as 2021 MY on a limited scale. We adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time.

The agencies received comments from manufacturers arguing for the agencies to establish compliance margins that would allow actual production vehicles to exceed the standards by some fixed amount.

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<sup>52</sup> 49 CFR 393.40.

<sup>53</sup> Lascrain, M. B. (2015, June). Effects of tire rolling resistance on Class 8 tractor-trailer stopping distance. (Report No. DOT HS 812 176). Washington, DC: National Highway Traffic Safety Administration. Available at <https://www.regulations.gov/#!documentDetail;D=NHTSA-2014-0132-0009> (last accessed June 16, 2016).

These comments included specific requests for an aerodynamic compliance margin. We also received comments from UCS supporting the elimination of the aerodynamic compliance margin. As explained in Section I.C.1 of the Preamble, although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA$ s and solicited supplemental comments on it. See 81 FR 10825. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment<sup>54</sup> throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur.

The agencies included the technology cost of aerodynamic improvements, such as wheel covers and active grill shutters, in RIA Chapter 2.11.

#### *Vehicle Speed Limiters*

The agencies considered DOT's upcoming actions with respect to mandatory vehicle speed limiters for heavy-duty trucks, but could not take it into account in this Phase 2 rulemaking because that rule is not final yet.

The existing VSL flexibilities provide opportunities for manufacturers to account for the impact of VSLs on reducing GHG emissions and fuel consumption, while still allowing the settings to change after an "expiration" time determined by the manufacturer or to include a soft top. At this time, we believe that the Phase 1 flexibilities sufficiently balance the desire to encourage technologies that reduce GHG emissions and fuel consumption while ensuring the benefit in the real world and minimizing the compliance burden of trying to accommodate changes throughout the useful life of the vehicle. Therefore, the agencies are not adopting any new VSL provisions for Phase 2.

**Organization:** American Trucking Associations (ATA) and NHTSA

The discussion topics included potential safety impacts of MDHD Phase 2 fuel efficiency technologies, with specific questions on effects of further reductions in tire rolling resistance entire/vehicle traction and handling. Mr. Kedzie communicated his questions on the subjects. Mr. MacIsaac referred him to two NHTSA safety studies in the Phase 2 Notice of Proposed Rulemaking (NPRM) docket, as well as recent comments from Michelin North America in the related Phase 2 Draft Environmental Impact Statement (DEIS) docket. [NHTSA-2014-0132-0063-A1 p.1]

#### **Response:**

The agencies considered the safety impacts of the Phase 2 rule, as described in RIA Chapter 9.

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<sup>54</sup> See 40 CFR 1068.5 for a description of "good engineering judgment" and how EPA evaluates it.

**Organization:** Aperia Technologies

We recommend that test methods for automatic tire inflation incorporate robustness to usage and vibration over representative time frames. Different technologies employ different configuration and component complexity such that in-use tire inflation performance is likely to vary by design. [NHTSA-2014-0132-0104 p.2]

We recommend that tractor and trailer solutions be treated differently. On a per-axle basis, tractors account for disproportionately more miles driven and more GHG emitted than trailers. Drive axle tire under-inflation can be solved by installation of Aperia's Halo Tire Inflator and likely other system designs, including central tire inflation systems (CTIS), in the near future. Devices, which differ in their capacity to serve steer, drive and trailer axles should be credited accordingly differently. [NHTSA-2014-0132-0104 p.2]

**Response:**

The regulations state that the emission standards apply for the full useful life of the vehicle (for example, see 40 CFR 1037.106 and 1037.107).

The agencies treat the ATIS and TPMS installed on tractors and trailers separately. We have considered the technologies mentioned in the comment while setting our adoption rates of ATIS and TPMS in our technology packages.

**Organization:** Bendix Commercial Vehicle Systems, LLC

**Idle Reduction** [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

However, the agencies request comment on whether we should extend this vocational vehicle idle reduction approach to day cab tractors. [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

Bendix would like to see the vocational vehicle idle reduction approach extended to day cab tractors. Like many companies that perform vehicle level engineering testing, Bendix does instrument vehicles that are in commercial operation to collect particular data of interest. Among the data collected, engine speed, vehicle speed, driver demand for acceleration and braking are typical. We see from this data that there are many applications of day cab tractors that spend a significant portion of their day's drive time at idle. This is true for most pick-up and delivery type applications and is also true for a growing number of fleets that run hub and spoke type operations. [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

**Automatic Tire Inflation Systems** [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

Tire pressure monitoring systems notify the operator of tire pressure, but require the operator to manually inflate the tires to the optimum pressure. Because of the dependence on the operator's action, the agencies are not proposing to provide a reduction value for tire pressure monitoring systems. We request comment on this approach and seek data from those that support a reduction value be assigned to tire pressure monitoring systems. [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

As noted in a previous section, Bendix does believe that TPMS should be included and an appropriate reduction provided. Our previous comments also support arguments in this area, the key being that drivers, when properly incented by the fleet, through such practices as incentives for improving fuel

economy, data tracking and potential vehicle strategies, have a strong reason to ensure that they maintain tire pressure. Fleets would not be interested in these systems if they were not providing the ROI, achieved through improved tire wear and fuel economy, they need to justify the investment. With significant growth over the past 5 years and expected continuation of growth into the future, TPMS deserves consideration. [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

More choices ensure flexibility to achieve goals [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

Bendix by virtue of our comments does not want our position on TPMS to be viewed as advocating the replacement of ATIS by TPMS, nor to discount the value of ATIS. We agree that ATIS can provide a benefit in some select cases and situations. [EPA-HQ-OAR-2014-0827-1241-A1 p.6]

Along the same lines, the agencies do run the risk of hurting the market for TPMS, and reducing the benefits that fleets could be receiving long ahead of implementation of the Phase 2 regulations. The agencies should not be in the business of picking winners and losers in technology choice, but enabling the market to offer the broadest possible package of possibilities to meet the agencies targets while not inhibiting OEMs, fleets and owner/operators from choosing the best combination to fit their unique operational needs. Therefore, both ATIS and TPMS should be available and receive appropriate credit to help deliver on the expected benefits of the proposed regulation. [EPA-HQ-OAR-2014-0827-1241-A1 p.7]

### **III. Class 7 and 8 Combination Tractors, D. Feasibility of the Proposed Tractor Standards, (2) Projected Technology Effectiveness and Cost [EPA-HQ-OAR-2014-0827-1241-A1 p.7]**

However, the agencies welcome comment from industry and others on their projected timeline for deployment of hybrid powertrains for tractor applications. [EPA-HQ-OAR-2014-0827-1241-A1 p.7]

The agencies state in the Phase 2 NPRM that “To date, hybrid systems for tractors have been primarily focused on idle shutdown technologies and not on the broader energy storage and recovery systems necessary to achieve reductions over typical vehicle drive cycles. The proposed standards reflect the potential for idle shutdown technologies through GEM.” [EPA-HQ-OAR-2014-0827-1241-A1 p.7]

Bendix appreciates the potential for idle shutdown technologies through GEM and have commented to this fact earlier in this document. While it is true that hybrid systems for tractors have not been focused on broader energy storage and recovery systems, there is in fact further opportunity in this area. Based on previous work, we believe that mild hybrid systems should be included in GEM for fuel consumption reduction credit. This should include stop-start and electrification of accessories as most mild hybrid systems incorporate. [EPA-HQ-OAR-2014-0827-1241-A1 p.7]

#### **Response:**

##### *Day Cab Idle*

The agencies considered the comments, both supporting and raising concerns over idle reduction in day cabs. The agencies determined that neutral idle for automatic transmissions is an appropriate technology for use in tractors. Therefore, the agencies are adopting provisions in Phase 2 to recognize neutral-idle in automatic transmissions as an input to GEM. Our analysis shows that neutral idle effectiveness is approximately 0.8 to 1 percent over the composite day cab tractor cycles. The agencies will also include neutral idle as a GEM input for sleeper cabs, though the effectiveness is very low. The agencies are predicating the standards for day cabs based a technology package that includes neutral idle.



In terms of stop-start technologies in tractors, the agencies are not including it as a technology input to GEM because we believe the technology needs further development before application to the tractor sector. If this technology is developed in the future for tractors, then manufacturers may consider applying for off-cycle technology credits. Consistent with the technology not being an input to GEM, the agencies are not predicating the Phase 2 standards based on adoption of stop-start in tractors.

It is also worth noting that there are a set of day cab tractors that may qualify as “vocational tractors” and be treated as vocational vehicles. This set of vehicles will be able to utilize the vocational approach to idle reduction.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS, though we have set the effectiveness of TPMS lower than ATIS to reflect the need for operator intervention.

With respect to costs, all of the agencies’ technology cost analyses include both direct and indirect costs. Indirect costs include items such as warranty. In terms of maintenance, the presence of tire inflation management systems, should serve to improve tire maintenance intervals and perhaps reduce vehicle downtime due to tire issues; they may also carry with them some increased maintenance costs to ensure that the tire inflation systems themselves remain in proper operation. For the analysis, we have considered these two competing factors to cancel each other out.

#### *Hybrids in Tractors*

After considering the comments, the agencies are continuing the Phase 1 approach of not including hybrid powertrains in our feasibility analysis for Phase 2. Because the technology is still under development for the tractor sector we cannot confidently assess the effectiveness of this technology for tractors at this time. In addition, due to the high cost, limited benefit during highway driving, and lacking any existing systems or manufacturing base, we cannot conclude with certainty that such technology will be available for tractors in the 2021-2027 timeframe. However, manufacturers will be able to use powertrain testing to capture the performance of a hybrid system in GEM if systems are developed in the Phase 2 timeframe. In addition, the agencies are recognizing electrified accessories in GEM in Phase 2.

**Organization:** California Air Resources Board (CARB)

#### **Comment – CARB strongly prefers proposed Alternative 4 Phase 2 Heavy-Duty Combination Tractor Emission Standards**

The NPRM requests comments on the proposed alternatives, with special interest in Alternatives 3 and 4. In total, the NPRM considers five alternatives as summarized in Table II-22 of the NPRM, shown below:[EPA-HQ-OAR-2014-0827-1265-A1 p.42]

[Table II-22 can be found on p. 42 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

For tractors as with all vehicle categories, Alternative 1 is the no action alternative. Alternative 2 would base the standards on the application of off-the-shelf technologies, which is the same approach taken in Phase 1. Alternative 3 is U.S. EPA and NHTSA's preferred alternative. Alternative 4 is identical in stringency to Alternative 3, but its implementation schedule is accelerated by three years (i.e., from 2027 to 2024). Alternative 5 is the most aggressive alternative, requiring the highest market adoption rate of more advanced technologies amongst the five alternatives. CARB strongly prefers Alternative 4 standards over Alternative 3 standards over all vehicle categories including tractors. [EPA-HQ-OAR-2014-0827-1265-A1 p.42]

For a compliant Phase 2 tractor, U.S. EPA and NHTSA estimate that Alternative 3 standards would achieve up to 24 percent reduction in CO2 emissions compared to a Phase 1 tractor at a cost of approximately \$13,000 per vehicle. Alternative 4 achieves the same percent reduction in CO2 emissions and fuel consumption compared to a Phase 1 tractor, but does it three years earlier, at a per vehicle cost of approximately \$14,000 per vehicle (i.e., \$1,000 more per vehicle than Alternative 3). [EPA-HQ-OAR-2014-0827-1265-A1 p.42]

Alternative 4 is technologically feasible and will result in more emission and fuel consumption reductions from heavy-duty tractors in MYs 2021 through 2026. The increased cost due to the accelerated implementation is minimal – about \$1,000 per vehicle as estimated by U.S. EPA and NHTSA. The improved fuel efficiencies resulting from either alternative would decrease fuel use, which equates to fuel savings that would eventually offset the upfront cost of the required technologies. U.S. EPA and NHTSA estimate the payback period for tractor and trailers for both Alternative 3 and 4 is similar at about 2 years. [EPA-HQ-OAR-2014-0827-1265-A1 p.42-43]

When looking more broadly at not only tractors, but also tractor engines and the trailers they pull, Alternative 4 achieves greater emission benefits and greater net societal benefits, than Alternative 3. As summarized in Table 7, Alternative 4 for tractors, tractor engines, and trailers would cumulatively achieve 75.7 more MMT CO2 reductions nationally than Alternative 3 for MYs 2018 through 2029 vehicles. This additional reduction would occur with a \$16.7 billion greater net benefit in the U.S. [EPA-HQ-OAR-2014-0827-1265-A1 p.43]

[Table 7 can be found on p.43 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

The tractor vehicle technologies used to set the tractor standards varied by class of tractor (class 7/8), type of tractor cab (day cab or sleeper cab), and height of roof (low roof, mid roof or high roof). Table 9 shows the Alternative 3 and Alternative 4 technology adoption rates for class 8 high roof sleeper cab tractors. The conclusions drawn from comparing these adoption rates of these tractors can be applied to all tractor types addressed by the standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.44]

[Table 9 can be found on p.45-46 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

As shown in Table 9, there is no increase in market penetration between Alternative 3 and Alternative 4 for extended idle reduction, predictive cruise control, automatic tire inflation systems (ATIS), axle lubricant technologies, 6x2 axle or 4x2 axle technologies, direct drive technologies, and dual clutch transmissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.46]

The market penetration rates for aerodynamic technologies and low rolling resistance (LRR) tires show a decrease in the penetration rates for technologies that are equivalent to SmartWay and SmartWay Elite technologies and a higher penetration of more advanced aerodynamic treatments and LRR tire materials and designs. Currently, aerodynamic technologies are dominated by existing, widely-used fairings and

more aerodynamic shapes of the tractor body itself. Bin II represents currently available SmartWay aerodynamic technologies. Bin V through VII tractors incorporate more advanced technologies which are currently in the prototype stage of development, such as advanced gap reduction, rearview cameras to replace mirrors, wheel system streamlining, and advanced body designs. To the extent that these advanced designs use existing technologies in new and innovative ways (i.e., rearview cameras) concerns over reliability are minimal. For the steer and drive tire technologies, level 1 represents rolling resistance equivalent to today's SmartWay tires. Level 2 represents the best in class rolling resistance tires available today. Level 3 represents a 25 percent improvement over level 2 which should be achievable in the 2024 timeframe. Should more complex systems or advanced materials require more reliability testing prior to MY 2024 tractor production date deadlines, higher applications of one or more of the other proven technologies from the other categories (i.e., level 2 LRR tires, predictive cruise, ATIS, etc.) can be used to meet the 2024 Alternative 4 standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.46]

For transmissions, the market penetrations decrease for manual transmissions and increase for automatic transmissions when comparing Alternative 3 to Alternative 4. This change is reflected in the increase in the application of downspeeding, since advanced transmissions enable downspeeding. With the exception of dual clutch transmission technology, automated manual transmission and automatic transmission technology is mature and should not result in reliability concerns associated with its application in MY 2024 tractors. [EPA-HQ-OAR-2014-0827-1265-A1 p.46-47]

#### **Comment – Extended idle reduction approach to day cab tractors**

The NPRM requests comment on the applicability of the idle test cycle to day cab tractors. [EPA-HQ-OAR-2014-0827-1265-A1 p.47]

Day cab tractors often idle while cargo is loaded or unloaded, as well as during the frequent stops that are inherent with driving in urban traffic conditions near cargo destinations. To recognize idle reduction technologies that reduce workday idling, U.S. EPA and NHTSA have developed a new idle-only duty cycle that is proposed to be used in GEM for vocational vehicles only, because these types of vehicles spend more time at idle than tractors. However, U.S. EPA and NHTSA request comment on whether they should extend this vocational vehicle idle reduction approach to day cab tractors. [EPA-HQ-OAR-2014-0827-1265-A1 p.47]

CARB staff believes U.S. EPA and NHTSA should extend the idle provision to day cab tractors. Currently, limited numbers of specific types of day-cab tractors (e.g., low-roof bottle delivery tractors) may be reclassified as vocational tractors. These reclassified tractors can take advantage of the vocational vehicle idle reduction approach. See 40 CFR 1037.630. By extending the workday idle provisions to all day-cab tractors, manufacturers would have some incentive to install neutral idle or stop-start systems on mid-roof and high roof day-cabs. Although the first user may not see significant emission reductions from these technologies, many of the high roof and mid roof day cab tractors are used in port and drayage applications in their second life – where start-stop and neutral idle technologies could result in significant emission reductions as these trucks travel in and out of ports and rail yard facilities. [EPA-HQ-OAR-2014-0827-1265-A1 p.47]

Extending the idle provision to day cab tractors would require U.S. EPA and NHTSA to set a fixed GEM composite cycle weighting factor at a value representative of the time spent at idle for a typical day cab tractor. For vocational vehicles in the regional category, the idle cycle weighting factor is 10 percent. U.S. EPA and NHTSA suggest 5 percent may be the appropriate value. Initial reaction is that the factor will probably be between 5 and 10 percent. CARB staff would like to work with U.S. EPA and NHTSA staff to determine the appropriate value for the day cab factor. [EPA-HQ-OAR-2014-0827-1265-A1 p.47-48]

### **Comment – Tire pressure monitoring system**

The NPRM requests comment on whether they should assign a fixed credit in fuel consumption and CO<sub>2</sub> emissions for tire pressure monitoring systems, and if so, what would be an appropriate assigned fixed value. Maintaining properly inflated tires can extend tire life, save fuel, and improve safety, so CARB staff generally supports the use of systems that assist in the maintenance of properly inflated tires. However, CARB staff strongly supports U.S. EPA and NHTSA not providing credit for tire pressure monitoring systems for heavy-duty tractors and trailers. Unlike ATISs, tire pressure monitoring systems only monitor pressure and alert the driver regarding the variance between the recommended target pressure and the actual measured pressure in the tire. Tire pressure monitoring systems require action from the drivers to reinflate the affected tire(s), hence the benefit of such systems is dependent on driver behavior. Because there is no guarantee what action, if any, drivers will take in response to tire pressure monitoring systems, CARB staff recommends no credit for such systems in Phase 2. [EPA-HQ-OAR-2014-0827-1265-A1]

In the Tire Pressure Systems – Confidence Report dated August 2013, the North American Council for Freight Efficiency (NACFE) indicated that ATISs are more common than tire pressure monitoring systems by a ratio of about four to one for trailers. The ATIS is designed to monitor and continually adjust the level of pressurized air in tires, automatically keeping tires properly inflated even while the vehicle is in motion. CARB staff concurs with U.S. EPA and NHTSA’s proposal to provide credit in GEM for the installation of ATISs on tractors and trailers. This system was included in CARB’s evaluation of vehicle efficiency technologies for heavy-duty vehicles that would result in improved fuel consumption and reductions in GHG emissions. For more information on ATIS, please refer to CARB’s Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency, June 2015 at: [http://www.arb.ca.gov/msprog/tech/techreport/epdo\\_ve\\_tech\\_report.pdf](http://www.arb.ca.gov/msprog/tech/techreport/epdo_ve_tech_report.pdf). [EPA-HQ-OAR-2014-0827-1265-A1 p.138]

### **Comment – Solar control clarification**

The RIA includes some incorrect statements, as described further below. First, the RIA states, “Solar control glazing reflects some of the solar energy from the glass.” The implication of this sentence is that solar control glazing is synonymous with solar reflective glazing. However, in fact, solar control glazing includes both solar absorbing glazing and solar reflective glazing. The RIA states, “CARB found that most heavy-duty trucks today use solar absorbing glass.” The Enhanced Protective Glass Automotive Association (not CARB) has indicated that new trucks are typically provided with solar absorbing glazing (total solar transmission of around 60 percent, compared to 88 percent for clear glass). Note also that the statement applies to original glazing and may not be true for replacement glazing. [EPA-HQ-OAR-2014-0827-1265-A1 p.154]

U.S. EPA and NHTSA further note they are “not proposing [solar control paint and glazing] as part of heavy-duty Phase 2, but these types of technologies could be considered under the innovative technology program.” CARB believes it is appropriate to retain the flexibility to consider solar control credits where such controls are shown to reduce overall GHG emissions and agrees that it is appropriate to require demonstration of quantified benefits before credit is granted for class 4-8 vehicles. See CARB docket letter dated December 3, 2014 for a thorough discussion of issues involved in determining appropriate solar control credits for heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.154]

<sup>59</sup> See <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-0035> for our comment regarding solar load.

### **Comment – VSL Benefit**

According to the NPRM, VSLs were not considered when setting the proposed Phase 2 standards; however, U.S. EPA and NHTSA propose to allow use of VSL as a technology to meet the proposed standards. The NPRM proposes that manufacturers would receive credit for installing tamper-proof VSLs with maximum drive cycle speeds set at 65 mph; the draft GEM appears to offer up to 22 percent credit for use of VSL. [EPA-HQ-OAR-2014-0827-1265-A1 p.155]

CARB staff recommends not giving any credit for VSLs at this time because available data do not fully support whether VSLs result in real-world fuel consumption and CO<sub>2</sub> reductions. In addition to the concerns regarding possible tampering of VSLs when in use, which the NPRM mentions, the data are still inconclusive as to whether VSLs can provide real-world fuel benefits, especially for modern trucks.<sup>60</sup> In fact, CO<sub>2</sub> emissions were shown to decrease as vehicles' speed increase (improved fuel economy at higher speeds) in Oak Ridge National Laboratory's (ORNL) Transportation Energy Data Book (Table 5.11, Fuel Economy for Class 8 Trucks as a Function of Speed and Tractor-Trailer Tire Combination, and Figure 5.3 (shown below – Figure 6), Class 8 Trucks Fuel Economy as a Function of Speed and Tractor-Trailer Tire Combination and Percentage of Total Distance Traveled as a Function of Speed, available at <http://cta.ornl.gov/data/chapter5.shtml>). [EPA-HQ-OAR-2014-0827-1265-A1 p.155]

[Figure 6 can be found on p.156 of docket number EPA-HQ-OAR-2014-0827-1265-A1]<sup>61</sup>

The data presented above indicates there may be no benefit through use of VSLs or even possibly a dis-benefit; hence, CARB staff recommends no credit in GEM for VSLs. [EPA-HQ-OAR-2014-0827-1265-A1 p.156]

The issue of whether and what credit to offer for VSLs is timely and important because tamper-proof VSLs may soon be required in the U.S. by federal regulation. In 2006, the American Trucking Association (ATA), Road Safe America and a group of motor carriers petitioned NHTSA to initiate rulemaking to require vehicle manufacturers to install a device to limit the speed of trucks with a GVWR greater than 26,000 lbs to no more than 68 mph. The petitions were based on a desire to reduce the number and severity of crashes involving large trucks.<sup>62</sup> NHTSA in 2011 agreed to consider a rule requiring speed limiters and has stated they intend to propose such a rule later this year (<http://www.regulations.gov/#!documentDetail;D=NHTSA-2007-26851-3854>).<sup>63</sup> As a result, VSLs are likely to be widely utilized in heavy-duty truck fleets in the near future; thus, the issue of understanding whether or not VSLs have an emissions benefit and not offering too much credit for them in GEM is imperative. [EPA-HQ-OAR-2014-0827-1265-A1 p.156-157]

Before offering any credit for VSLs, CARB staff suggests that U.S. EPA and NHTSA should thoroughly evaluate whether they would result in real-world CO<sub>2</sub> and fuel consumption benefits. CARB staff is willing to offer our help in this evaluation if needed. [EPA-HQ-OAR-2014-0827-1265-A1 p.157]

If U.S. EPA and NHTSA decide to give credit in Phase 2 GEMs for VSLs, VSL benefit should also be included in premising the proposed standards. If credit for use of VSLs is granted without considering them when setting stringency, use of VSLs will only reduce use of other technologically feasible technologies that were included when setting stringency, without providing further benefit. [EPA-HQ-OAR-2014-0827-1265-A1 p.157]

### **Comment – VSL credit in GEM**

The NPRM proposes that manufacturers would receive credit for installing tamper-proof VSLs with maximum drive cycle speed set at 65 mph or less (the minimum VSL value input in GEM is set at 45 mph). The draft GEM model appears to offer up to 22 percent credit for use of VSL,<sup>64</sup> which is unreasonably high. In addition, as mentioned in the above comment, whether or not use of VSL will provide emissions benefit is still an open question. Thus, CARB staff strongly suggests U.S. EPA and NHTSA remove the credit offered for use of VSL in GEM, pending confirmation of the actual fuel consumption and CO2 benefits VSLs achieve in the real world. [EPA-HQ-OAR-2014-0827-1265-A1 p.157-158]

### **Comment – Participation of owners in VSLs’ emissions credit transactions**

The NPRM requests comment on potential means by which truck owners that use VSLs could directly participate in Phase 2 emission credit transactions. It is not clear what fleet owners would do with Phase 2 credits and allowing fleet owners to garner such credits would unnecessarily complicate implementation and enforcement of the Phase 2 program. As a result, CARB staff recommends not including owners in emission credit transactions for VSL installation. [EPA-HQ-OAR-2014-0827-1265-A1 p.158]

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60 See Attachment 7 for California Air Resources Board’s Portable Emissions Measurement System’s Data on 2010 Standard Trucks – Carbon Dioxide Emission Rate vs. Speed.

[Attachment 7 can be found on p.39 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

<sup>61</sup> (ORNL, 2008) Capps, Gary, Oscar Franzese, Bill Knee, M.B. Lascrain, and Pedro Otaduy. “Class-8 Heavy Truck Duty Cycle Project Final Report,” ORNL/TM-2008/122, Oak Ridge National Laboratory, Oak Ridge, TN, December 2008.

<sup>62</sup> (NACFE, 2011) North American Council for Freight Efficiency, “Speed Limiters Save Money and Fuel without Significant Productivity Loss,” February, 2011, <<http://nacfe.org/wp-content/uploads/2011/04/NACFE-ER-1003-Speed-Limiters-Mar-2011.pdf>>, accessed on July 9, 2015.

<sup>63</sup> (NHTSA, 2011) Federal Motor Vehicle Safety Standards: Engine Control Module Speed Limiter Device, Federal Register Notice, January 3, 2011, <<http://www.regulations.gov/#!documentDetail;D=NHTSA-2007-26851-3854>>, accessed on July 30, 2015.

<sup>64</sup> This is estimated based on GEM results for sample GEM input file of tractor. The specified tractor configuration (350 hp with AMT transmission) was run with four scenarios (no VSL - baseline, 45 mph speed limit VSL, 55 mph speed limit VSL, and 65 mph speed limit VSL). Projected CO2 emissions for each scenario were used to calculate percent CO2 reduction from baseline (no VSL use) (22%, 11%, and 0.01% CO2 reduction for VSL set at 45 mph, 55 mph, and 65 mph, respectively).

### **Response:**

*Alternative 3 vs. 4*

The agencies considered all of the general comments associated with the proposed Alternative 3 and Alternative 4 tractor standards. We believe there is merit in many of the detailed comments received

regarding technologies. These are discussed in detail in the following sections. Instead of merely choosing from among the proposed alternatives, the agencies have developed a set of final tractor standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies. In general, the final Phase 2 tractor standards are similar in overall stringency as the levels proposed in Alternative 3, but have been determined using new technology packages that reflect consideration of all of the technology comments, and in several respects reflect greater stringency than the proposed Alternative 3.

#### *Day Cab Idle*

The agencies considered the comments, both supporting and raising concerns over idle reduction in day cabs. The agencies determined that neutral idle for automatic transmissions is an appropriate technology for use in tractors, as discussed in Section III.D.1.b of the Preamble to the final rule. Therefore, the agencies are adopting provisions in Phase 2 to recognize neutral-idle in automatic transmissions as an input to GEM. Our analysis shows that neutral idle effectiveness is approximately 0.8 to 1 percent over the composite day cab tractor cycles, as shown in RIA Chapter 2.8.2.6. The agencies will also include neutral idle as a GEM input for sleeper cabs, though the effectiveness is very low. The agencies are predicating the standards for day cabs based on a technology package that includes neutral idle.

In terms of stop-start technologies in tractors, the agencies are not including it as a technology input to GEM because we believe the technology needs further development for tractors. Since the agencies are not predicating the Phase 2 standards on adoption of start-stop technologies, the agencies are also not including this technology as a GEM input. If this technology is developed in the future for tractors, then manufacturers may consider applying for off-cycle technology credits.

#### *Tire Pressure Systems*

As noted in earlier responses in this unit, after consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS; however, we set the effectiveness of TPMS slightly lower than ATIS to reflect that operators will be required to take some action to insure that the proper inflation pressure is maintained.

#### *Solar Control*

The agencies received a letter from the California Air Resources Board prior to the proposal requesting consideration of including technologies that reduce solar heating of the cab (to reduce air conditioning loads) in setting the Phase 2 tractor standards. Solar reflective paints and solar control glazing technologies are discussed in RIA Chapter 2.4.9.3. The agencies requested comment on the Air Resources Board's letter and recommendations.<sup>55</sup> The agencies received some clarifications from ARB on our evaluation of solar technologies and some CBI from Daimler, but not a sufficient amount of information to evaluate the baseline level of solar control that exists in the heavy-duty market today, determine the effectiveness of each of the solar technologies, or to develop a definition of what qualifies

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<sup>55</sup> California Air Resources Board. Letter from Michael Carter to Matthew Spears dated December 3, 2014. Solar Control: Heavy-Duty Vehicles White Paper. Docket EPA-HA-OAR-2014-0827.

as a solar control technology that could be used in the regulations. Therefore, the agencies would consider solar control to be a technology that manufacturers may consider pursuing through the off-cycle credit program. As such, the agencies did not include solar load management technologies in the technology packages used in setting the final Phase 2 tractor standard stringencies.

#### VSL

The agencies conducted in-use tractor testing at different speeds and in turn used this data to validate the GEM simulations of VSL, as discussed in more detail in RIA Chapter 4.3.2. The agencies are confident that GEM appropriately recognizes the impact of VSL on CO<sub>2</sub> emissions and fuel consumption. The agencies have limited the range of inputs to the VSL in Phase 2 GEM to a minimum of 55 mph to align with the regulations in 40 CFR 1037.631 that provide exemptions for vocational vehicles intended for off-road use. A 55 mph VSL installed on a typical day cab tractor would reduce the composite grams of CO<sub>2</sub> emitted per ton-mile by 7 percent. Similarly, a 55 mph VSL on a sleeper cab would reduce the composite grams of CO<sub>2</sub> per ton-mile emitted by 10 percent. Please see RIA Chapter 2.8.2.10 for additional details of the technology impacts.

**Organization:** Caterpillar Inc., et al.

As proposed, the regulation will limit or eliminate our ability to meet the basic customer requirements for many of the thousands of widely varying applications we support today. Based on our current analysis, it is not clear that the proposed Alternative 3 targets – which include a number of unrealistic technology penetration rates – can be achieved. [EPA-HQ-OAR-2014-0827-1215-A1 p.7]

Aerodynamic: 60% in Bins V, VI, and VII – Given the proposed aerodynamic testing procedures, the Phase 2 test trailer, and the lack of any audit margin for these highly variable test processes, it is infeasible to design tractors that can achieve even bin V, much less bins VI and VII. In fact, none of the vehicles developed within the Department of Energy’s SuperTruck program are capable of meeting the aerodynamic targets the agencies assumed when setting stringency levels. The agencies must eliminate expected penetration in these higher bins unless they agree to wholesale changes to the aerodynamic testing procedures and restore the audit margin available in the Phase 1 rule. [EPA-HQ-OAR-2014-0827-1215-A1 p.5-6]

6x2’s: 60% - 6x2’s may not be used legally in all 50 U.S. states and in parts of Canada. In particular, six state laws limit tire and axle loading in such a way that 6x2’s cannot be used as intended, and many other states have confusing regulations that effectively prevent usage of 6x2’s. Most fleet owners must purchase tractors that can operate in all 50 states, and many cross the border between the U.S. and Canada. EPA and NHTSA should assume no more than a 5% penetration rate for 6x2’s through 2027 and should engage in additional study of the safety and regulatory challenges associated with 6x2’s. [EPA-HQ-OAR-2014-0827-1215-A1 p.6]

Tire Inflation Systems: 40% - Customers are more likely to purchase tire pressure monitoring systems, which provide all of the benefits of tire inflation systems at a lower cost. In addition, a customer who simply checks tire pressure daily can achieve all of the same benefits without purchasing either technology and incurring its costs. Tire inflation systems should not be forced into the market by assuming any penetration rate. To the extent credit is provided for these systems, both tire inflation systems and tire pressure monitoring systems should receive the same amount of credit. [EPA-HQ-OAR-2014-0827-1215-A1 p.6]



Idle Shutdown Timers (“AES”): 90% - The agencies base stringency on an assumed 90% penetration rate of tamper-resistant idle shut down timers. Notably, most fleets already purchase customer programmable idle shutdown timers which limit idling. However, fleets do not purchase tamper-resistant versions of idle shutdown timers because of the negative perception in the secondary market regarding such technology, and the importance of considering resale value when purchasing a new vehicle. In practice, idle shutdown timers are typically used for the useful life of the vehicle, whether they are customer programmable or tamper-resistant. If forced to purchase mandatory shutdown timers, many fleets will pre-buy vehicles to delay the negative costs associated with such technology. AES’s should not be considered part of stringency, unless the agencies choose to provide credit for programmable versions of AES’s that provide essentially the same environmental benefits as the non-programmable version. [EPA-HQ-OAR-2014-0827-1215-A1 p.6]

Low Rolling Resistance (“LRR”) Tires – Tires must meet the most demanding needs of the customers. LRR tires may suffice for many conditions, but they must meet the demands of all conditions. This includes sloped loading docks, which frequently are not treated or plowed in winter conditions. Unpaved and uneven trailer drop lots also create challenges for traction. In addition, tire casings must have adequate durability to allow as many as 5 retread operations. Including widespread use of LRR tires when determining a baseline from which to apply reductions will result in overly stringent standards. [EPA-HQ-OAR-2014-0827-1215-A1 p.6-7]

In addition, many technologies in the proposal can have unaccounted negative impacts to vehicle fuel economy and the corresponding greenhouse gas emissions (e.g. aerodynamic impact from increased wheelbases due to APU installation, payload loss due to increased weight of hybrid systems, and weight and aerodynamic impacts due to waste heat recovery installation). These losses decrease any expected payback on the technology investment. Some of the assumed technologies also may drive increased cycle times or vehicle trips due to decreased payload, requiring additional trucks and operators in the fleet to perform the same quantity of work. Regardless of the specific technologies an OEM chooses to meet the mandate, the compressed design cycles driven by the Phase 2 regulation’s timing and unrealistic stringencies will drive increases in total cost of ownership for vehicle owners. On top of this, for truck OEMs to remain viable businesses, the billions of dollars in industry development cost must be amortized over the relatively small volumes in the heavy-duty vehicle market, adding many thousands of dollars in cost per vehicle that have not been adequately considered. [EPA-HQ-OAR-2014-0827-1215-A1 p.7-8]

As such, the Truck OEMs request the agencies take a total cost of ownership approach when considering technology feasibility and penetrations, as well as stringency levels and their timing. Failure to do so will result in an unrealistic cost and penetration rate assessment, severely impacting a truck OEM’s ability to meet the mandated fleet reductions. [EPA-HQ-OAR-2014-0827-1215-A1 p.8]

**Response:**

*Aerodynamics*

In consideration of these comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). The agencies’ assessment for the final rule is that only Bins I through V are achievable with known aerodynamic technologies, but that Bins VI and VII have less known technology paths. Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . See RIA Chapter 2.8.2.2. These aerodynamic improvements have been demonstrated within the program on two vehicles in

2015. In the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing these aerodynamic technologies as early as 2021 MY on a limited scale. We adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time. The agencies phased-in the aerodynamic technology adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies. For example, in the 2021 MY technology package, the agencies have assumed that 10 percent of high roof sleeper cabs and 5 percent of high roof day cabs will have Bin V aerodynamic performance. This phase-in structure is consistent with the normal manner in which manufacturers introduce new technology to manage limited research and development budgets as well as to allow them to work with fleets to fully evaluate in-use reliability before a technology is applied fleet-wide. The agencies believe the phase-in schedule will allow manufacturers to complete these normal processes. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the NPRM, the actual aerodynamic technology being projected is very similar to what was projected at the time of NPRM.

### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>56</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>57</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.<sup>58</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

### *Tire Pressure Systems*

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<sup>56</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>57</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>58</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." January 2014. Page 19.

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS; however, we set the effectiveness of TPMS slightly lower than ATIS to reflect that operators will be required to take some action to insure that the proper inflation pressure is maintained.

#### *Idle Reduction Technologies*

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data.<sup>59</sup> We found that high roof sleeper cabs are certified today with steer tire rolling resistance levels that ranged between 4.9 and 7.6 kg/ton and with drive tires ranging between 5.1 and 9.8 kg/ton. In the same analysis, we found that high roof day cabs are certified with rolling resistance levels ranging between 4.9 and 9.0 kg/ton for steer tires and between 5.1 and 9.8 kg/ton for drive tires. This range spans the baseline through Level 3 rolling resistance performance levels. Therefore, for the final rule we took an approach similar to the one taken in Phase 1 and proposed in Phase 2 that considers adoption rates across a wide range of tire rolling resistance levels to recognize that operators may have different needs. 76 FR 57211 and 80 FR 40227.

In our analysis of the Phase 1 certification data, we found that the drive tires on low and mid roof sleeper cab tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found only a minor difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. This is also consistent with the approach that we took in setting the Phase 1 tractor standards. 76 FR 57211. In addition, the final rule reflects a reduction in Level 3 adoption rates for low and mid roof tractors from 25 percent in MY 2027 used at proposal (80 FR 40227) to zero percent adoption rate. The technology packages developed for the low and mid roof tractors used to determine the stringency of the MY 2027 standards in the final rule do not include any adoption rate of Level 3 drive tires to recognize the special needs of these applications, consistent with the comments noted above raising concerns about applications that limit the use of low rolling resistance tires.

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<sup>59</sup> Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. Docket EPA-HQ-OAR-2014-0827.

The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies. In addition, the levels of rolling resistance used in all of the technology packages are achievable with either dual or wide based single tires, so the agencies are not forcing one technology over another.

#### *Total Cost of Ownership*

The agencies considered the total cost of ownership during the payback calculations, included in RIA Chapter 7 of the final rule. The payback calculations include the hardware costs of the new technologies and their associated fixed costs, increased insurance, taxes, and maintenance. The agencies found that for each category of vehicle – tractor/trailers, vocational vehicles, and HD pickups and vans - included in the Phase 2 rule that the fuel savings significantly exceed the costs associated with the technologies over the lifetime of the vehicles.

**Organization:** Center for Biological Diversity

#### *Tractor-Trailers*

Tractor-trailers consume approximately 20 percent of on-road transportation fuel and emit a similar proportion of greenhouse gas emissions. Furthermore, combination tractor-trailers emit two-thirds of the total greenhouse gases from commercial trucks. As such, maximizing efficiency for these vehicles will both carry a significant environmental benefit and save the most fuel among the various classes of trucks subject to the Proposed Rule. We support the agencies’ decision to set standards for both tractors and trailers in this second phase of truck efficiency standards: the Phase 1 standards did not apply to box trailers. The Proposed Rule would result in approximately a 10.4 percent reduction in combined tractor-trailer energy use between 2017 and 2027,<sup>43</sup> but current and future technology would allow reductions of 25 to 27 percent over this same time frame.<sup>44</sup> A stakeholder workshop on tractor-trailer efficiencies generated an impressive suite of technologies that have both short term (before 2018) and longer term (2020 to 2030) potential to reduce fuel use and emissions by up to 38 percent.<sup>45</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.10]

A recent analysis<sup>46</sup> indicates that the Proposed Rule does not even meet the potential that has already been demonstrated through the Department of Energy’s SuperTruck program – a clear indication that the standards are not technology forcing. The SuperTruck public-private partnership aims to demonstrate a 50 percent increase in tractor-trailer efficiency and a 20 percent improvement in engine efficiency between 2010 and 2015.<sup>47</sup> Impressive strides have been made reaching – and exceeding – these goals: the Cummins-Peterbilt team achieved a 76 percent increase in tractor-trailer efficiency<sup>48</sup> and more recently the Daimler-Freightliner team achieved a 115 percent improvement in efficiency.<sup>49</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.10-11]

Most importantly, when directly comparing the Proposed Rule 2027 standards and what SuperTruck partners have already achieved, the proposed standards for tractors-trailers would achieve only about three-quarters of the fuel savings that have been demonstrated by SuperTruck partners.<sup>50</sup> The Proposed Rule takes SuperTruck research and development into account when calculating the dynamic baseline, or reference truck, but fails to properly employ the demonstrated improvements from the SuperTruck program when determining what technology is maximally feasible. In fact, the Draft Regulatory Impact Analysis (“RIA”) explicitly acknowledges that there are likely to be more advanced aerodynamics options by 2027.<sup>52</sup> Since the agencies already predict such advances, the technology-forcing nature of the

governing statutes requires that they be included in the standards, especially when the proposed time horizon is within the range of tractor redesign cycles.<sup>53</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.11]

Although the Proposed Rule assumes a wide range of technologies, the penetration rates assumed by the agencies and potential improvements appear to be underestimated.<sup>54</sup> The technology forcing nature of Clean Air Act § 202 and EPCA/EISA requires more aggressive assumptions regarding technology adoption. The agencies are proposing standards that are either already attained or easily attainable, and then hoping that manufacturers will explore and continue to improve technologies of their free will.<sup>55</sup> This is contrary to the specific language, structure, and intent of the statutes: a clear regulatory signal is necessary and intended to drive innovation, ensuring that technology improvements occur as rapidly as possible. [EPA-HQ-OAR-2014-0827-1460-A1 p.11]

In sum, the total reductions of greenhouse gas emissions and fuel usage could be significantly greater if the agencies adopt standards that represent true maximum efficiency improvements, even while remaining economically feasible and safe. The NHTSA may not adopt standards that undermine the purpose of the EPCA/EISA – energy conservation. Yet, the proposed fuel use reductions for tractor-trailers would provide only about one-third of the maximal feasible benefits. This constitutes an arbitrary and capricious balancing of factors that significantly impedes the congressional mandate to promote energy conservation. Likewise, these minimal reductions fail the Clean Air Act’s technology-forcing requirement. [EPA-HQ-OAR-2014-0827-1460-A1 p.11-12]

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43 US EPA, *Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles–Phase 2 Draft Regulatory Impacts Analysis* 5-15 (June 2015) (“Draft RIA”).

<sup>44</sup> INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION, *ADVANCED TRACTOR-TRAILER EFFICIENCY TECHNOLOGY POTENTIAL IN THE 2020-2030 TIMEFRAME* 54 (Apr. 2015), available at <http://theicct.org/us-tractor-trailer-efficiency-technology>.

<sup>45</sup> *Id.* at 8.

<sup>46</sup> Nic Lutsey, *Will new U.S. truck standards bring “SuperTrucks” to the market?*, International Council on Clean Transportation, (Aug. 31, 2015) (“ICCT SuperTruck blog”), <http://theicct.org/blogs/staff/will-new-us-truck-standards-bring-supertrucks-to-market>.

<sup>47</sup> See <http://energy.gov/eere/articles/supertruck-making-leaps-fuel-efficiency>.

<sup>48</sup> *Id.*

<sup>49</sup> See <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>.

<sup>50</sup> ICCT SuperTruck blog, *supra* note 46.

<sup>52</sup> Draft RIA at 2-18.

<sup>53</sup> *Id.* at 2-16 (“tractor model lifecycle of up to 10 years”).

<sup>54</sup> For example, dual clutch systems are assumed to provide only up to 2% improvement (Proposed Rule at Table III-7), but the stakeholder workshop assigned this technology approximately 5.5 (+ 2) % improvement (ICCT Tractor-Trailer report, *supra* note 44); the Proposed Rule omits weight reduction in setting stringency assigning an improvement of 0.3 % (Proposed Rule at 40223), while the stakeholder workshop found over 3 (+ 1) % improvements from weight reduction (ICCT Tractor-Trailer report, *supra* note 44).

<sup>55</sup> See, e.g., Draft RIA, *supra* note 43 at 2-16 (“we anticipate manufacturers would continue to apply these techniques [sealing gaps] across their models and continue to explore refinements and re-designs in other areas of the tractor”). But note that the agencies are also fully aware that a regulatory signal is necessary to correct private market failures and “provide regulatory certainty and thus generate important economic benefits in addition to reducing externalities.” *Id.* at 8-5.

**Response:**

The proposed Phase 2 program would lead to up to 24% percent reduction in GHG emissions from high roof sleeper cabs and up to 8% from box trailers for greater than 30% reduction in tractor-trailers when compared to a baseline tractor-trailer meeting the Phase 1 standards, not the 10% stated by the commenter. In addition, EPA conducted GEM simulations evaluating both the best projected tractor-trailer in the 2027 timeframe that showed much greater reductions than the 10% stated by the commenter (Docket Entry EPA-HQ-OAR-2014-0827-0050).

The agencies considered all of the general comments associated with the proposed Alternative 3 and Alternative 4 tractor standards. We believe there is merit in many of the detailed technology comments received and these are discussed in detail in the following sections. Instead of merely choosing from among the proposed alternatives, the agencies have developed a set of final tractor standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies. In general, the final Phase 2 tractor standards are similar in overall stringency as the levels proposed in Alternative 3, but have been determined using new technology packages that reflect consideration of all of the technology comments, and in several respects reflect greater stringency than Alternative 3.

DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations (only one of the ten tractor subcategories) that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway under somewhat controlled circumstances. However, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to damage from potholes or other road hazards. In addition, each manufacturer only produced a single high roof sleeper cab for demonstration purposes at a cost of nearly \$40-\$80 million each. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the limited purpose of SuperTruck and the plenary applicability of a regulation to all operating conditions and duty cycles, it is helpful to assess the achievements and evaluate how the technologies could be applied into mass production into a variety of real world applications while maintaining performance throughout the full useful life of the vehicle.

**Organization:** Cline, C and J

But, one technical problem exists that permeates throughout the transport industry, including the regulators that reduces safety, damages driver health, and damages our world. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

We should not be going backwards. Saving fuel to the detriment of other costs, safety, our health, or our world is simply dumb. And the reason for this letter, is something that is so dumb, it simply amazes me that we have let this practice continue for so long. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

Incorrect Tire Pressures are used throughout the transport industry. Incorrect tire pressures are used in regulations aimed at truck safety. Incorrect tire pressures are promoted as environmentally responsible, yet they aren't. In fact, correct tire pressures are ignored almost totally. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

Every quality tire manufacturer, along with all Wheel and Tire Associations recommend that tire pressures must be adjusted to suit the load. Truck Tire 'Load to Inflation' tables are easily available on the web. Yet, these are ignored. In any other industry, anyone failing to follow the manufacturer's recommendations would be liable for litigation, fines, and often imprisonment. Yet, the entire transport industry, including the regulators, do just that. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

Almost every class 8 steer tire is under inflated. All of the load carrying tires, drive tires, and trailer tires are 30% over inflated, at least, even when fully legally laden. When empty, the load carrying tires can easily be 300% over inflated. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

For instance, a class 8 tractor tandem or bogie axle set is typically limited to 34,000 pounds. The correct cold tire pressure for this weight, running standard 11R22.5 tires, is only 75 psi. Hence the traditional truck tire cold pressure of 100 to 110 psi is 30% over inflated. [EPA-HQ-OAR-2014-0827-0803-A2 p.1]

[Table, 'Radial Ply Tires for Trucks, Busses and Trailers used in Normal Highway Service', can be found on p.1 of docket number EPA-HQ-OAR-2014-0827-0803-A2]

According to the Michelin USA site, running a 30% over inflated tire will reduce its life by 20% or more, depending upon where it is placed, drive or trailer. Many trucks are not running maximum weights, so the tires are over inflated even more, with more tire life lost. Again, Michelin states that over inflated tires have less traction, suffer more punctures, and suffer uneven wear and tear. Hence over inflation results in more accidents, more deaths, more blown tires, more damaged vehicles, and more pollution and waste to dispose of. [EPA-HQ-OAR-2014-0827-0803-A2 p.2]

[Figure, 'Pressure Effects on Tread Life', on drive axles and steer axles, can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-0803-A2]

Two years ago, tests in Australia overseen by Australian Road Research Board and Australian Road Transport Suppliers Association did braking tests on a modern semi-trailer rig on a concrete skid pan. The correct tire pressure decreased stopping distances by a whopping 15% on a lightly loaded rig. As empty semi-trailers are considered the most dangerous condition, this amazing improvement in stopping ability is simply that, amazing. It stopped short and straight. [EPA-HQ-OAR-2014-0827-0803-A2 p.2]

[Image of truck with explanatory text can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-0803-A2]

Many other tests have been done throughout the world, on the many benefits of optimizing tire pressures. Many tests have been done by various US government departments. A little research will provide numerous tests. Simply google 'Central Tire Inflation'. [EPA-HQ-OAR-2014-0827-0803-A2 p.2]

Central Tire Inflation is a simple bolt on attachment that makes on the fly tire changes easy. The driver simply pushes a button on the dash mounted controller to raise or lower the tire pressure. CTI is used extensively in logging and other off road/on road transport, throughout the world, especially where traction, and or tire life is difficult. [EPA-HQ-OAR-2014-0827-0803-A2 p.2]

Tire pressures on standard Load to Inflation tables typically show a limited range of loads and pressures. The lowest pressure is often 65 or 70 psi. The reason is that, without CTI, the truck must be considered a load carrying vehicle. With CTI, heavy truck tire pressures usually go to 25 psi as the lowest pressure at light loads, or off road. For instance, at speeds of 50 mph or lower, 25 psi is recommended for a tire load of up to 2,300 pounds per tire (USA Tire and Rim Association hand book). Another example is a Michelin reference paper on 11R22.5 XTE1 tires, where a pressure of 50 psi is recommended at a weight of 2,750 psi per tire, at highway speeds. [EPA-HQ-OAR-2014-0827-0803-A2 p.2]

[Figure, 'Design Guide, Reduced Inflation Pressure Limits for Truck Tires Used Off Highway at Reduced Speed (For Single and Dual Applications, can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-0803-A2)]

But, it gets worse. Over inflated tires bounce off of every road irregularity. Just like a super ball, over inflated tires will hammer the truck and the driver to an early grave. Whole Body Vibration is now a proven health hazard. There are many reports on Whole Body Vibration. Conferences are held every year. Damage starts at the brain ocular system, down through the skeletal and organs. Truck drivers suffer from 15 to 20 years shorter life expectancy. Average life expectancy is only 56 years! Over inflated tires are killing our drivers. [EPA-HQ-OAR-2014-0827-0803-A2 p.3]

Yet more: Over inflated tires are killing our roads. Over inflated tires amplify any axle end out of balance, causing excessive vibration that hammers our roads. Over inflated tires input higher loads into the road surface, damaging our crumbling infrastructure. [EPA-HQ-OAR-2014-0827-0803-A2 p.3]

As truck tires consume large quantities of oil and energy to manufacture and transport, and are costly and difficult to recycle or dispose of, wasted tires add significantly to our pollution and climate change levels. [EPA-HQ-OAR-2014-0827-0803-A2 p.3]

To explain the problem further, consider a standard US automobile that weighs around 4,000 pounds empty, or around 1,000 pounds per tire. Fairly typical tire pressures recommended by the manufacturer will be around 32 to 35 psi. An empty tractor will weigh around 18,000 pounds. The weight on the steer axles will be around 11,000 pounds, leaving 7,000 pounds on eight tires, or less than 1,000 pounds per tire. Similarly, a flat top trailer will have even less weight on its 8 tires. Imagine running your Chev or Ford with 100 psi in the tires.... It wouldn't handle, it wouldn't ride well, it wouldn't stop, and tire life would be terrible. Yet this is exactly what we do to our trucks and drivers. [EPA-HQ-OAR-2014-0827-0803-A2 p.3]

More explanation: My company has developed, refined, and manufactures the best Central Tire Inflation for trucks for the last 17 years. We developed this product to serve the intensive logging industry in Australia, which is a great testing ground. We have thousands of heavy class 8 trucks, from log truck, fuel tankers, dump trucks, right through to road trains providing services to mining companies 500 miles from the nearest town. In every case, running the correct tire pressures has reduced tire wear and costs by at



least 30%. In some cases, tire life almost doubled. Many of our customers run 92 psi loaded at speed, 60 psi loaded on gravel roads, or empty on highway, and 30 psi empty on gravel. Note: these are hot pressures that are actually used. These trucks carry slightly more weight than US trucks, and, when empty have the trailers folded up on the back. My own class 6 tray truck runs pressures between 25 and 100, depending upon load. [EPA-HQ-OAR-2014-0827-0803-A2 p.3]

[Images of tires and explanatory text can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-0803-A2]

We've witnessed identical trucks, one group operating highways only, with traditional tire pressures, and one group hauling logs on mixed highway and gravel, with CTI and optimal pressures. The highway traditional trucks were simply falling apart, with cracked axles, spring breakages, cabin mount problems, cracked dashes, while the CTI equipped trucks operating in rougher conditions, had twice the miles, and no failures. This single firm operated dozens of highway trucks and a dozen log trucks. [EPA-HQ-OAR-2014-0827-0803-A2 p.3-4]

[Image of truck and explanatory text can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-0803-A2]

Other operators reported doubling the life of transmissions and differentials with optimized tire pressures. Another company did a vibration test at the driver's seat. The optimized tire pressure truck exceeded their vibration limit 13 times. Three identical trucks, running traditional tire pressures, exceeded the vibration limit by 531, 560, and 573 times! [EPA-HQ-OAR-2014-0827-0803-A2 p.4]

To summarize, almost every truck in America is running the wrong tire pressures. The information is readily available. Unfortunately, no one knows that cares. I believe that many are happy with the status quo. Many of the tire salesmen can't be bothered to tell their customers, and put up with the arguments, or risk 'losing face'. And why bother when everyone else is doing the same thing. Truck drivers are often second or third generation. Many fleet operators are ex truck drivers. Traditionally, all trucks ran either 100 to 110 psi, depending upon their preference. This is left over from cross ply/bias ply tire needs. We just haven't changed our mentality to radial truck tires. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]

Regulators should know better, should be well informed, yet, again, the traditional pressures are the law. Even rules regarding road vehicle safety, use the same ridiculous pressures. For instance; 'a tire that is inflated to a pressure 20 psi below the intended target is considered non serviceable'. In my nearly 20 years of researching tire pressures, I have never found any government in any country that mentions optimizing tire pressures. In fact, I recently read an 'expert' report explaining that 'tire load to inflation pressures' are the 'minimum' tire pressures. 'In fact, any pressure between this 'minimum' pressure and the maximum pressure listed on the side wall is correct.' Unbelievable, and so wrong. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]

Incorrect tire pressures add other problems. Miss matched tires on a dual assembly are known to cause problems, but Bridgestone proved that having just a 5 psi difference caused a 5/16 inch difference in rolling circumference. In a typical tire life, this is equivalent to spinning the tire for 160 miles! Tires are destroyed, rolling resistance increases, burning more fuel and energy. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]

Further:

- Throwing away one tire out of three wastes a lot of CO<sub>2</sub>, in manufacture, in materials, in energy, and in transport. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]
- Rough roads increase transport accidents and deaths. Over inflation reduces traction, damages drivers, fatigues drivers, and reduces vehicle control. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]
- Whole Body Vibration is a proven cause of health problems, helping to kill our drivers. Optimizing tire pressures lets them absorb road irregularities and vibration, improving driver health and helping to fight fatigue. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]
- High vibration damages trucks, drivers, and cargo, needlessly wasting money, energy, fuel, and CO<sub>2</sub>. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]
- Worn out tires, uneven worn tires, damaged carcasses, damaged trucks, and damaged infrastructure add to the cost of everything that our civilization uses. Waste just adds to our problems, with no benefit what so ever. [EPA-HQ-OAR-2014-0827-0803-A2 p.4]
- High vibration over inflated tires hammer our roads into an early grave. Pot holes, washboards, ruts, are all minimized or eliminated with optimized tire pressures. [EPA-HQ-OAR-2014-0827-0803-A2 p.4-5]
- Damaged roads and infrastructure costs our country and world twice. Perfectly good roads and bridges are damaged, and new roads and bridges cost millions and billions, adding to the Global Warming/Climate change pollutants. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]
- Old roads, damaged tires, worn out trucks all cost money and energy to dispose of. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]
- New roads, new tires, new trucks all cost money, and energy to manufacture and deliver. If trucks, roads, and tires last longer, much energy and pollution is saved. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]
- Why is transport ignoring the manufacturer's recommendations?[EPA-HQ-OAR-2014-0827-0803-A2 p.5]
- Why are the regulators/governments not following manufacturer's recommendations? [EPA-HQ-OAR-2014-0827-0803-A2 p.5]
- Why are we ignoring the increased risk, the known health risks, and wasting billions of dollars? [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

### **Where should we go?**

Fuel and pollution reduction is vitally important. Government incentives and requirements motivate manufactures and the industry. But, we mustn't continue, and we mustn't allow bad practices to continue, or be promoted. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

Education and regulation is the first step.

Then Tire Pressure Maintenance is the minimum that is must be fitted and regulated. The pressures must be set to optimize the truck and trailer. Central Tire Inflation is required on trucks that travel empty regularly, like dump trucks, bulk grain trucks, tankers, low loaders. When empty, semi-trailers are currently dangerous. Brake balance, significant overly braked, and ridiculously over inflated tires create a condition that jack knives are probable. Any truck working off highways needs CTI too. Either will eliminate almost every blow out and alligators that litter our highways, if we're lucky, or kill, if not. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

Over inflation is dangerous, costly, damages health, and damages our world. Over inflation is unacceptable. In the 21st century, we have the ability to optimize our world. Any other option is simply a death certificate for ourselves. The tire manufacturer's recommendations must be the law, and must be enforced. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

### **Additional thoughts:**

Fitting Truck and Trailer Aerodynamics are common sense. I have been designing and advocating aero for 40 years. Yet, almost no aero trucks exist. I was pleased in my latest 10,000 mile drive around the states that side skirts are being fitted, and the design is reasonably good. There is so much more that can be done. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

Why do proper aero trucks simply not exist on our highways? Where are they? Why do so many waste so much pushing air? [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

A problem exists in truck aero. Most of the manufacturers manufacture a product. They are not aero enthusiasts or even experts. Most are fiberglass manufactures. Aero is just one of their products, along with pots for planting flowers. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

I regularly see poorly designed aero, and even more often, poorly installed aero. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

Side skirts often have large gaps between the panel and the bottom of the body. A code of practice is drastically needed. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

I have had a lifelong obsession with optimizing motor vehicles of all types. Every component can be improved, without costing a fortune. In my 45 years owning, driving, working on, and modifying trucks, I've accumulated a lot of practical knowledge. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

My obsession means I've built actual vehicles to test my theories. This white truck was continuously upgraded over the last 20 years. Notice the fit of the cab deflector, the large side skirts, the front spoiler and the self-inflating boat tail, along with AIR CTI on all wheels. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

As this truck is quite old, I've built a new test truck. See below. [Image can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-0803-A2] Front spoiler, that automatically deploys over 30 mph (retracted in the picture), side skirts, small aero mirrors, and aero spats over rear wheels. The tapered tool boxes before and after the rear wheels deflect air around the wheel, and acts like an integral boat tail behind. The tray is aluminum for light weight. The tray is slides rearward and to the ground for loading vehicles, and to swap for the box as shown above. Additionally, AIR CTI is being fitted front and rear. Soon, speed sensitive automatic side skirts, tapered to the center of the truck immediately below the transmission, will drop to 4 inches above the road surface, to drag the air from underneath out and around.

A behind cab self-inflating tray boat tail is also designed. A new 6.7 liter Cummins B series engine and overdrive road ranger transmission is fitted. A FASS fuel air separation system ensures the engine gets pure fuel. We've seen 4 to 8% improvements in fuel economy with the FASS unit. Propane supplementation is another add on that will be fitted soon. As propane is half the price of diesel, propane makes good economic sense, and provides a cleaner running truck. We have seen some great results. We look forward to continuous improvement to help show our industry how to optimize their truck. [EPA-HQ-OAR-2014-0827-0803-A2 p.6]

AIR CTI is undoubtedly the best CTI available. AIR CTI is sold throughout Australia, by all Paccar dealers, and other truck businesses. AIR CTI is operating in South Africa, Malaysia, Indonesia, Papua New Guinea, New Zealand, Canada, USA, Italy, and the Middle East. Working with my brother in Texas, AIR CTI is starting its American debut, bringing me closer to my home country. The benefits of CTI are simply amazing. The reports from customers, and my own experience, along with 50 years of off-roading, from Missouri mud to the Canning Stock Route in outback Australia, CTI works. [EPA-HQ-OAR-2014-0827-0803-A2 p.7]

AIR CTI continues to grow at around 20% annually, our staff includes truck people with hundreds of years of experience. We have electronic experts, welders, mechanics, truck parts specialists, and a structural engineer as staff. I belong to ARTSA, Australian Road Transport Suppliers Association, with members from Paccar to Michelin to Meritor and BPW. I also belong to the National Bulk Tankers Association, and have spoken at several TMC's run by our ATA. In the states, we've joined several logging associations, and concrete associations, as both are great potential users. We exhibited at the Mid America Truck Show earlier this year with more coming up. [EPA-HQ-OAR-2014-0827-0803-A2 p.7]

I have dedicated the rest of my life to improving transport. I will do whatever is necessary to make trucks safer, greener, and more profitable. [EPA-HQ-OAR-2014-0827-0803-A2 p.7]

**Response:**

*Tire Pressure Systems*

The agencies agree with the commenter that maintenance of tire pressure is important. The agencies also agree with the consequences discussed by the commenter of incorrect tire pressure – such as higher fuel consumption for underinflated tires and higher tire wear and vibration for overinflated tires. Consistent with the comment, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520) to help encourage the better management of tire pressure in tractors, trailers, and vocational vehicles. The agencies also utilized tire pressure systems in the technology packages developed to determine the Phase 2 standards. The agencies appreciate the commenter's information on their AIR CTI system.

*Aerodynamics*

The technologies cited by the commenter, such as automatic front spoiler, trailer side skirts, small aerodynamic mirrors, and aero spats over rear wheels, are some of the technologies that the agencies considered in developing aerodynamic bins that reflect the performance of technologies like these. Additional discussion on tractor-trailer aerodynamics can be found in RIA Chapter 2.4.1 and 2.8.2.2.

**Organization:** Convoy Solutions LLC

I think I heard you mention that EPA hasn't put much emphasis on examining or projecting the EPS segment because it didn't seem very significant and because it is 'off-board'. I think that you might have mentioned that, 'a handful of independent truck stops may have invested in small amounts of EPS. But it isn't very important overall in achieving major idle reduction metrics.' [EPA-HQ-OAR-2014-0827-1281-A1 p.1]

If this is your department's position, then I feel obliged to share my own biased opinion that in our current form, IdleAir's version of EPS is at worst, an important bridge-technology to a day of more pervasive adoption of various anti-idling technologies. This 'bridge' can extend for more than 10 years. Our infrastructure is already in the process of morphing into a precursor to eTRU and EV infrastructure along major transport corridors. We are in a growth spurt where it is a struggle to keep up with demand from large fleets for dedicated IdleAir terminals on their private yards. [EPA-HQ-OAR-2014-0827-1281-A1 p.1-2]

To the extent that NACFE's 2014 Idle Alternative Confidence Report has had a significant role in informing EPA of the status of off-board idle reduction technologies, then I think I need to clarify that although we are a financial sponsor of NACFE, we have repeatedly asked NACFE to consider correcting certain items in their report relating to EPS, but these corrections have not taken place. [EPA-HQ-OAR-2014-0827-1281-A1 p.2]

#### *Interesting Comparison to APUs*

Our cost per installed electrified parking space ranges from \$5 - 10k, this is very similar to what we believe APUs actually cost (though EPA's number seems to be a surprisingly low \$4,800 figure). [EPA-HQ-OAR-2014-0827-1281-A1 p.2]

Most of our hardware is rated to last for more than 25 years as compared to 5 years for the average APU, thus our amortized marginal cost of ownership is much lower than an APU. [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

EPS has comparatively low Carbon Intensity (1lb CO<sub>2</sub> per gallon/hour of mitigation versus 4lb CO<sub>2</sub> per hour of APU usage). [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

EPS doesn't produce any local criterion pollutants (APUs do) and depending on who owns EPS it can have very low marginal operating cost (\$.25 - \$.50/hour on a fleet terminal) versus \$1/hour to operate Diesel or Battery APUs at current fuel price. If APUs were required to have DPF technology, then the \$4,800/unit price seems even more unrealistic as an assumption from which to build life-time IRRs from. [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

These EPS metrics all rival the comparable metrics on APUs, yet I don't feel like we have been given a fair chance to state our case in how we can cost-effectively help EPA and NHTSA meet their GHG goals. [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

Earlier this year, The American Carbon Registry recognized IdleAir with their Corporate Excellence award for pioneering carbon finance in the long-haul trucking space:  
<https://www.idleair.com/news/idleair-wins-award-from-american-carbon-registry/> [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

I'm concerned that the regulations themselves might jeopardize our ability to provide that meaningful transitional role for the 70% of class 8 trucks that don't have APUs of any sort today or the large audience

of used trucks - especially those typically owned by Owner Operators who tend to be slower to adopt efficiency technologies with a meaningful upfront cost. Market places try to adapt in anticipation of pending regulation, so we fear that if non-adjustable AES is expected by carriers, they may start transitioning away from impactful low GHG choices like EPS even though we are gaining momentum on private fleet yards today. [EPA-HQ-OAR-2014-0827-1281-A1 p.3]

Since more than 80% of new fleet truck purchases do include a fuel fired bunkheater, I believe that the relative window of idle-mitigating relevance for non-adjustable AES is potentially overstated in the ROI/fuel savings calculations since bunkheaters should not be considered part of the incremental cost/benefit of complying with Phase 2. Bunkheaters are essentially a standard option already. That means APUs are primarily necessary for less than 6 months of the year (typically Air Conditioning months) and thus the idle savings they bring should be calculated from less than 900 hours/year as a baseline rather than the 1,800 - 2,000 hours/year that Argonne Labs (and EPA and DOT) estimate trucks idle to generate overnight hotel loads for powering comfort and convenience. I believe that a large number of fleets can achieve compelling GHG and PM reductions at a fraction of the true cost of APUs using a combination of complimentary idle-mitigation solutions as follows: Bunkheater (40% of annual idle needs - cold weather) + EPS (25% idle needs - stationary yard and some truck stop usage) + adjustable AES (25% of idle during OTR activities). The combined upfront cost for users of these technologies is genuinely less than the \$4,800 attributed to pre-DPF APUs and the marginal carbon and PM intensity of these technologies is comparable (if not superior) to APUs, but since the technologies can't address 100% of idle elimination, truck buyers would have to get an APU if non-adjustable AES is mandated in order to avoid unacceptable comfort and safety risks posed by not having an on-board summertime idle alternative. [EPA-HQ-OAR-2014-0827-1281-A1 p.3-4]

We are currently in an unexpectedly low diesel price environment which is making the financial ROI calculation for many energy efficiency options more challenging. At the same time, services like IdleAir that typically have no upfront investment requirement for users are on their way to becoming an important idle-mitigation choice of many fleets in their private yards. Many fleets (and drivers) tell us sadly that they think that idling today is cheaper than getting an APU. Fortunately, IdleAir typically prices its dedicated fleet terminal product at an average of \$1.35/hour which is arguably less than half the lifetime cost of owning and using an APU and so we are increasingly able to convince fleets TODAY that embracing EPS can immediately pay for itself and is therefore worth doing even if APUs have a more challenging cost/benefit proposition. Since we use grid and renewable electricity as our fuel source, our 1.5kW/h service actually only costs us about \$.25/hour, which is comparable to a bunkheater and much lower than the \$.75 - \$1.00/hour that an APU costs in the current diesel price environment. As we gain market share, fleets may decide to buy EPS outright and pay for their own electrical usage. In that scenario, there is no question that we are much cheaper and cleaner than APUs in stationary applications (like poor neighborhoods with non-attainment status that frequently encircle truck stops and large fleet terminals). [EPA-HQ-OAR-2014-0827-1281-A1 p.4]

In the end, I understand that EPA and NHTSA can only regulate a manufacturer and rewarding AES is not a new concept. However, the ambitious efficiency goal of Phase 2 becomes a de facto mandate of AES. Mandating AES will force the industry towards the only solution that can address 100% of the instances where a truck might need to idle - APUs. An owner cannot risk driver (or pet) safety even one night per year under AES. This is true even for truck owners who have been able to manage nearly all of their idling with a combination of best-cost idle mitigation technologies. An APU might not be the right choice for net GHG reduction for some buyers, but I fear that this rule makes that decision for them and it risks rewarding OEMs for including APUs while neglecting alternative idle-reduction technologies. [EPA-HQ-OAR-2014-0827-1281-A1 p.4]

**Response:**

The agencies made several changes to the treatment of AES and idle reduction technologies in the final rule. We, however, did not specifically include EPS as one of the technologies on the menu of idle reduction technologies included in GEM due to the lack of data supporting the amount of idle operation that is reduced in the real world through the use of EPS on a given tractor. Tractors manufactured during the Phase 2 timeframe with either the tamper-proof AES or adjustable AESS options would receive a CO<sub>2</sub> emissions and fuel consumption reduction in GEM. EPS paired with an AESS could receive the level of reduction specified in GEM for an Adjustable AESS or Tamper-Proof AESS, depending on whether the AESS is tamper-proof or not. We recognize that EPS could be an important idle reduction technology, but believe the technology should be evaluated in the off-cycle credit program so that data on specific vehicles can be considered.

It is also worth noting that the agencies are not mandating AES under the Phase 2 rulemaking. The agencies have adopted CO<sub>2</sub> emissions and fuel consumption standards based on our analysis of *one* technology pathway for each level of stringency, but manufacturers will be free to use any combination of technology to meet the standards, as well as the flexibility of averaging, banking and trading, to meet the standards on average.

In the final rule, EPA has started with an estimated APU price of \$8,000 (retail price, 2013\$). From there, we have adjusted the cost to arrive at a direct manufacturing cost of \$5882 (DMC, 2013\$, applicable in MY2014)). So the \$4800 value mentioned by the commenter has been adjusted upward to \$5882, and should be understood to be a direct manufacturing cost which is not comparable to an installed cost of \$5-10K for an electrified parking space (which EPA interprets to be an installed price rather than cost). Our total cost for the APU, with markups and in 2018 (i.e., roughly today), is \$6248 (total cost, 2013\$ in 2018, see Chapter 2.11.6.1 of the final RIA).

**Organization:** Corwin, Michael

On the issue of aerodynamics, the truck can be made aerodynamic, regardless of the trailer it is pulling, so the regulations should be separate for the tractor and for the trailer. This would allow regulators to take into account the different types of trailers regardless of the truck that is pulling it and no matter what truck pulled it the aerodynamics would be good. The vast majority of companies pull one type of trailer vs multiple types but one truck lease operators may switch companies several times in their careers and pull a different type of trailer each time. By having the requirements separate the long term effects would be better. [EPA-HQ-OAR-2014-0827-0730-A1 p.1]

**Response:**

The agencies are setting GHG emissions and fuel consumption standards separately for the tractor and trailer. The commenter states one of the reasons it is appropriate for there to be separate standards.

**Organization:** Cummins, Inc.

*Cummins urges the Agencies to establish a more representative Phase 2 baseline gearing* [EPA-HQ-OAR-2014-0827-1298-A1 p.36]

The Phase 2 proposal provides a 2018 baseline gearing that is substantially above typical fuel economy recommendations for best efficiency. Figure 14 compares the Phase 2 baseline gearing to Cummins'

recommendations for best FE performance. While Cummins' recommendation is a minimum value, there is concern that the Phase 2 baseline may not be the appropriate representative gearing and may inadvertently over-represent gearing improvements. Cummins urges the agencies to reevaluate the baseline and establish a more representative gearing for 2018. [EPA-HQ-OAR-2014-0827-1298-A1 p.36-37]

[Figure 14 can be found on p.36 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

**Response:**

The agencies re-evaluated the final drive ratio (gearing) used in the tractor baseline. We recognize that there is a wide range of final drive ratios being offered in the market today for tractors. Several companies offer fuel economy packages that would include gearing that takes advantage of downspeeding. However, the baseline should represent the *average* tractor performance in 2018MY. Meritor and Daimler provided CBI to assist us in developing the baseline. Our evaluation of this data supported the final drive ratio of 2.7 (based on a rear axle ratio of 3.70 and top gear ratio of 0.73) used in the NPRM and the baseline for the final rule reflects this ratio.

**Organization:** Daimler Trucks North America LLC

8. Technology Penetration and Adoption Rate

• **Introductory comment** - Several assumptions are wrong about penetration rates of 6x2 axles, regulatory idle shutdown timers, and tires. And these flawed assumptions result in unrealistically difficult stringency. Based on our analysis of the agencies' assumptions regarding penetration rates of certain technologies in order to meet the proposed standards we caution against a) sweeping assumptions across multiple vehicle subcategories and b) against assuming unrealistically high penetrations, as described below. [EPA-HQ-OAR-2014-0827-1164-A1 p.86]

• **HFC Refrigerant from Cabin Air Conditioning (A/C) Systems** – The agencies request comment on other possible improvements in the design of air conditioning systems that EPA could recognize for the purposes of compliance with this proposed standard. The agencies propose to provide a credit of 0.5% for tractors with a “high-efficiency air conditioning compressor” without thoroughly defining what that is. (The agencies state that it “includes” the configurations in 40 CFR § 86.1868–12(h)(5) and electrical compressors). Most importantly, [redacted]. Rather, an improvement factor more like [redacted]% is closer to the benefits that the agencies should expect from the technologies they are proposing. Further, we think that a manufacturer should get credit for other improvements to the system rather than simply the compressor. For example, a blend air system, which minimizes pumping losses, should get credit even if it uses a standard compressor. [EPA-HQ-OAR-2014-0827-1164-A1 p.110-111]

a. Aerodynamic Improvements

**Erroneous Estimate of Time By Which Manufacturers Can Improve Tractor Aerodynamics** – In section 2.4.1 of the RIA, the agencies state that tractor model lifecycles are “up to 10 years.” This is approximately half of the correct number. The Freightliner Century, an industry benchmark for efficiency, was sold from 1996 to 2009—23 years. The successor vehicle, the Cascadia has been sold for only eight years, since 2007, so we should expect at minimum another fifteen years of production of that vehicle. And more likely, this vehicle will be in production much longer, due to the larger costs of developing so complex and advanced a vehicle. So while it is correct that radical changes to vehicle aerodynamics “occur in a long-term timeframe,” as the agencies state, we think that the statement of that timeframe



being “10-15 years from today [the date of the RIA]” is too short to reflect the industry’s actual patterns and the long time required to amortize the hundreds of millions of dollars necessary for cab redesigns. In short, the agencies need to base the penetration rate of improved aerodynamics on a much longer timeframe for adoption; the aero improvements take much longer than the agencies expected. [EPA-HQ-OAR-2014-0827-1164-A1 p.87]

**Improvements Possible** - In section 2.4.2.1.4 of the RIA, the agencies state that there are 206 to 460 counts of drag available for improvement on vehicles, based on National Research Council (NRC) of Canada research. But of utmost importance is the baseline. While it may be the case that there were up to 460 counts of drag available on the vehicle that NRC used for its analysis, it is not necessarily the case that the same opportunities exist on vehicle that meet the agencies’ 2017 GHG/FE standards. In fact, as we found in our Super Truck work at Daimler, there are diminishing opportunities on the tractor. Rather we found most of the aerodynamic benefits of our work on the trailer. Moreover, even if all of the drag improvements are theoretically possible, there may be impediments to implementing them all, such as reliability concerns, limitations on accessing the back of cab, etc. [EPA-HQ-OAR-2014-0827-1164-A1 p.88]

Preface: As discussed elsewhere in the EMA comments, the agencies’ assumptions about 1) achievable aero bins for various vehicles are impossibly aggressive and 2) the percent penetrations in each bin are unrealistic. For example, Super Truck vehicles would be in Bins IV or V at best, as opposed to the expected Bin VII, which means that the expectation of (e.g.) 5% penetration in Bin VII is unrealistic, given that Super Truck vehicles are the best vehicles ever made and even then are mere prototype vehicles. The basic idea behind both proposals is to correct the aero bins by approximately one bin width, which rectifies the agencies’ error. [EPA-HQ-OAR-2014-0827-1164-A1 p.56]

For penetration rates used in standard setting, we propose to keep the same weighted-average for the penetration rates in each bin as the agencies assumed in the NPRM. That said, we do not believe the agencies’ proposed penetration rates in each bin are realistic, given that we expect that there will always be Bin I vehicles, because there are market needs (e.g., severe duty tractors that do not get classified as “heavy-haul tractor” for whatever reason). If this is the case, then the agencies cannot just take the penetration rates in Tables III-8, -9, and -10. The agencies may, however, keep the same average. One should not be concerned about the actual penetration rates in any bin. Rather, one should be concerned with the average. [EPA-HQ-OAR-2014-0827-1164-A1 p.58]

This proposal is based on the expectations that 1) there will remain some small need for classic styled vehicles in the future, for example for logging where large cooling packages are needed; 2) we cannot shift all vehicles right away to (for example) Bin VI; 3) Bin VII may never be achievable, but remains an aspirational target only, and thus should not contain a large penetration rate. The result is that in 2021, we would need to average the middle of Bin V, 2024 the bottom of Bin V, and 2027 Bin VI. Clearly, given that the agencies recognize it may not be possible to do better than Super Truck, it would be unreasonable to have the whole target fleet average be below Super Truck level (meaning at 5.3 m<sup>2</sup> on Cd\*A basis, after the inclusion of a safety margin, or approximately 5.0 m<sup>2</sup> based on test data). Therefore, we think that the above proposal shows the maximum possible achievable aero improvement, based on our knowledge today.[EPA-HQ-OAR-2014-0827-1164-A1 p.58]

**Day cab high roof:** for day cab, we expect that vehicles have different bin designations than sleeper because (generally speaking) it is more difficult to make a short vehicle aerodynamic than it is a similar, long vehicle. So we would adjust the bin definition so that 1) a classic vehicle is in Bin I, 2) the standard setting vehicle in Phase 1 is in Bin III, and 3) future production vehicles would be in Bins IV, V, and VI, and 4) Bin VII reserved for something that looks like Super Truck without a sleeper. But even if we

properly aligned the bin definitions per #1-4 above, the day cab market might reasonably choose a penetration rate with less aerodynamic vehicles, given the lower percentage of the time spent at highway speeds. In other words, we would dispute the EPA's assumption of the exact same penetration rates in each bin for day cabs as for sleepers. So 5) we should adjust the average of the penetration rates so that the average is somewhat worse than the EPA's proposed average in Tables III-8, -9, and -10. [EPA-HQ-OAR-2014-0827-1164-A1 p.59]

Below are the landmarks that we used in setting our proposed aero bins for high roof Class 7/8 day cabs: [EPA-HQ-OAR-2014-0827-1164-A1 p.59]

[Tables, listing Cd\*A values for various vehicle types and giving BIN numbers for the EPA and DTNA proposals, can be found on p.59-60 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

**Mid- and low-roof, day cab and sleeper** - And we agree with the first step that the agencies took in calculating the penetration rates for mid-/low-roof in 2021 and 2024: they carried over the high-roof penetration rates and the high- to mid-/low- transition methodology. But the agencies missed the crucial second step: adjusting the average bin down (meaning toward Bin I) in recognition of the fact that mid-/low-roof vehicles should have lower penetration rates of aerodynamic vehicles to reflect market needs. That is, for tractors more likely to be used in rough environments or hauling non-aerodynamic trailers, it does not make sense to apply an equivalent aero bin penetration rate as for the high-roof, more aerodynamic, more on-highway vehicles. Furthermore, when we look at 2027, Table III-10, we see an additional problem: Bin VII in raised-roof gets a vehicle into mid-/low-roof Bin IV, and Bin VII is supposed to be unattainable or attainable by only 5% of the market, yet the agencies propose 10% of the mid-/low-roof vehicles be Bin IV (Super Truck equivalents). Considering how much less this portion of the market is affected by aero, this assumption is the wrong direction. So 2027 penetration rates have to be [redacted] using the general procedures described above. [EPA-HQ-OAR-2014-0827-1164-A1 p.60]

a. Tractor Stringency

· **Method of Setting Standards** - The agencies propose to set standards for tractors (and vocational vehicles) by estimating the Fuel Consumption Reductions (FCRs) for various technologies and calculating the achievable penetration rates for each technology. We agree with this approach (although as we discuss below, we do not agree with all of the FCRs or penetration rates). It does not make sense to assume a 100% penetration rate of any technology, even aerodynamic features, given that vehicles have different uses for which some FE technologies do not make sense. [EPA-HQ-OAR-2014-0827-1164-A1 p.68]

· **The Agencies' FCRs and Penetration Rates Create Unrealistic Stringency Targets** – DTNA analyzed the agencies' assumptions based on the original aero numbers in the NPRM and our understanding that the agencies would fix a one bin error in the aero binning. Our findings are that the standards of even Alternative 3 are impracticably stringent. Below are several scenarios—none of which we are certain we can achieve, and all of which would take years of major development work to achieve—to demonstrate how unrealistically stringent the agencies' Alternative 3 proposal is. [EPA-HQ-OAR-2014-0827-1164-A1 p.68]

[multiple bullet points redacted]

Below, for reference, we show the same analysis but with the NPRM's aero bin designations:[much of following section is redacted] [EPA-HQ-OAR-2014-0827-1164-A1 p.69]

[redacted]

As can be seen, even our best vehicles with a host of unrealistic assumptions cannot achieve the standards. [EPA-HQ-OAR-2014-0827-1164-A1 p.70]

[redacted]

· Here we repeat the analysis for day cabs. We assume that the aero bin problems are solved so that a current vehicle might be in Bin IV and future vehicles might get (on average) in Bin V—again a big assumption as this requires 1) fixing the aero binning and 2) manufacturers being able to make further aero improvements within the limitations of the Bridge Law and the weight constraints, which are much more stringent for day cabs. [EPA-HQ-OAR-2014-0827-1164-A1 p.71]

· Results if we do not assume that the agencies correct the aero bin numbers are shown below: [EPA-HQ-OAR-2014-0827-1164-A1 p.71]

[redacted]

· **Result** – Only by correcting the aero bin errors do we get close to compliance. And then, only by making unrealistic assumptions of FE technology penetration rates can we see achieving the proposed standards of Alternative 3. Therefore, we believe that Alternative 3 is beyond the “greatest degree of emission reduction achievable” (quoting CAA § 202(a)(3)(A)). Note that this is the analysis for our best vehicles; for the other RSCs that contain vehicles focused on more vocational tasks, such that FE is a lower priority, the standards are even more difficult. Important note – We were unable to do such an analysis for vocational vehicles because of the lack of clarity about the normalization and equalization processes. We cannot understand how those regulations will affect us without the agencies clearing up problems in those processes. [EPA-HQ-OAR-2014-0827-1164-A1 p.72]

**Vehicle technologies, their FCRs, and achievable penetration rates for setting stringency** - The agencies omitted several very important fuel saving technologies (e.g., eCoast, TPMS). If the agencies have concerns about these technologies, then we should address them and count them in Phase 2. For example, if the agencies have concerns about TPMS, then we can document the actual fuel savings and can perhaps agree upon a method of locking in TPMS improvements. Similarly, the aggressive assumptions about tire Crr's are beyond our capabilities; we do not control tire design and development. [EPA-HQ-OAR-2014-0827-1164-A1 p.74]

**Achievable Improvements in Aerodynamics is Poorly Defined** – In section 2.4.2.1.4 of the RIA, the agencies state that there are 206 to 460 counts of drag available for improvement on vehicles, based on National Research Council (NRC) of Canada research. But of utmost importance is the baseline. While it may be the case that there were up to 460 counts of drag available on the vehicle that NRC used for its analysis, it is not necessarily the case that the same opportunities exist on vehicle that meet the agencies' 2017 GHG/FE standards. In fact, as we found in our Super Truck work at DTNA, there are diminishing opportunities on the tractor. Rather we found most of the aerodynamic benefits of our work on the trailer. [EPA-HQ-OAR-2014-0827-1164-A1 p.61-62]

b. Tires

· **The agencies project unrealistically low Crr's and in turn come up with unrealistic stringency values** – We recommend that the agencies work with our end-of-year reports to see trends like are shown

in the data below. [EPA-HQ-OAR-2014-0827-1164-A1 p.88] [The table 'Tire Crr's for MY 13 and 14 vehicles' can be found on p.88 of docket number EPA-HQ-OAR-2014-0828-A1]

In short, the agencies made identical assumptions for tire rolling resistance targets across all tractor subcategories despite the vehicles' differences. Specifically, based on our GHG vehicle data it is evident that there are clear trends when comparing average CRRs of individual subcategories. There is a distinct Crr increase going from high roof to low roof sleepers and there is also a noticeable difference from sleeper cabs to their corresponding day cab categories. We believe that these real world trends need to be taken into consideration when setting the Phase 2 standards; fleets have actual needs for wear-resistant tires for their business. As we project toward the future, we see that in most RSCs, the agencies assumed Crr's to decrease from today's actual values by unrealistically large amounts—up to 22%. It is not at all clear that this is possible for tires that still allow work trucks to get into and out of worksites, to turn and bump curbs, to run over obstacles, etc. as HDVs must. In short, we need to work extensively with the agencies to define realistic Crr targets. [EPA-HQ-OAR-2014-0827-1164-A1 p.88-89]

[redacted section]

c. 6x2's

**· Gross overestimate of the possible penetration rate of 6x2's (unless NHTSA and Canadian provinces change the laws)** - The agencies' assumptions of penetration targets of 6x2 tractors are inconsistent with the laws in the US and Canada, and they will lead to tractors that are unusable in many states and provinces during inclement weather. In our tractor population we can see a 6x2 penetration of less than 5% and insurmountable barriers to increasing that value—which makes a 60% penetration for Class 8 High Roof Tractors in 2027 unachievable. It is important to remember that going from a 6x4 to a 6x2 tractor is anything but a clear cut decision. There are many factors involved, for example concerns about 1) the inherent rapid tire wear on the drive axle and 2) the practical inability to drive 6x2's in several US states because of the traction issues and the limited ability to shift loads onto the drive axle enough to get traction, 3) the inability to drive 6x2's in one province at all, given that 6x2's are prohibited at weights at which heavy-duty vehicles often operate. Ultimately, there are a lot of issues to be resolved before 6x2's can be used by any more than a niche portion of the heavy-duty fleet, and the agencies should not premise regulations on a high penetration rate of a technology that faces such legal obstacles. Until 1) the US agencies, in particular NHTSA, create an allowance to briefly overload a 6x2's drive axle for traction purposes and 2) the Canadian government allows 6x2's in all provinces with temporarily shifted weights, the agencies should not predicate a rule on such a high penetration rate. [EPA-HQ-OAR-2014-0827-1164-A1 p.89]

[The table '6x2 & WBS Tire Compliance - Current Status' can be found on p.90 of docket number EPA-HQ-OAR-2014-0828-1164-A1]

For reference, below are our penetration rates for the various regulatory subcategories and axle configurations. For example, 6x2 is [redacted] of the total population of RSC14 vehicles, Class 8 high-roof sleeper cab tractors. Included with these numbers are the percentages of total sales that each RSC constitutes, so that the agencies can see that (for instance) [redacted] of sales in RSC09 is of little importance given that that RCS constitutes only [redacted] of total sales. Even though our customer base is extremely concerned with fuel efficiency and understands the benefit of 6x2 technology, we see that approximately [redacted] of sleeper customers and less than [redacted] of vocational customers choose 6x2's - likely because of the difficulty in operating those vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.90]

[redacted section]

- **EPA and NHTSA proposals for 6x2 penetration rates are inconsistent with many states' laws:** the EPA and NHTSA should only push such a high 6x2 penetration rate if the agencies can change the laws such that 6x2's may be used legally [redacted] in all 50 states and in all Canadian provinces. [redacted] Moreover, many Canadian provinces prohibit the axle loading [redacted], and British Columbia prohibits 6x2's altogether. Because heavy-duty vehicles must be designed for cross-country operation in all 50 states and in Canada, the EPA and NHTSA's use of 60% penetration of a technology is inconsistent with the technology's being unusable or impractical to use in more than 10% of the states and provinces. The agencies, particularly NHTSA, have the authority to affect US laws on 6x2 usages, but until the agencies do so, they are mandating a high penetration rate of a technology that cannot actually be used. We recommend no more than a 5% penetration rate until the laws change. [EPA-HQ-OAR-2014-0827-1164-A1 p.86-87] Note that we are not discussing penetration rates in this table. So, for example, we do not question 6x2 FCR of 2.5% although we think that the 60% penetration rate is impossibly high. [EPA-HQ-OAR-2014-0827-1164-A1 p.86]

d. AES

**FCR of APUs or Other Idle Reduction Devices** - The agencies, recognizing that many idle-reduction devices are installed in the aftermarket after a truck manufacturer has sold a vehicle, request comment on other approaches that would appropriately quantify the reductions that would be experienced in the real world besides requiring that the vehicle manufacturer install an idle-reduction device in order to get credit. 80 FR 40224. We agree that manufacturers should get idle-reduction credit for vehicles that clearly do not idle, whether because they have shutdown timers or because they have APUs and the like--in either case, it is clear that the vehicle will not idle. Why would a vehicle owner spend more than thousands of dollar on an APU or the like if he intended to idle frequently? Likely he intends to idle very rarely, thus making the technology worth the cost. If he does happen to order no shutdown timer, there might be a reason, like an occasional job where he needs to idle. But he still clearly intends to do so rarely and thus should be credited accordingly. [EPA-HQ-OAR-2014-0827-1164-A1 p.79]

- **Regulators Should Credit Normal AESs** - Customers almost all take non-regulatory idle shutdown timers of such short duration as to prevent overnight idling, yet none of them will take the regulatory kind. Yet the EPA premises its standards on 80 to 90% penetration of APUs (which the agency uses as equivalent to AESs). We think that this level is unrealistically high, given the agency's experience. If, however, the agency insists on such a high penetration rate, then we have a proposal below for making the AES requirements more realistic. Additionally, we think that the APU costs that the agency used are an order of magnitude too low: APUs cost [redacted], and if the penetration rate is near 100%, then the average cost will be around [redacted]. Yet the agency assumes approximately \$2,000 (see, e.g., Table III-29). [EPA-HQ-OAR-2014-0827-1164-A1 p.91]

[redacted table]

Table showing the take rate of non-regulatory AESs in each RSC and the sales percentage that each RSC constitutes (the latter of which helps explain why a [redacted] take rate of AESs in RSC10 is nearly irrelevant, given the [redacted] sales percentage). As can be seen well over 90% of the primary sleeper category, RSC14, takes AESs—but the agencies do not recognize this in their regulations, either today or in Phase 2. [EPA-HQ-OAR-2014-0827-1164-A1 p.91]

- **Proposal for Crediting Normal AESs** – Based on an analysis of our database, looking for the number of customers who chose a non-regulatory AES at or below 5 minutes and then subsequently

disabled it, we find that nearly 99% had not done so. Approximately 1% of our EPA10 engines (manufactured in calendar years 2010/2011/2012) that were initially programmed with a shutdown timer of 5 minutes or less were reprogrammed to a value above 5 minutes or for complete deactivation. This low rate of reprogramming is understandable: why would a person voluntarily buy an item only to disable it? The only AESs that we expected would be disabled would be the regulatory ones if customers were forced into them. In light of the facts that most customers buy AESs, that the agencies would like to take credit for AESs in the fuel or GHG savings, that manufacturers work hard to produce (non-regulatory) AESs that function well and meet our customers' fuel saving needs while not interfering with their operations, and that customers rarely disable the AESs, DTNA proposes that the agencies credit non-regulatory AESs at 95% of the value of a regulatory one—a little less than the fraction of AESs that remain functional today. We would agree that, in our 270 day end-of-year reports, we would report to the agencies the AESs that remain active, so that the agencies can be sure we are not gaming the system by enabling AESs as vehicles leave the manufacturing plants and disabling them shortly afterward. Following this approach the agencies could claim the targeted savings while avoiding unintended market disruptions. [EPA-HQ-OAR-2014-0827-1164-A1 p.91-92]

e. APUs and Other Idle Reduction Technology

- **Credits for AESs, Regardless Whether a Vehicle Has an APU** – The agencies discuss idle reduction technology on 80 FR 40223. The goal of reducing fuel consumption during idle can be done through different technologies such as APUs, diesel fired heaters, and battery powered units. The agencies discuss as adopted in Phase 1 of only allowing idle emission reduction technologies which include an automatic engine shutoff (AES). We believe that this is the correct approach. In other words, we believe that that an AES should receive credit if it installed, regardless if there is an APU or battery-powered idle reduction system on the vehicle. Therefore, we recommend the agencies clarify that they recognize this technology as a stand-alone system and provide credit for an AES but no APU on a vehicle. [EPA-HQ-OAR-2014-0827-1164-A1 p.92]
- **Cost of APUs With and Without DPFs** – The agencies request comment on the cost estimates associated with DPF systems for APUs. As a preface to this comment: the agencies far understated the cost of APUs generally. First, APUs were estimated to cost on the order of \$3,000 (which is the listed figure, back-calculating for penetration rate). See III-29 of the NPRM, 80 FR 40241. In reality, APUs are approximately [redacted]. And the DPF-equipped APUs are [redacted] more expensive (depending on the options selected) than the equivalent non-DPF equipped APU. The agencies should consider the accurate final cost of the APU with DPF as in the end the heavy-duty vehicle owner will be forced to bear the price difference. [EPA-HQ-OAR-2014-0827-1164-A1 p.92]

Second, some of the crucial assumptions in GEM are flawed. For example, the agencies assume a flawed value for the effectiveness of an automatic engine shutdown timer (AES). Below are the values for several configurations of AES and auxiliary power unit (APU): [EPA-HQ-OAR-2014-0827-1918-A2 p.1-2]

- o Non-regulatory AES: 1%
- o Non-regulatory AES plus APU: 3%
- o Regulatory AES plus APU: 4%
- o Non-regulatory AES plus battery APU: 5%
- o Regulatory AES plus battery APU: 6%

As we have shown the agencies, data demonstrates that vehicle owners rarely disable even the non-regulatory AESs, which means that the system will shut down the engine in five minutes or less

(depending on the setting). So the non-regulatory AES will prove effective at shutting down an engine and stopping emissions, unless the driver of a vehicle equipped with an AES stays awake throughout the night to restart his engine or to reset the timer. In fact, to make it such that the non-regulatory AES were (for example) only 1/5 as effective as a non-regulatory AES plus battery APU, the driver would have to restart or reset such that the engine runs for an average of 48 minutes of every hour that the AES and APU functions, meaning he restarts or resets more than nine times per hour for a whole night every night, which is exceedingly unlikely. Rather, the non-regulatory AES is a relatively cheap and effective way to ensure nearly all—if not all—of the emission reductions of all the other configurations listed above, so it should get approximately the same credits; it certainly should not get so small a fraction as the agencies have proposed to give it. [EPA-HQ-OAR-2014-0827-1918-A2 p.2]

f. VSLs

- **Vehicle Speed Limiters and Extended Idle Provisions** - The agencies requested comment on whether it is appropriate to allow vehicle owners to participate in the overall compliance process for vehicle speed limiters and idle reduction. 80 FR 40250. First, we are glad that the agencies recognize the difficulties that manufacturers such as ourselves have encountered trying to push regulatory-compliant VSLs and AESs to a pull market. The agencies discussed the possibility of a means by which fleets could participate in the credit transactions. If the agencies were to follow such a path, then we would need to ensure that regulatory VSLs and AESs factor only into a program regulating fleets and not manufacturers. In other words, if vehicle buyers can choose to buy regulatory VSLs or AESs, and they get the credit for doing so, then manufacturers cannot be expected to accumulate credits for such VSL or AES sales. Rather, in such a case, the vehicle standards would have to be calculated without such features included. Because such a regulatory program is likely unwieldy (How would fleets be regulated? How would their interaction with vehicle manufacturers be regulated?), and because the agencies do not have authority over fleets within the scope of the CAA or EISA sections cited within the NPRM (given that those sections authorize vehicle and engine regulation, not regulation of vehicle users), it is more likely that the agencies will be limited to regulating vehicle features. In that respect, we applaud the agencies' recognition that the Phase 1 AES and VSL standards failed to capture the usage of those two features. In discussions with the agencies, we have presented the option of getting a partial credit for non-regulatory AESs and VSLs based on the rate at which customers leave the features in their operational states. We can show the agencies in a confidential setting that [redacted]. We work hard to make fuel saving features like AESs and VSLs that fleets and vehicle operators will buy; we should get credit for such work. [EPA-HQ-OAR-2014-0827-1164-A1 p.92-93]

- **Vehicle Speed Limiters and Extended Idle Provisions** - The agencies discuss the difficulties of getting heavy-duty vehicle owners to accept regulatory, tamper-resistant VSLs and AESs. 80 FR 40250. The agencies request comments on suggestions how to close the gap between provisions that would be acceptable to industry, which seeks to retain control over its vehicles' operations, and those that would be acceptable to regulators, who seek to ensure that society gets the benefit of speed limiters and decreased idling. Additionally, the agencies request comments on potential approaches which would enable feedback mechanism between the vehicle owner/fleet that would provide the agencies the assurance that the benefits of the VSLs and AESs will be seen in use but which also provides the vehicle owner/fleet the flexibility they may need during in-use operation. As a preface to our comments, we note that our customers overwhelmingly buy AESs and to a lesser extent VSLs. (See the statistics in the VSL and AES table, above). Although we have a large portion of vehicles sold with VSLs that achieve emission reductions and FE benefits, these VSLs do not get regulatory credit because they do not meet the regulatory requirements. HDV owners and fleets want to limit speeds and idling, but they do not want to be locked into a strategy. So our comments revolve around the fact that we wish to get credit for the owners' and fleets' purchases, largely because we have developed AESs and VSLs that meet with a high

level of customer approval, without locking our customers into the agencies' requirements. We recommend that the agencies give partial credit for non-regulatory AESs and VSLs in proportion to the fraction of non-regulatory ones that remained unaltered, based upon our study of our database. Since the introduction of our latest generation of engines we are able to effectively track parameter changes in our proprietary control modules (controllers for vehicle, engine and aftertreatment). [EPA-HQ-OAR-2014-0827-1164-A1 p.93]

- **VSL** – In section 2.8.3.5 of the RIA, the agencies note that there is such low take-rate of regulatory VSLs that the technology should not be used for standard setting. We agree. We do think, however, that if the agencies were to credit adjustable VSLs—recognizing heavy-duty vehicle operators' desire for speed reductions but balancing the need to adjust the speeds from time to time—that the technology could factor into standard setting. 2.8.3.5 of the RIA. [EPA-HQ-OAR-2014-0827-1164-A1 p.93-94]

- **Hybrid timeline for deployment** - The agencies requested comment from industry on the projected timeline for deployment of hybrid powertrains for tractor applications. DTNA is especially situated to comment on hybrids as we had sold hybrid vehicles (mostly vocational vehicles), and we were the sole Super Truck team to use a hybrid system, yet we dropped out of the hybrid market after our hybrid transmission supplier stopped selling the systems. Our response to the agencies' request is that we see no timeline for deploying hybrids in tractors or, for that matter, any heavy-duty vehicles. Quite the opposite: the market for hybrids has fallen apart, as hybrids have proved not cost-effective. In Super Truck, a tractor that was tested largely (but not entirely) on linehaul-type highway routes, the hybrid system provided little benefit beyond what eCoast achieved. See the figure below. The reason for this is that an eCoast system competes with hybrids for energy that might be lost on hills (given that linehaul vehicles spend almost all of their time on highways, rather than in stop-and-go traffic). But eCoast does not suffer the energy conversion loss that a hybrid does when the hybrid converts mechanical energy to electrical and back. Moreover, the hybrid was limited in both the energy that could be stored in the batteries and the power at which the batteries could be charged. When laden the vehicle inertia was so large that braking events could return to much power to be stored in our Super Truck batteries. This was with the Super Truck vehicle loaded to 65,000 lb. If the vehicle were at 80,000 lb., the problem would be worse. In other words, eCoast proved a 'poor man's hybrid,' meaning a far more cost-effective hybrid, optimizing energy transfers from potential to kinetic and vice versa much more efficiently and cheaply than the hybrid system did. Plus eCoast is much cheaper and lighter, as it requires no batteries or motors. So we expect no deployment—or more appropriately re-deployment—of hybrid vehicles in the foreseeable future. [EPA-HQ-OAR-2014-0827-1164-A1 p.96]

[The table 'Energy Consumption on Highway Route' can be found on p.96 of docket number EPA-HQ-OAR-2014-0828-1164-A1]

Analysis of DTNA Super Truck performance demonstrating that predictive technologies such as Predictive Cruise Control and eCoast, which help to minimize brake usage, provide essentially all of the FCR benefits of hybridization, which requires much hardware, weight, and cost to regenerate brake energy.

#### j. Stop-Start Functionality

- **Start-Stop Technologies (Engine Risks)** - EPA requests information regarding whether or not start-stop or auto-shutdown technologies are being developed for tractors; especially for Class 7 and 8 day cabs that could experience more frequent stops and more time parked for deliveries. To date, DTNA has not validated that stop-start strategies are viable for Class 7 and 8 applications and considers it premature to for EPA to include in its assumptions that stop-start strategies are viable for this class of engines.



Lubrication of critical bearing surfaces is lacking or severely compromised during engine start up due to the lack of lubricating oil pressure. Lack of proper lubrication leads to metal to metal contact, wear, and ultimately failure. In addition, firing pressures inherent to compression ignition engines further exacerbate wear as compared to, for example, spark ignition engines where stop-start technology is being increasingly applied. These known problems, coupled with the extremely long million mile plus service life expectations for this heavier class of heavy-duty engines, together pose a development challenge that is significantly more challenging than that posed to spark ignition engines in passenger cars. In addition to bearing lubrication during startup being a critical function of engine lubricant, lubricant also plays an important role in cooling of components. Heat soak of temperature critical parts and temporary disruption of their lubrication/cooling systems (ex: turbochargers, engine valve train) will have to be understood and possible degradations handled through modifications at either component or system basis, the extent of which is not yet fully quantified. Similarly, on the turbocharger side, the larger speed swings (theoretically all the way from engine 'off' to normal over the road operation) will shorten turbocharger wheel life, which is increasingly challenged in vocational applications that are characteristically more transient as compared to the relatively steady operation nature of line haul. Lastly, the design life targets (and associated costs) of today's starter systems fall far short of what may be to be required for ISS systems. In short, there are a lot of significant hardware issues to be resolved before stop-start can be considered "achievable" for use in setting standards. Even if stop-start is achievable, there remains significant uncertainty about its achievable penetration rate. For example, vocational vehicles generally have a significant need for launch capabilities, given how frequently they stop and start and the variety of conditions under which they must do it (for instance, on hills). Meanwhile, although passenger car stop-start system works quite well, rotational inertia inherent to heavy duty engines there are orders of magnitude greater than passenger car engines and pressure (fuel, charge air) build-ups that must occur before the vehicle can pull away from the curb differ significantly. The subsequent compromise to launch capability may ultimately be unacceptable in many applications from a performance standpoint which would lead to lower penetration either via disablement of the feature or rejection of the option. Lastly, it is not uncharacteristic of vocational applications to be laden with equipment that requires idling of engines to sustain system power draw and avoid excessive storage battery drain. The EPA should work with DTNA to establish a clear understanding of actual application needs that justifiably may diminish penetration rates. [EPA-HQ-OAR-2014-0827-1164-A1 p.98]

## 9. Standards for niche vehicle types

### i. Heavy-Haul Vehicles

- **Proposed Heavy-Haul Tractor Standards** - The agencies request comment on the approach of not considering the use of aerodynamic technologies in the development of the proposed Phase 2 heavy-haul tractor standards. 80 FR 40233. We think that this is appropriate. These are vehicles that are already quite heavy (by virtue of need), designed to meet high cooling need (thus having, for example, large grilles), and generally not designed primarily for hauling standard trailers on highways. In addition, these are often designed to be capable of operation off road or on difficult terrain. So mandating aerodynamic values (which pushes manufacturers toward smaller grilles) or aerodynamic components (which are often unsuitable for difficult terrain) could compromise the vehicles' work. [EPA-HQ-OAR-2014-0827-1164-A1 p.99]
- **Proposed Heavy-Haul Tractor Standards** - The agencies request comment on the heavy-haul tractor technology path and standards proposed by the agencies (Tables III-19 and -20). 80 FR 40234. First, we think that the agencies are correct not to require manufacturers input into GEM the heavy-haul vehicle's Cd\*A or aero bin. These vehicles are designed for hauling large and heavy loads, so they require large radiators, which forces non-aerodynamic designs. Moreover, the loads may often be much larger

than the vehicles, so that requiring aerodynamic measurements of a vehicle that will haul loads dramatically interfering with those aerodynamics does not make sense. [EPA-HQ-OAR-2014-0827-1164-A1 p.99]

Second, we believe that the agencies have set overly aggressive tire Crr targets. Heavy-haul vehicles need unusually high traction, given their loads. Moreover, they need unusually high stopping power. Assuming such aggressive reductions in Crr's as the agencies do is not supported by what we currently know about tire manufacturers' capabilities to minimize the Crr's of such heavy duty tires. Third, we think the agencies are correct in assuming no weight reduction in these vehicles. These vehicles need strong frames, axles, etc. in order to carry such heavy loads. Rather than reducing weight, it is consistent to expect that manufacturers will reinforce components as much as is necessary.[EPA-HQ-OAR-2014-0827-1164-A1 p.100]

- **Weight reduction credits generally:** Phase 2 should involve a better approach to calculating and crediting vehicle weight than Phase 1. In Phase 1, GEM assumes a fixed vehicle weight then subtracts weight for items made of low density materials (e.g., aluminum) to arrive at any given vehicle's simulation weight. It may be possible to accurately correct for the amount of weight saved when 1) a low density material is a direct replacement for a high density material and 2) both are of a known volume or weight. However, in other cases the mere use of a low density material does not translate directly into, nor necessarily even correlate with, a weight savings. For example, use of aluminum wheels in lieu of steel ones results in a well-known weight savings. By contrast, use of aluminum in cross members or suspension components does not necessarily result in known weight savings since, to achieve equivalent strength aluminum components generally need to be larger such that weight may actually increase. More generally, crediting individual components that are not one-for-one replacements for another, as EPA proposed to do with a 300 lb. weight credit for engines below 14 liters, is inappropriate: by contrast to aluminum wheels, which are nearly direct replacement for steel ones, swapping one engine for another forces different engine mounts, transmissions, etc. which may or may not have weight advantages. [EPA-HQ-OAR-2014-0827-1164-A1 p.52]

DTNA engineers have done benchmarking studies to identify any weight advantages of its products or areas to investigate for future improvements. In one such case, DTNA compared three vehicles: vehicle A, a 2014 Freightliner Cascadia with a 72 inch raised-roof sleeper, DD15 (15 liter) engine, and DT12 transmission; vehicle B, a concurrently sold competitor vehicle with 73" raised-roof sleeper, a 13 liter engine, and a leading brand of transmission; and vehicle C, also a concurrently sold competitor vehicle with 72" raised-roof sleeper, a 13 liter engine, and the same transmission as vehicle B. The vehicles were configured to be as close as possible in specification given the different manufacturers. Despite the larger displacement of vehicle A's engine, that vehicle was lighter than B and C by 1,004 and 644 lb. respectively. The result of a program that rewards lightweighting credits based on certain specifications such as engine displacement could be that heavier vehicles will receive lightweighting credits that may not be warranted, which seems misaligned with the intent of the regulation. In addition, such an approach would overlook a manufacturer's efforts to lightweight a particular engine platform (with the same displacement). Until the EPA has developed a robust procedure for extrapolating from the weight of individual components to a full vehicle, the EPA should seek to credit components only where they are direct replacements of well-known weight savings, (e.g. wheels), but not others. If the rulemaking seeks to truly credit and incentivize lightweighting, an integrated approach may be the best solution. However, such a solution comes with other tradeoffs, such as the effort of developing a robust measuring standard and additional compliance burden to manufacturers. 80 FR 40249. [EPA-HQ-OAR-2014-0827-1164-A1 p.52]

- **Weight Reduction Items That Are Missing From The Agencies' Approach** – The agencies propose to credit vehicles with use of low density materials, regardless of the amount of material used, but the agencies fail to credit vehicles for decreased use of material altogether. NACFE recently studied weight-reduction options for HDVs and found that, for example, horizontal exhausts save 150 pounds over vertical exhausts. We have encouraged our customers to choose these items for years because of the weight savings. The agencies should similarly recognize the weight savings. Similarly, opting for a short sleeper rather than a full one, smaller fuel tanks than were used in the past, a short Bumper to Back of Cab (BBC) vehicle, etc., should get weight reduction credit. In short, we wish to work further with the agencies to make sure that the agencies' lightweighting credits align with actual vehicle weights. [EPA-HQ-OAR-2014-0827-1164-A1 p.53]

- **Weight reduction** – In section 2.8.3.3 of the RIA, the agencies note that there is such high cost and low benefit to weight reduction that weight reduction should not be used for standard setting. We agree. RIA 2.8.3.3 [EPA-HQ-OAR-2014-0827-1164-A1 p.53]

**NGV weight penalty in GEM:** DTNA analysis shows that for the most popular sizes of NG tanks, 120 and 160 diesel gallon equivalent, the NG system is between 1500 and 2100 lb. heavier than the diesel systems. This analysis includes the weight of the diesel aftertreatment, which is not required with NG. Therefore, the 800 lb weight penalty for NGV in GEM is too low. 1037.520(e)(4)(iv). [EPA-HQ-OAR-2014-0827-1164-A1 p.100]

**Response:**

*A/C Systems*

We are interpreting Daimler's comment related to HFC emissions in air conditioning systems to be related to A/C system efficiency, not to an HFC issue. The agencies received several comments on the potential efficiency improvements of accessories. We are adopting as proposed the definition of what qualifies as a high efficiency A/C compressor. In terms of the level of effectiveness of compressors, we are also adopting the 0.5% effectiveness in GEM. Effectiveness of other types of accessory technologies may be demonstrated by manufacturers through the off-cycle provisions.

*Aerodynamics*

The agencies corrected the lifetime of tractors in RIA Chapter 2.

The agencies' assessment is that the best aerodynamic tractor tested by EPA in 2015 achieved Bin IV performance. This vehicle did not include all of the possible aerodynamic technologies, such as wheel covers or active aerodynamics like a grill shutter or front air dam. Thus, the agencies' assessment is that Bin V is achievable with known aerodynamic technologies, as discussed in RIA Chapter 2.8.2.2, but agree with the manufacturers that Bins VI and VII have less known technology paths. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2 program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so.

In Phase 1, the agencies determined the stringency of the tractor standards through the use of a mix of aerodynamic bins in the technology packages. For example, we included 10 percent Bin II, 70 percent Bin III, and 20 percent Bin IV in the high roof sleeper cab tractor standard. The weighted average aerodynamic performance of this technology package is equivalent to Bin III. 76 FR 57211. In

consideration of the comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ , as discussed above and in RIA Chapter 2.8.2.2. Consequently, the final standards are not premised on any adoption of Bin VI and VII technologies. Accordingly, we determined the adoption rates in the technology packages developed for the final rule using a similar approach as Phase 1 - spanning three aerodynamic bins and not setting adoption rates in the most aerodynamic bin(s) - to reflect that there are some vehicles whose operation limits the applicability of some aerodynamic technologies. We set the MY 2027 high roof sleeper cab tractor standards using a technology package that included 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors that we project could successfully apply these aerodynamic packages with this amount of lead time. The weighted average of this set of adoption rates is equivalent to a tractor aerodynamic performance near the border between Bin IV and Bin V. We believe that there is sufficient lead time to develop aerodynamic tractors that can move the entire high roof sleeper cab aerodynamic performance to be as good as or better than today's SmartWay designated tractors.

The agencies phased-in the aerodynamic technology adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies. The changes required for Bin V performance reflect the kinds of improvements projected in the Department of Energy's SuperTruck program. That program has demonstrated tractor-trailers in 2015 with significant aerodynamic technologies. For the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing some of these aerodynamic technologies on high roof tractors as early as 2021 MY on a limited scale. For example, in the 2021 MY technology package, the agencies have assumed that 10 percent of high roof sleeper cabs will have aerodynamics better than today's best tractors. This phase-in structure is consistent with the normal manner in which manufacturers introduce new technology to manage limited research and development budgets as well as to allow them to work with fleets to fully evaluate in-use reliability before a technology is applied fleet-wide. The agencies believe the phase-in schedule will allow manufacturers to complete these normal processes. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the NPRM, the actual aerodynamic *technologies* being projected are very similar to what was projected at the time of NPRM (however, these vehicles fall into Bin V in the final rule, instead of Bin VI and VII in the NPRM). Importantly, our averaging, banking and trading provisions provide manufacturers with the flexibility (and incentive) to implement these technologies over time even though the standard changes in a single step.

The agencies also received comment regarding our aerodynamic assessment of the other tractor subcategories. The agencies recognize that there are tractor applications that require on/off-road capability and other truck functions which restrict the type of aerodynamic equipment applicable. We also recognize that these types of trucks spend less time at highway speeds where aerodynamic technologies have the greatest benefit. The 2002 VIUS data ranks trucks by major use.<sup>60</sup> The heavy trucks usage indicates that up to 35 percent of the trucks may be used in on/off-road applications or heavier applications. The uses include construction (16 percent), agriculture (12 percent), waste management (5 percent), and mining (2 percent). Therefore, the agencies analyzed the technologies to evaluate the potential restrictions that will prevent 100 percent adoption of more advanced aerodynamic technologies for all of the tractor regulatory subcategories and developed standards with new penetration rates reflecting that these vehicles spend less time at highway speeds. For the final rule, the agencies

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<sup>60</sup> U.S. Department of Energy. *Transportation Energy Data Book*, Edition 28-2009. Table 5.7.

evaluated the certification data to assess how the aerodynamic performance of high roof day cabs compare to high roof sleeper cabs. In 2014, the high roof day cabs on average are certified to one bin lower than the high roof sleeper cabs.<sup>61</sup> Consistent with the public comments, and the certification data, the aerodynamic adoption rates used to develop the final Phase 2 standards for the high roof day cab regulatory subcategories are less aggressive than for the Class 8 sleeper cab high roof tractors. In addition, the agencies are also accordingly reducing the adoption rates in the highest bins for low and mid roof tractors to follow the changes made to the high roof subcategories because we neither proposed nor expect the aerodynamics of a low or mid roof tractor to be better than a high roof tractor.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found steer tires with rolling resistance as low as 4.9 and drive tires with as low as 5.1 kg/ton. The average tire rolling resistance that we used in the technology packages to derive the final rule standards are higher than the lowest rolling resistance tires made today, so the technology is feasible.

We also note that the certification data analysis shows that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the drive tires on high roof sleeper cabs. We found less of a difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

#### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>62</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>63</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2

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<sup>61</sup> U.S. EPA. Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. See Docket EPA-HQ-OAR-2014-0827.

<sup>62</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>63</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>64</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

### *Idle Reduction Technologies*

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

As described in RIA Chapter 2.4.8.1.1, the agencies determined the effectiveness of adjustable AESS through our determination of the split between idling hours using the main engine versus the idle reduction technology. For example, the baseline idle emission rate was assumed to be determined by 100% of the 1800 hours of idling conducted each year was done using the main engine. For APU and battery APU technologies with a tamper-proof AESS, the agencies assumed that these technologies would be operating 100% of the idling time. For automatic start/stop systems with a tamper-proof AESS, the agencies determined that the idling power would come from the battery half of the idling time and the other half would require main engine idling. For fuel operated heaters with a tamper-proof AESS, the agencies assumed that 800 of the idling hours would involve the use of the fuel operated heater and that the main engine would idle for the other 1000 hours per year to supply cooling and other needs. For idle reduction technologies with an adjustable AESS, the agencies discounted the number of hours operated by the idle reduction technology by 20 percent to account for the fact that it is an adjustable (non tamper-proof) system. For adjustable AESS without an additional idle reduction technology, the agencies set the number of main engine operating hours at 25% of the total idle time to also reflect that it is adjustable and that the agencies have less certainty in the continued use of this in the real world. The discount is greater for an adjustable AESS without additional idle reduction technologies because we believe that there is a potentially stronger incentive for vehicle owners to change the setting if they have not invested in the additional technology. Similar to other technologies, manufacturers may demonstrate off-cycle credits to account for additional effectiveness not shown in GEM.

In the final rule, EPA considered the APU cost comments and more closely evaluated NHTSA’s contracted TetraTech cost report which found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking. From there, we have adjusted the cost to arrive at a direct manufacturing cost of \$5882 (DMC, 2013\$, applicable in MY2014)). Our total cost for the APU, with markups and in 2018 (i.e., roughly today), is \$6248 (total cost, 2013\$ in 2018, see Chapter 2.11.6.1 of the final RIA). See also Responses in 4.6 below.

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<sup>64</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

### *Vehicle Speed Limiters*

The agencies considered DOT's upcoming actions with respect to mandatory vehicle speed limiters for heavy-duty trucks, but could not take it into account in this Phase 2 rulemaking because that rule is not final yet. The existing Phase 1 VSL flexibilities provide opportunities for manufacturers to account for the impact of VSLs on reducing GHG emissions and fuel consumption, while still allowing the settings to change after an "expiration" time determined by the manufacturer or to include a soft top. At this time, we believe that the Phase 1 flexibilities sufficiently balance the desire to encourage technologies that reduce GHG emissions and fuel consumption while minimizing the compliance burden of trying to accommodate changes throughout the useful life of the vehicle. Therefore, the agencies are not adopting any new VSL provisions for Phase 2.

### *Hybrids*

After considering the comments, the agencies are continuing the Phase 1 approach of not including hybrid powertrains in our feasibility analysis for Phase 2 for tractors. Because the technology for tractor applications is still under development we cannot confidently assess the effectiveness of this technology at this point in time. In addition, due to the high cost, limited benefit during highway driving (see Daimler's comment) and lack of any existing systems or manufacturing base, we cannot conclude that such technology will be available for tractors in the 2021-2027 timeframe. However, manufacturers will be able to use powertrain testing to capture the performance of a hybrid system in GEM if systems are developed in the Phase 2 timeframe, so this technology remains a potential compliance option (without requiring an off-cycle demonstration).

### *Stop-Start*

The agencies are not including any technology inputs to GEM reflecting stop-start technology. We believe the technology needs further development for tractor applications. If this technology is developed in the future for tractors, then manufacturers may consider applying for off-cycle technology credits. Since the agencies are not predicating the Phase 2 standards on adoption of start-stop technologies, the agencies are also not including this technology as a GEM input.

### *Heavy-Haul Tractors*

After considering the comments, the agencies are basing the stringency of the final standards on a technology package that does not use aerodynamic improvements, as we proposed.

We received comments from stakeholders about the application of technologies other than aerodynamics for heavy-haul tractors. After considering these comments and the information regarding the tire rolling resistance improvement opportunities, discussed in Section III.D.1.b.iii of the Preamble, the agencies have adjusted the adoption rate of low rolling resistance tires.

### *Weight Reduction*

The agencies are maintaining the Phase 1 approach to weight reduction. A more complex approach would require a significant amount of data to develop a baseline because there is a large variation in the baseline weight among tractors that perform roughly similar functions with roughly similar configurations. Therefore, we are limiting the weight reduction to specific components that can be replaced with light weight components. The differences can then be readily quantifiable and well-understood. 76 FR 57151. In addition, a more complex approach would require a significant increase in test burden for the manufacturers because it would require the empty weight of the tractor be measured

and input into GEM for each configuration built. The agencies at this time do not believe this added burden is necessitated.

For the final rule, the agencies are only adopting weight reduction values that are reductions, not weight penalties (such as natural gas). The agencies are adopting weight reductions in the powertrain (smaller displacement engines and 6x2 axles) because Phase 2 includes the impact of the powertrain in the vehicle's CO<sub>2</sub> emissions and fuel consumption values. Additional weight reduction, such as the items mentioned by the commenter, may be evaluated as a potential off-cycle credit.

**Organization:** Diesel Technology Forum

### **Vehicle Technologies Will Be Critical to Meet Proposed Phase 2 Benefits**

Class 7 and 8 vehicles that today consume about 70 percent of all the fuel used in the medium- and heavy-duty fleet, are expected to achieve a 24 percent improvement in fuel economy and reduction in carbon emissions through the lifetime of the proposed rule relative to the existing Phase 1 standard.

Consideration of the Phase 2 proposal will include a suite of technologies from advanced engine designs to lightweight and more aerodynamic materials, innovative and adaptive cruise controls, next generation transmission designs and safety features and many more. All of these technologies build on the continued gains in diesel engine efficiency to consume even less fuel and help to quickly achieve greater fuel savings and greenhouse gas reductions. [EPA-HQ-OAR-2014-0827-1171-A2 p.4]

Technologies envisioned to meet these proposed Phase 2 standards may deliver significant additional fuel economy benefits and greenhouse gas emission reductions on the order of 1.8 billion barrels of crude oil saved and 1 billion tons of carbon emissions eliminated. Unlike Phase 1, where many technologies were already commercially available and proven, in order to achieve the ambitious goals outlined in Phase 2, EPA and NHTSA should proceed with caution in that they have incorporated reliance on adoption of some technologies that are not currently widely tested, proven or commercially available. [EPA-HQ-OAR-2014-0827-1171-A2 p.4]

### **Response:**

The agencies carefully considered the lead time required for each individual technology while setting the standards, consistent with the respective statutory requirements to consider lead time as part of the standard setting process.

**Organization:** Doran Manufacturing

Currently, the proposed Phase 2 of the EPA's and NHTSA's Greenhouse Gas Emissions Standards includes only automatic tire inflation systems (ATIS) as an acceptable technology for maintaining tire inflation pressures in order to reduce rolling resistance, fuel consumption and associated greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

Historically, tire pressure monitoring systems (TPMS) have not been included in the EPA's SmartWay program because the Agency had no way to determine the effect this technology had on fuel economy unless each requesting fleet provided a clear description of their compliance strategy. This information was necessary to help the EPA to calculate the associated fuel savings from running on properly inflated tires. The benefit which is calculated was determined to be fleet-specific, since it depends upon a fleet's individual compliance strategy and was not able to be generalized industry-wide. This meant that tire



pressure monitoring systems were not able to be SmartWay approved at the time, since the fuel savings depended upon the follow-up action by the fleet, rather than the technology itself. [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

Fortunately, a significant amount of development has occurred since the inception of the SmartWay program to help verify the fuel savings and the associated reduction of replacement tires by utilizing TPMS and telematics integrations. [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

-- The Federal Motor Carrier Safety Administration (FMCSA) has studied TPMS for a number of years pointing to the positive impact of TPMS: [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

- 2006: FMCSA found that this technology accurately reported tire inflation pressure values to within 2 to 3 psi of the measured value and accurately created low pressure alerts within 2 to 3 psi of the expected threshold [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

- 2007: performance and durability of TPMS was studied in a field test on transit buses [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

- This study found that using a TPMS display is essential to impact tire maintenance practices, fuel economy and tire life

- In addition, it found that only using diligent tire pressure maintenance did not increase the average tire pressures

- 2011: the FMCSA published the results of a Field Operational Test of tire pressure monitoring systems (TPMS) and automatic tire inflation systems (ATIS) on two fleets that were considered to have good tire maintenance which was conducted over the previous twenty-four months which created the following conclusions: [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

- TPMS or ATIS use will reduce fuel consumption of equipped tractor-trailers with test fleets seeing a 1.4% improvement in fuel economy

- TPMS or ATIS use will reduce road calls for damaged/flat tires of equipped tractor-trailers

- TPMS or ATIS use will not introduce unscheduled maintenance that adversely affects day-to-day fleet operations [EPA-HQ-OAR-2014-0827-1165-A1 p.1]

-- Significant technological advancements related to integrating TPMS data between TPMS providers and telematics companies have occurred over the past few years which creates an even greater effect on fuel consumption and greenhouse gas emission than the original tire pressure monitoring systems which were tested and proven to deliver 1.4% improvement in fuel economy by the FMCSA: [EPA-HQ-OAR-2014-0827-1165-A1 p.2]

- It is recommended that drivers are still required to inspect tires during a pre-trip inspection. Due to the advancements and in-cab monitoring, drivers can know instantly and accurately if any of their tires are under inflated before departing on their trip [EPA-HQ-OAR-2014-0827-1165-A1 p.2]

- In cab display examples, with visual and audible low pressure alert notifications:

- The tire pressure data and alert notifications are also captured and transmitted off the truck to provide real time access for fleet management to increase awareness and improve driver accountability

- Examples of real-time TPMS data: [sample of TPMS data can be found on p.2-3 of docket number EPA-HQ-OAR-2014-0827-1165-A1]

- the capability is now being used by a significant and growing number of fleets to not only visually and audibly alert the driver of a low pressure event, but to also transmit tire pressure/temperature data and low pressure alarms off the truck to create e-mail/text message alerts for dispatch or maintenance personnel and/or to generate reports to help fleets quickly identify which trucks/trailers and tires have low pressures that need to be addressed [EPA-HQ-OAR-2014-0827-1165-A1 P.4]

- In addition, the date/time and GPS location for each low pressure alarm is available which can be used to identify when and where tire pressure events occur and to hold drivers accountable [images can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1165-A1]

- Below is actual trailer tire data from a fleet that is utilizing a TPMS telematics integration to help monitor tire pressures and temperatures in conjunction with ATIS: [EPA-HQ-OAR-2014-0827-1165-A1 p.4]

- the tire pressure dropped below 20psi while the trailer was detached and the inflation system wasn't powered

- a low pressure alarm was generated by TPMS and transmitted by a telematics provider to a web portal which created the awareness to the potential tire problem

- the tire was inspected, repaired and put back into service

- the repair did not correct the problem and the tire began to deflate/inflate again

- more low pressure alarms were triggered and the tire was inspected/replaced which will help to minimize rolling resistance and improve fuel economy for that trailer

- most likely, this tire would have continued to have drastic changes in tire pressure resulting in an extended period higher rolling resistance and reduction in fuel economy and ultimately ended with a catastrophic tire failure [chart, 'TPMS History Summary Report', can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1165-A1]

-- 2009-2010: a waste hauling fleet conducted a 12-month comprehensive study on the impact of tire pressure monitoring systems on 60 trucks out of a terminal in Jacksonville, FL [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

- Overall, the fleet replaced 204 fewer tires (from 1,439 down to 1,235) which is a 14.2% reduction during the 12-month period with TPMS on the vehicles compared to the prior 12-month period without TPMS on the vehicles [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

[Chart, 'Tires Replaced: Monthly Summary', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1165-A1]

- According to the Rubber Manufacturers Association, it can take up to 7 gallons of crude oil to produce a single tire [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

- approving the use of an existing and reliable technology that is proven to reduce the number of replaced tires will also help to reduce the carbon footprint and reduce greenhouse gas emissions

Overall, it is Doran's position that the advancements in technology which have been implemented with the continued development of tire pressure monitoring systems and telematics offerings, should be included in Phase 2 of the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles. [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

There are simply too many documented conclusions by FMCSA and cases of real-world results in support of improved fuel economy and a reduction in the number of replaced tires from a significant number of fleets across the country which have occurred after SmartWay's initial ruling to not include TPMS in Phase 2 of this Standard. [EPA-HQ-OAR-2014-0827-1165 p.1]

Furthermore, without including this technology, there will not be a system available in this Standard to address tire inflation pressure for powered vehicles because automatic tire inflation systems (which are plumbed inside an axle) are currently only available for trailers. [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

It would be shortsighted to overlook an advanced and proven technology which can dramatically impact the reduction of greenhouse gas emissions in a number of ways. [EPA-HQ-OAR-2014-0827-1165-A1 p.5]

**Response:**

*Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS. However, the effectiveness value in GEM for TPMS is less than that for ATIS, reflecting the loss in efficiency reflecting need for driver interaction. See RIA Chapter 2.4.3.3.

**Organization:** Eaton Vehicle Group

Phase 2 does not prescribe technology and provides a flexible structure that allows OEM's to use advanced powertrains, and their significant potential to save fuel, for regulatory compliance. Eaton believes that deep engine-transmission integration, Dual Clutch Technologies and ultra-efficient transmissions are cost-effective methods to save fuel and achieve compliance, without adding the weight, cost and complexity common to some new and/or un-tested technologies. Technologies available to the market today are only partially accounted for in the pathways to compliance and cost analysis. We believe that they offer OEMs increased flexibility to achieve the standards in the NPRM without any significant additional cost, thus reducing the technology and reliability risks required to comply with the proposed standards. [EPA-HQ-OAR-2014-0827-1194-A1 p.5]

## Hybrids

In the HD line haul segment the potential for hybridization is driven by improved aerodynamics. An analysis [Vinjamoor 2015]<sup>1</sup> on a typical high speed line haul route, shown in the figure below, compares current and more aerodynamic trucks. A significant improvement in the tractor-trailer aerodynamics from current levels of  $C_d = 0.65$  to  $C_d = 0.45 - 0.52$  and a reduction in tire rolling resistance from  $C_{rr} = 6.9 - 7.3$  to  $C_{rr} = 5.6 - 5.9$  increases the coasting time and braking loads (and thus the regeneration opportunities). A parallel 100kW hybrid system can further improve the fuel consumption of such a vehicle by more than 5%. In such a configuration, a Waste Heat Recovery system would also make use of the electrical infrastructure to lower its conversion losses, and the combined system could provide more than 8% fuel reduction over the conventional powertrain on a constant speed cycle over a relatively flat road as shown below. These results are consistent with analyses presented by Volvo and Daimler and seen on SuperTruck demonstrators. [EPA-HQ-OAR-2014-0827-1194-A1 p.17]

[Figure 3, HD Line haul route for Hybrid analysis, can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1194-A1]

We recommend the EPA revisit the assumptions behind the 6x2 impact of 2.5%. Our experience shows a lower value. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

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1 Vinjamoor, H., Patil, C., Tsourapas, V., Dorobantu, M., (2015) 'Fuel saving potential of hybrid powertrains with electric waste heat recovery for heavy duty line haul applications', Int. J. Powertrains, Vol. 4, No. 3, pp. 196-207

2 Benjey, R., Biller, B., Tsourapas, V., (2015) 'Cost effective hybrid boosting solution with application to light duty vocational vehicles' Int. J. Powertrains, Vol. 4, No. 3, pp. 302-314

3 Patil, C., Naghshtabrizi, P., Deng, Y., Vinjamoor, H., (2015) 'Real-time implementable optimal control strategy for hybrid electric vehicles energy management: application to medium-duty commercial vehicles', Int. J. Powertrains, Vol. 4, No. 3, pp. 225-242

## Response:

After considering the comments, the agencies are continuing the Phase 1 approach of not including hybrid powertrains in our feasibility analysis for Phase 2 tractors. Because the technology is still under development for tractor applications we cannot confidently assess the effectiveness of this technology at this point in time. In addition due to the high cost, limited benefit for tractors during highway driving, and lacking any existing systems or manufacturing base, we cannot conclude with certainty, that such technology will be available for tractors in the 2021-2027 timeframe. However, manufacturers will be able to use powertrain testing to capture the performance of a hybrid system in GEM if systems are developed in the Phase 2 timeframe.

The agencies reassessed the effectiveness of 6x2 axles. Meritor stated in their comments that their internal testing and real world testing supported the 2.5 percent efficiency proposed by the agencies for 6x2 axles. The agencies' assessments of these technologies show that the reductions are in the range of 2 to 3 percent.<sup>65</sup> For the final rule, the agencies are simulating 6x2, 4x2, and disengageable axles within

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<sup>65</sup> See Section III.D.2.b of the Preamble for further discussion.

GEM instead of providing a fixed value for the reduction. This approach is more technically sound because it will take into account future changes in axle efficiency.

**Organization:** FedEx Corporation

4. Components Ratings: While the proposal currently states that it is the responsibility of manufacturers to document the contributive benefit of the components installed on the Tractor and or Trailer; fleets such as FedEx need the verified efficiency of the available components separately, and/or when used in combination. There should be a government-provided rating of components to assist a fleet in its deliberation as to which components are the most effective and should be included in future purchases. Implementation would be inhibited if fleets were required to conduct their own evaluations of individual components. [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

**Response:**

For tractors, the agencies are not adopting a program to provide a rating of components to the fleets or public. The Phase 2 tractor program has been designed to drive reduction of GHG emissions and fuel consumption of new tractors through performance-based standards that are met on average by each manufacturer. We believe this is the most efficient method of driving reductions.

**Organization:** First Industries Corporation

The following EPA-proposed penetration rates are too aggressive and in our estimation must be adjusted downward: [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

**6x2's:** 60% - 6x2's may not be used legally and safely in all 50 U.S. states and Canada. In particular, six state laws limit tire and axle loading in such a way that 6x2's cannot be used as intended, and many other states have confusing regulations that effectively prevent usage of 6x2's. Fleet owners must purchase trucks that can operate in all 50 states, and many cross the border between the U.S. and Canada. As long as state and provincial laws limit the use of 6x2's, fleet owners will only purchase the technology in limited areas and quantities. Moreover, while fuel savings can be realized with 6x2's, 6x2's also see an increase in tire wear and associated costs, and have lower resale value. Accordingly, the payback period for 6x2's can be longer, making them cost-ineffective for some applications. EPA should assume no more than a 5% penetration rate for 6x2's through 2027 and should engage in additional study of the safety and regulatory challenges associated with 6x2's. [EPA-HQ-OAR-2014-0827-1145-A2 p.3]

**6x2's** — EPA should include in its cost calculation the additional tire wear and the negative impact on resale value associated with 6x2's. [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

**Auxiliary Power Units ('APUs'):** 90% - Many operations do not require APUs, and basing stringency on the assumption that 90% of customers will purchase APUs skews what is actually achievable and ultimately imposes unnecessary costs. Further, no environmental benefit results from the purchase of an APU by a fleet that does not idle. Many fleets use diesel-fired heaters to greatly reduce idling in cooler weather, but still need to use idling when cab cooling is required. Fleets that already limit idling either via slip seat operation (where drivers are rotated) or use of fuel-fired heaters will not get adequate payback from an APU. Fleets will also see reduced load capacity due to the APU weight and possibly worse aerodynamics from a larger trailer gap if the space for an APU requires a longer wheelbase. Notably, most fleets already purchase programmable idle shutdown timers which limit idling. However, fleets do not purchase regulatory versions of idle shutdown timers because of the negative perception in the

secondary market regarding such technology and the importance of considering resale value when purchasing a new vehicle. In practice, idle shutdown timers are typically used for the useful life of the vehicle, whether they are regulatory or not. If forced to purchase APUs or regulatory shutdown timers, many fleets will pre-buy vehicles so as to delay the negative costs associated with such technology. APU's and AES's should not be considered part of stringency, unless the agencies' choose to provide credit for non-regulatory versions of AES's that provide essentially the same environmental benefits as the regulatory version. [EPA-HQ-OAR-2014-0827-1145-A2 p.3]

**APU's** — EPA estimates on the cost of APU's in 2027 will be \$4,327. The cost of the APU today is two to three times above that number. EPA should use the actual cost of APU's in its calculation and adjust the numbers upward to reflect the future costs. [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

**Tire Inflation Systems:** 40% - Customers are more likely to purchase tire pressure monitoring systems, which provide all of the benefits of tire inflation systems at a lower cost. In addition, a customer who simply checks tire pressure daily can achieve all of the same benefits without purchasing either technology and incurring its costs. Tire inflation systems should not be forced into the market by assuming any penetration rate. To the extent credit is provided for these systems, both tire inflation systems and tire pressure monitoring systems should receive the same amount of credit. [EPA-HQ-OAR-2014-0827-1145-A2 p.3]

**Tire Inflation Systems** — The cost estimates for tire inflation systems must include warranty risk and maintenance costs, as well as the cost of false warnings. Consideration of the benefits must factor in system leakage, which forces increased operation of the air compressor and therefore depending on the type of system, could require more fuel to be burned by the truck ultimately creating a penalty to the engine. [EPA-HQ-OAR-2014-0827-1145-A2 p.5]

**Lower Low Rolling Resistance ('LRR') Tires** — EPA and NHTSA should do an independent study of the LRR tires that they are seeking to push into the market, both in terms of safety and availability. In particular, the agencies should look at the effect on stopping distance and whether such tires should and can be used safely in all weather conditions. Fleets will use LRR tires when appropriate. However, including wide spread use of these tires when determining a baseline from which to apply reductions will result in overly stringent standards. Because EPA's tampering rules require retention of all features that reduce GHG emissions, another unintended consequence of this action is that fleets will likely choose tires with higher rolling resistance (less efficient), so that they have more flexibility in replacing tires in the field when needed. EPA also errs in its tire analysis by using the same rolling resistance for day cabs, sleepers, and raised roof sleepers. The need for and benefit of LRR tires on a raised roof sleeper is very different from the other, categories. EPA should examine fleet tire data and adjust stringency to account for variations and different business needs. [EPA-HQ-OAR-2014-0827-1145-A2 p.3-4]

**Lower LRR Tires** — EPA erred in its cost calculations for LRR tires by basing its cost figures on 1999 tire data indexed for inflation, rather than using current cost data. Moreover, EPA's cost figures did not account for additional wear and tear and lifetime replacement costs of LRR tires. Also, EPA should not assume the same level of fuel economy benefit for the life of the tire, since fuel economy associated with higher rolling resistance tires generally improves with wear. [EPA-HQ-OAR-2014-0827-1145-A2 p.4-5]

**Aerodynamic Devices** — EPA's estimated cost of future aerodynamic devices appears very low given the historical nature of the proposed changes. In the rule the agencies should describe in detail and on an individual basis what components they expect to be used for compliance, the costs of these individual components, and how this will change over-time to maintain compliance with stricter standards. [EPA-HQ-OAR-2014-0827-1145-A2 p.5]

## Response:

### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>66</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>67</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.<sup>68</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

The agencies considered the maintenance impact of 6x2 axles. As noted in the NACFE Confidence Report on 6x2 axles, the industry expects an overall reduction in maintenance costs and labor for vehicles with a 6x2 configuration as compared to a 6x4 configuration.<sup>69</sup> Among other savings, the reduction in number of parts, such as the interaxle drive shaft, will reduce the number of lubrication procedures needed and reduce the overall quantity of differential fluid needed at change intervals. The agencies have taken an approach to the maintenance costs for the 6x2 technology where we believe that the overall impact will to be zero.

### *Idle Reduction Technologies*

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the

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<sup>66</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>67</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>68</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." January 2014. Page 19.

<sup>69</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." 2014

agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

EPA considered the comments and more closely evaluated NHTSA's contracted TetraTech cost report found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking. See also Preamble Section III.C.3 and response 4.6 below.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS.

With respect to costs, all of the agencies' technology cost analyses include both direct and indirect costs. Indirect costs include items such as warranty. In terms of maintenance, the presence of tire inflation management systems, should serve to improve tire maintenance intervals and perhaps reduce vehicle downtime due to tire issues; they may also carry with them some increased maintenance costs to ensure that the tire inflation systems themselves remain in proper operation. For the analysis, we have considered these two competing factors to cancel each other out.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found less of a difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

We have estimated the cost of lower rolling resistance tires based on an estimate from TetraTech of \$30 (retail, 2013\$). We also have applied a "medium" complexity markup value for the more advanced low rolling resistance tires. We expect that, when replaced, the lower rolling resistance tires would be replaced by equivalent performing tires throughout the vehicle lifetime. As such, the incremental increases in costs for lower rolling resistance tires would be incurred throughout the vehicle lifetime at intervals consistent with current tire replacement intervals. A recent study conducted by ATA's Technology and Maintenance Council found through surveys of 51 fleets that low rolling resistance tires and wide base single tires lasted longer than standard tractor tires.<sup>70</sup> Due to the uncertainty regarding the life expectancy of the LRR tires, we maintained the current tire replacement intervals in our cost analysis.

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<sup>70</sup> Truckinginfo. TMC Survey Reveals Misinformed View of Fuel-Efficient Tires. March 2015.



## *Aerodynamics*

The agencies included the technology cost of aerodynamic improvements, such as wheel covers and active grill shutters, in our analysis of aero bin V. The direct manufacturing cost of aero bin V, as shown in RIA Chapter 2.11.9, is \$3089 for high roof sleeper cabs and \$2660 for high roof day cabs (2013\$ in 2014). The agencies did not receive any detailed cost estimates for aerodynamic devices in the comments to the NPRM.

**Organization:** Gaines, Linda

Similarly, long-haul trucks are evaluated at the manufacturer level, which does not easily take into account the many retrofits, including aftermarket idling reduction devices not installed on initial purchase, or the actual use patterns. It might therefore make sense to measure truck efficiency at the fleet level, using telematics data to infer actual fuel use. Although this could be considered intrusive, at least telematics data measures what is actually of concern rather than a poor proxy. [EPA-HQ-OAR-2014-0827-1357-A1 p.1]

### **Response:**

The agencies developed the Phase 2 rule under their respective authorities. Clean Air Act section 202(a)(1) and (2) authorize EPA to establish standards for emissions of pollutants from *new* motor vehicle and engines.

**Organization:** Green Transportation Solutions

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 234-236.]

So beyond the costly vehicle upgrades and modifications that are being discussed here today, it is rather difficult for some of these drivers to purchase some of these things. We usually actually recommend three simple and inexpensive ways to reduce petroleum consumption, and, thus, greenhouse gas emissions with our clients.

The third is to incorporate a tire pressure screening system

It's very important for not only fuel efficiency, but for safety. It is one of the simplest ways to increase your fuel economy. It does take management. It does take participation by the drivers. And also many, many safety improvements having properly inflated tires.

### **Response:**

The agencies have included tire pressure monitoring systems in the menu of technologies recognized in Phase 2 GEM.

**Organization:** He, Leard, McConnell

We do not directly measure the adoption of these technologies and vehicle design characteristics over time. Instead, the effects of these advances are absorbed by model year fixed effects in our estimation.

Therefore, the time period fixed effects potentially reflect the adoption of a combination of these technologies. [NHTSA-2014-0132-0115-A1 p.3]

## 2.2 Trade-off Factors

Some truck attributes have a negative correlation with fuel economy, *ceteris paribus*. We examine closely two of these trade-off attributes, engine displacement and vehicle weight. [NHTSA-2014-0132-0115-A1 p.3]

[Figure 1, 'Theoretical illustration: trade-off between MPG and vehicle weight', can be found on p.4 of docket number NHTSA-2014-0132-0115-A1]

## 4 Empirics

Our main regression is specified as follows. [NHTSA-2014-0132-0115-A1 p.6]

$$\ln \text{MPG}_i = \alpha_1 \ln \text{Weight}_i + \alpha_2 \ln \text{CIDs} + \text{MY}_i \gamma + X_i \beta + E_i \quad (1)$$

$\text{MY}_i$  are the model year fixed effects. The estimated coefficient  $\gamma$  indicates how technological progress changes over time. A list of controls,  $X_i$ , include body/trailer type, number of axles on the power unit, cab type, whether equipped with air-conditioning,  $\ln(\text{odometer reading})$ , main cargo type, vehicle make, fuel type (interacting with model years), survey year fixed effects and region fixed effects. The estimation results are shown as model 1 in Table 1 and Table 2. [NHTSA-2014-0132-0115-A1 p.6]

In the second model, we aggregate the data by fuel type, model year, body/trailer type, vehicle make, number of axles on the power unit and cab type to recover the average fuel economy at the truck model level. We compute the probability weight based on the distribution of each truck model in the original dataset. The estimation results are shown in columns (2) and (4) in Table 1 and Table 2. [NHTSA-2014-0132-0115-A1 p.6]

Third, we apply the Oaxaca/Blinder method of decomposition to estimate the technological progress. The base period is from model year 1973 to 1975. We run the regression as specified in (1) only for observations from the base period, and use the estimated parameters from the base period to fit the fuel economy in each of the following model years. That is to say, we are holding the coefficients of trade-off variables, Weight and CID, constant. The difference between actual and fitted fuel economy can be decomposed into an explained part and an unexplained. The explained part is the effect of changes in trade-off variables; the unexplained part reflects the technological progress. The estimated progress (in percent) in each model year after the base period is shown in the third and sixth columns in Table 1. [NHTSA-2014-0132-0115-A1 p.6]

[Table 1, 'Technological Progress' and Table 2, 'Estimation Results of the Trade-off Variables', can be found on p.7 and 8, respectively, of docket number NHTSA-2014-0132-0115-A1]

### Response:

The agencies have analyzed two tractor baselines in the Phase 2 final rulemaking to recognize that there is uncertainty in projecting the future fleet in the absence of Phase 2 standards. The fuel consumption and CO<sub>2</sub> emissions in the "flat" baseline remains the same over time with no assumed improvements after 2017, absent a Phase 2 regulation. An alternative baseline was also evaluated by the agencies in which

there is a continuing uptake of technologies in the tractor market that reduce fuel consumption and CO<sub>2</sub> emissions absent a Phase 2 regulation. This alternative baseline, referred to as the “dynamic” baseline, was developed to estimate the potential effect of market pressures and non-regulatory government initiatives to improve tractor fuel consumption. The dynamic baseline assumes that the significant level of research funded and conducted by the Federal government, industry, academia and other organizations will, in the future, result in the adoption of some technologies beyond the levels required to comply with Phase 1 standards. As documented in the RIA, the choice of stringency for final standards for each source category was identical under analysis for either of these baselines.

**Organization:** Idle Smart

We believe that automatic stop/start systems like Idle Smart have and will continue to provide significant GHG benefits in addition to providing fleets of all sizes a compelling solution to reduce fuel usage [EPA-HQ-OAR-2014-0827-1128-A1 p.1]

We are concerned that the Phase 2 rulemaking excludes automatic start/stop systems from continuing to play the vital role that it does today in reducing GHG emissions and fuel consumption. As a result, the Phase 2 rulemaking provides an unnecessarily incomplete set of viable alternatives to achieve its stated goals, it underrepresents costs associated with the limited set of onboard idle reduction technology solutions presented, and it creates unintended but very predictable and quantifiable consequences that are counter to successfully achieving Phase 2’s goals. [EPA-HQ-OAR-2014-0827-1128-A1 p.1]

**1. The EPA and NHSTA omit and thereby effectively eliminate other viable Extended Idle technologies that have proven market results to reduce fuel consumption.** Auxiliary power units (APUs), fuel operated heaters, battery supplied air conditioning, and thermal storage systems are the only solutions presented as viable Extended Idle Reduction solutions, and only one technology – diesel APUs – is modeled economically. By omitting other solutions, notably automatic start/stop systems, and combined with the AES provisions presented in the rulemaking, technologies that have proven to reduce an equal amount of fuel consumption are not provided a level playing field. [EPA-HQ-OAR-2014-0827-1128-A1 p.2]

The proposed rulemaking presumably uses diesel APUs as its exemplar given that it is the only four season idle reduction solution presented, which is understandable. Nevertheless, the singular focus on diesel APUs provides an incomplete analysis, particularly since Idle Smart’s automatic stop/start system has quantifiable and verifiable operational data that yields an identical reduction in fuel consumption when compared to diesel APUs. While we believe some of the modeling inputs are inaccurate (e.g., diesel APU gallons/hour), below we use the operational metrics as provided<sup>3</sup> to generate a simple but instructive side-by-side comparison of diesel APUs and Idle Smart in terms of fuel reduction for Extended Idle times: [EPA-HQ-OAR-2014-0827-1128-A1 p.2]

[Table of Extended Idle times fuel reduction comparisons can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1128-A1]<sup>4</sup>

In its rulemaking, EPA and NHTSA requested comment on other approaches that would appropriately quantify the reductions that would be experienced in the real world. To that end, Idle Smart’s fuel reduction performance metrics provide proven market results that are, at a minimum, at parity with diesel APUs, quantifiable and measurable, and can be achieved using an automatic engine shutdown (AES) with the appropriate override provisions. [EPA-HQ-OAR-2014-0827-1128-A1 p.2]

As mentioned earlier, we are concerned that the Phase 2 rulemaking excludes automatic start/stop systems from continuing to play the vital role that it does today in reducing GHG emissions and fuel consumption. As a result, we would ask that care be given to ensuring a level playing for all viable onboard technologies, including automatic start/stop solutions and appropriate AES override provisions. [EPA-HQ-OAR-2014-0827-1128-A1 p.4]

It is our hope that two of the areas highlighted above, items 1 and 3, speak directly to Idle Smart's ability to address the stated goals of the Phase 2 rulemaking at a level that is at parity with (fuel consumption) or materially better than (PM2.5 emissions) the implied Extended Idle technology highlighted in the Phase 2 Draft. Automatic start/stop solutions such as Idle Smart have proven themselves in the market, and we have quantifiable data and reporting that supports our ability to offer a viable alternative that meets the collective needs of both fleets and the EPA and NHTSA. [EPA-HQ-OAR-2014-0827-1128-A1 p.4]

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4 Idle Smart performance metrics (2014)

**Response:**

We generally agree with several commenters that encouraged the agencies to consider the effectiveness of a variety of idle reduction technologies. The Phase 2 regulations differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer, including automatic stop/start technologies such as the system described by Idle Smart. See RIA Table 2-5.

**Organization:** IdleAIR

IdleAir's core offering, Electrified Parking Spaces ("EPS"), as it is referenced in the proposed rule, provides long-haul truck drivers an alternative to idling their main engines to maintain a comfortable cabin temperature, sustain vehicle battery charge and power electronics such as televisions and laptops during their overnight stays. EPS provides other benefits such as cleaner air with the reduction of black carbon and soot emitted from diesel engines, reduced noise pollution, local job creation, and an increased tax base for the local economy. Drivers benefit from improved sleeping conditions without the noise, vibration and exhaust fumes from idling and are therefore better rested and safer on the road. Dedicated truck site sales staff, national maintenance, nearly 24 x 7 customer support, highway signage, and other important investments have all uniquely contributed to achieve a growing user base of over 40,000 active driver customers. [EPA-HQ-OAR-2014-0827-1250-A2 p.1]

**MANDATING AES IS THE MOST EFFECTIVE WAY TO CURB MAIN ENGINE IDLING FOR MODEL YEAR 2021 AND BEYOND, BUT OVERALL FUEL ECONOMY AND AIR QUALITY WILL DECREASE, WHEN ALSO CONSIDERING ALL UNINTENDED CONSEQUENCES**

The agencies intend for the market to dictate how an OEM may achieve compliance with the fuel efficiency standard. However, a stringent standard that recognizes Automatic Engine Shutdown (AES) as the only idling mitigant effectively mandates AES. Indeed, the stated goal is 90% adoption of AES. The agencies maintain that its decision to recognize only AES is technology agnostic, since an owner is left to choose among all alternatives to idling. However, a truck owner cannot risk the driver's safety even one night per year, and therefore must buy and transport a technology that is available wherever the vehicle stops. The GEM model input is either Yes or No for "idle reduction w/ APU," which suggest a presumption that Auxiliary Power Units (APUs), will be the de facto solution. IdleAir is concerned that mandating AES is effectively mandating APUs, even if a consumer believes that a combination of

alternative technologies are superior. And many do. As stated above, IdleAir has 40,000 active driver customers and fleet agreements with 750 Fleets. Within the last two years, six “mega fleets” built IdleAir facilities within their own terminals and nine more are planned within the next two years. Mandating APU adoption will threaten the continued growth and viability of IdleAir, the electrified truck parking space industry at large. Although some APU owners patronize IdleAir, their savings is too small for IdleAir (and a host of other providers) to operate a viable business. [EPA-HQ-OAR-2014-0827-1250-A2 p.2]

#### **UNACCEPTABLE NEAR TERM IMPACT:**

Most trucks in today’s fleet do not have an APU, and therefore need some alternative like EPS. Class 8 trucks have a design life of 2mm miles or 8 or more years. Even if 100% of all trucks are sold with an AES and APU in model year 2021, then in the year 2025, we conservatively estimate that half of all trucks on the road will still have no choice but to idle during their extended stays if IdleAir and other non-APU technologies are regulated out of existence. The slow turnover of durable long haul trucks renders our solution, at worst, an important bridge technology that should not be taken lightly. [EPA-HQ-OAR-2014-0827-1250-A2 p.2]

#### **ELECTRIFIED PARKING SPACES ARE MORE EFFICIENT THAN APUS:**

APUs add 400-500 pounds, which increases fuel consumption by about 200 to 280 gallons per year in order to carry the heavier load. At worst, however, the extra weight results in additional vehicle trips. It should be noted that interstate highways and some states have additional weight allowance for APUs, but several state routes do not. Heavy loads have to plan their entire trip for the most stringent state through which it plans to travel. We recommend EPA further study the effect of these additional trips. [EPA-HQ-OAR-2014-0827-1250-A2 p.2]

#### **Diesel APUs:**

Diesel APUs consume less fuel, but are generally unfiltered, and therefore generate substantially more emissions tied to respiratory ailments than the main engine. PM emissions from idling trucks are well documented and occur at locations with the greatest impact to human health – congregated on large truck stops where drivers spend the night. Surrounding neighborhoods that are most likely to permit truck stop siting are least likely to have adequate access to health care services. [EPA-HQ-OAR-2014-0827-1250-A2 p.2]

Our site staff receives complaints that drivers report headaches from neighboring diesel APUs. We encourage additional research on the health impacts of drastically increasing the adoption rate of APUs. We note that the cost of maintenance or filters were not modeled into the rule. Some large fleets have removed all APUs (numbered in the thousands) in light of maintenance alone. [EPA-HQ-OAR-2014-0827-1250-A2 p.2]

#### **Battery Power APUs:**

Battery power APUs are predominantly charged by two methods. 1) while the truck is in operation, an oversized alternator creates additional drag on the main engine, and 2) during extended stays, to recharge the battery, the main engine activates in high idle mode to consume more fuel than ordinary idling. Both methods involve fuel consumption and emissions that should be accounted for. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

### **Indirect emissions from EPS:**

Even electrified parking spaces generate emissions which should not be ignored, however, the carbon footprint of EPS service is orders of magnitude less than an APU, and the difference in PM emissions are even more striking. Through a methodology approved by the American Carbon Registry, the carbon intensity of EPS service is 6% of an idling truck. It should be noted that most of our service is delivered off-peak, when the cleanest power-plants are powering the grid. A side by side comparison of the indirect but substantial and quantifiable emissions caused by EPS and APUs should be considered against the emissions of AES. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

### **MORE DATA IS NEEDED TO STUDY A DIESEL APU'S EFFECT ON SLEEP QUALITY:**

IdleAir commissioned a third party study to evaluate the effects an idling engine has on sleep quality. The study is published on our website [www.idleair.com](http://www.idleair.com) and will be uploaded separately as supporting documentation. All evidence concluded a significant loss of sleep quality resulted from the idling engine. Staff and customer observations report diesel APUs are actually louder and vibrate more than a main engine, and we encourage NHTSA and EPA to evaluate the impact on sleep quality of drivers. It goes without saying driver alertness requires high quality sleep. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

### **RECOMMENDATIONS**

Fuel efficiency standards are not the right tool to regulate idling. Idling is a behavioral activity that has a loose relationship to onboard attributes. A regulation with influence over only one small cog (OEM's) in the large wheel of the idling problem may have adverse consequences on market choice, driver health and safety, and ultimately the environment. On its face, AES with limited override appears technology agnostic, but it instead dictates the subsequent decision in favor of APUs, and not because APUs are superior. The environmental benefits of AES combined with the environmental costs of APUs create an inferior outcome to a regulation that promotes greater flexibility for a range of solutions – even if some main engine idling exists as a backup. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

If we are forced to improve upon a rule within the confines of on-board solutions to idling, we recommend a scheme that allows for partial credit for adjustable AES or stop start devices, such as those offered by Idle Smart. Telematics can demonstrate the substantial and measurable decrease that adjustable AES has on idle time, and it permits the owner to more flexibly address nearly all of the other instances where the device permits idling. This flexibility is necessary to preserve driver/owner choice for a host of idle mitigation solutions. The comfort of knowing that isolated idling episodes are mechanically possible affords owners the margin of safety necessary to effectively employ bunk heaters, EPS, heaters, screen windows, etc. depending on the circumstances. The adoption rate of AES did not budge after the Phase I forecasted 80% adoption, because flexibility is critically important to the owner, driver, and free market. It is dangerous to underestimate the reasons that OEM's opted out of AES. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

Although the current rule does not address whichever additional idle mitigation technology is employed, in the event that it is modified to award credit to technologies other than AES, IdleAir implores the agencies to treat on-board and off-board technologies fairly. It will be challenging for such a modification to avoid picking winners. Off-board technologies are not traditionally provided by manufacturers. IdleAir requests an additional opportunity to comment if such a change is considered. [EPA-HQ-OAR-2014-0827-1250-A2 p.3-4]

As a prior draft of the rule contemplated, however, it is possible to recognize off board behavior at the OEM level. That draft recognized that a buyer of a new truck could enter into a contract with an EPS provider prior to accepting delivery. In a market where owner operators pay high teen interest rates to factor loads, part of the EPS value proposition is the ability to “pay as you go.” In fact, about \$765,000 of IdleAir sales last year were cash transactions because many drivers have no additional credit available. We maintain that a commitment to use EPS can be demonstrated with a binding agreement upfront, without the obligation of prepayment. The calculation for hours of idle mitigation should reflect the fact that every hour consumed is an hour that would have otherwise been spent idling. This premise was accepted by the most credible carbon credit verifiers, in part because our service module detects idling and discontinues services. For each hour of service, about .8 to 1 gallon of fuel is saved, and the efficiency credit issued to the OEM can be backed into after discounting the small fraction of waste at the power-plant level. We would want the indirect waste of APU uses to be factored into the efficiency score for APU-enabled trucks, because that inclusion is accurate and important. It should be noted that the network of EPS locations has tripled in the past four years, and the two biggest operators, comprising over 90% of all locations, are willing to cross-honor membership agreements so as to enhance ubiquity. Ultimately, an OEM can have high confidence of sum certain idle reduction if it is presented with an executed agreement between the buyer and an EPS provider specific to a vehicle identification number, and the OEM should receive an improved vehicle credit for the associated VIN. No modification is necessary for existing EPS service procedures in order to document the utilization of a vehicle bearing a specific VIN – all transactions are recorded and vehicle specific. The fairest protocol is not straightforward, but it is accurate, enforceable, and important for market efficiency. [EPA-HQ-OAR-2014-0827-1250-A2 p.4]

**Response:**

The agencies made several changes to the treatment of AES and idle reduction technologies in the final rule. We, however, did not specifically include EPS as one of the technologies on the menu of idle reduction technologies due to the lack of data supporting the amount of idle operation that is reduced in the real world through the use of EPS on a given tractor. Tractors manufactured during the Phase 2 timeframe with either the tamper-proof AES or adjustable AES options would receive a CO<sub>2</sub> emissions and fuel consumption reduction in GEM. EPS paired with an AES could receive this level of reduction. We recognize that EPS could be an important idle reduction technology, but believe the technology should be evaluated in the off-cycle credit program so that data on specific vehicles can be considered.

It is also worth noting that the agencies are not mandating AES under the Phase 2 rulemaking. The agencies have adopted CO<sub>2</sub> emissions and fuel consumption standards based on our analysis of *one* technology pathway for each level of stringency, but manufacturers will be free to use any combination of technology to meet the standards, as well as the flexibility of averaging, banking and trading, to meet the standards on average.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

We have heard repeated concerns from our employers that the proposed emission standards might inadvertently be more stringent than EPA had intended. For example, the assumed 2017 aero baseline uses the best aero trucks available, not the average. This baseline increases stringency by roughly 2.5%. The compliance margin for aerodynamic audits has been removed. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

**Response:**

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The baseline was not determined by or declared to be the average results of the vehicles tested, as some commenters maintained. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

The agencies' assessment for the final rule is that only Bins I through V are achievable with known aerodynamic technologies, but that Bins VI and VII have less known technology paths. Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . See RIA Chapter 2.8.2.2. These aerodynamic improvements have been demonstrated within the program on two vehicles in 2015. In the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing these demonstrated aerodynamic technologies as early as 2021 MY on a limited scale. We adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time.

The agencies received comments from manufacturers arguing for the agencies to establish compliance margins that would allow actual production vehicles to exceed the standards by some fixed amount. These comments included specific requests for an aerodynamic compliance margin. We also received comments from UCS supporting the elimination of the aerodynamic compliance margin. As explained in Section I.C.1 of the Preamble, although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA$ s and solicited supplemental comments on it. See 81 FR 10825. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur.

**Organization:** International Council on Clean Transportation (ICCT)



*Transmissions* – Advanced integrated transmissions, including automated manual transmissions that enable downspeeding and optimal engine operation, by leading companies like Eaton and Volvo, have already been introduced (Stoltz and Dorobantu, 2014; Greszler, 2014). Automatic transmissions are the norm in Europe, and increasingly advanced dual-clutch transmissions are being introduced there. The agencies considered this technology as part of their stringency determination, but more advanced versions of this technology have been demonstrated in SuperTruck (Delgado and Lutsey, 2014). [EPA-HQ-OAR-2014-0827-1180-A4 p.4]

## **Tractor-trailers**

The ICCT offers several new technical data inputs and suggestions for the agencies to consider in their final tractor and tractor-trailer stringency determination. We suggest that the agencies consider the two recent ICCT analyses that include rigorous state-of-the-art tractor-trailer vehicle simulation modeling (Delgado and Lutsey, 2015) and a detailed synthesis of best-available technology cost inputs (Meszler et al, 2015) in their final tractor standard determination. The scope of these studies were designed to the particular technologies under consideration by manufacturers, and the particular simulation, cost, cost-effectiveness, and benefits calculation methods are matched to those of the agencies analysis in their light-duty vehicle and initial phase heavy-duty vehicle rulemakings. [EPA-HQ-OAR-2014-0827-1180-A4 p.10]

Our analysis indicates that the technology potential is higher, and the technology cost is lower, than the agencies assessed. In those studies, we find that technology levels beyond the proposed 2027 standards can achieve 9 mile-per-gallon tractor-trailers on highly comparable drive cycles to the agencies' new cycles, while also delivering payback periods for truck owners of 6 months (under high fuel prices) up to 1.5 years (with sustained low fuel prices). This compares to the agencies' approximately 8 mile-per-gallon tractor-trailer standards in 2027, when tractors and trailer improvements are combined. In addition, we found the total cost of delivering a 9-mpg tractor-trailer is approximately \$9,000, which is over 20% lower than the agencies' \$11,680 projection for tractors complying with the proposed 2027 standards (see Delgado and Lutsey, 2015; Meszler et al, 2015). As a result, the new ICCT technology assessment – not included in the proposal's assessment – demonstrates that the tractor-trailer stringency could be increased to above 9 mpg in 2027 and would cost several thousand dollars less per tractor-trailer than the agencies estimated. We recommend that the agencies consider these data inputs in their final technical inputs and in their final tractor-trailer stringency determination. [EPA-HQ-OAR-2014-0827-1180-A4 p.10-11]

The increased incorporation of incremental engine efficiency technology, discussed above, appears to a key discrepancy between the ICCT and agencies' analyses on tractor-trailer efficiency. Based on that ICCT tractor-trailer analysis and the engine research above, our primary recommendation is to incorporate the required improvements from greater engine technology, as described above, as equivalent required tractor efficiency fuel consumption and CO2 reductions that go beyond the proposed 2021, 2024, and 2027 standards. Including the engine improvements (i.e., 4.2% as proposed, up to 10% in 2027) would approximately reduce the fuel consumption and emissions across all of the tractor categories in 2027 by 6%. [EPA-HQ-OAR-2014-0827-1180-A4 p.11]

For additional technical context, especially relevant for 2027 standards, the ICCT analyzed the extent to which the agencies' assessment of applicable technologies in the proposed tractor stringency differ from SuperTruck tractor-trailer efficiency. The SuperTruck teams are achieving 10.7 mpg (Peterbilt) and 12.2 mpg (Daimler/Freightliner) in real-world testing (Buchholz, 2014; Daimler, 2015). To rigorously compare the technologies we utilized the EPA GEM model (Phase 2 GEM v1.0) with the physical attributes and off-cycle credits just as applied in the agencies' analysis and on the official GEM test cycles, and assessed differences for SuperTruck teams' demonstrated physical attributes (See Lutsey, 2015b). As analyzed, the

regulation would result in tractor-trailers that achieve about 8 miles per gallon on the new regulatory test. SuperTruck technologies would go further, delivering 9-10 mpg for tractor-trailers on the same test cycle. Although the off-cycle credits (e.g., automated manual transmission, 6x2, direct drive, tractor automatic tire inflation) are included for all the technology packages, idling reduction technology is not included in the numbers shown. [EPA-HQ-OAR-2014-0827-1180-A4 p.11]

Based on this Phase 2 GEM analysis of the standards and SuperTruck technology, it appears to be clear that the proposed standards are at considerably lower technology levels than the technical potential as indicated from the U.S. DOE SuperTruck Peterbilt/Cummins and Daimler demonstration prototypes. Considering the very large gap in efficiency between the proposed standards and improvements achieved through the SuperTruck program, and considering the research progress and current uptake of SuperTruck technologies in the marketplace (see Bloch-Rubin and Gallo, 2014), we recommend that the agencies investigate the full spectrum of SuperTruck technologies and assess standards up to those efficiency technology levels. [EPA-HQ-OAR-2014-0827-1180-A4 p.11]

**Response:**

*Transmissions*

The agencies have evaluated the various transmission configurations available for heavy-duty tractors. The agencies recognize the effectiveness of these technologies in two ways. First, the agencies recognize the benefit of automation in reducing the variability of drivers which should lead to operation in the optimal gear more often. The second is through the optional transmission efficiency test that will recognize the benefits of improved gear efficiencies. The agencies have built some improvements in transmission gear efficiency into the technology package used to derive the final standards. The agencies have included ICCT's assessment of transmissions in our transmission technology discussion in Section III.D.1.b.

*Overall Stringency*

The agencies considered all of the general comments associated with the proposed Alternative 3 and Alternative 4 tractor standards. We believe there is merit in many of the detailed comments received regarding technologies. The agencies have included ICCT's assessment of tractor technologies in our technology discussion in Preamble Section III.D.1.b. and considered their assessments along with other literature and comments for the final rule. The agencies have developed a set of final tractor standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies. In general, the final Phase 2 tractor standards are similar in overall stringency as the levels proposed in Alternative 3, but have been determined using new technology packages that reflect consideration of all of the technology comments, and in several respects reflect greater stringency than the proposed Alternative 3. Specifically, the engine improvements for the final rule reflect greater reductions. Consistent with the commenter, we have incorporated the required improvements from the more stringent engine assessment into the tractor (i.e. vehicle) fuel consumption and CO<sub>2</sub> standards for the final rule.

As noted by the commenter, DOE has partnered with the heavy-duty industry to demonstrate high roof sleeper cab tractor and box trailer combinations (only one of the ten tractor subcategories) that achieve a 50 percent improvement in freight efficiency evaluated as a 65,000 pound vehicle operating on the highway under somewhat controlled circumstances. However, these SuperTrucks are not necessarily designed to handle the rigors of daily use over actual in-use roads. For example, they generally have very limited ground clearance that would likely preclude operation in snow, and would be very susceptible to

damage from potholes or other road hazards. In addition, each manufacturer only produced a single high roof sleeper cab for demonstration purposes at a cost of nearly \$40-\$80 million each. While the agencies cannot simply apply the SuperTruck program achievements directly into the Phase 2 program because of the significant differences in the limited purpose of SuperTruck and the plenary applicability of a regulation to all operating conditions and duty cycles, it is helpful to assess the achievements and evaluate how the technologies could be applied into mass production into a variety of real world applications while maintaining performance throughout the full useful life of the vehicle.

**Organization:** International Foodservice Distributors Association

IFDA member companies are among the largest private fleet operators in the country using tractors and refrigerated trailers to service their hundreds of thousands of operator customers each day. The Phase 1 emissions regulations currently in effect have resulted in considerable increases in acquisition costs for power units over the last 10 years. The proposed Phase 2 requirements would only add to this already considerable additional expense for member companies. While the proposal maintains that these additional costs will be offset by reduced fuel consumption, we are concerned that the proposal includes unrealistic analyses of the state of technology, rates of adoption of new technologies and the potential return on investment. [EPA-HQ-OAR-2014-0827-1258-A1 p.1

As purchasers of equipment, the burden of meeting the emissions requirements would not fall on IFDA members. Instead the proposal sets emissions targets for original equipment manufacturers (OEMs), yet these companies must rely on adoption of their technology by purchasers to meet these targets. IFDA is strongly concerned that targets should not be set in a manner that would force users such as IFDA members to purchase unproven and unreliable equipment in order for OEMs to meet the requirements. Each company has different transportation requirements depending upon such issues as location and customer base. Many of the solutions anticipated in the proposal would not make sense for different types of transportation operations. Foodservice distributors should not be required to purchase technologies that are not cost effective for their fleets. [EPA-HQ-OAR-2014-0827-1258-A1 p.2

IFDA is also concerned that the foodservice distribution industry would be disproportionately impacted by the technology required to comply with the new targets. Industry drivers are generally not long haul but rather make multiple stops during the day which limits the ability of many technologies to be effective in reducing emissions. Many of the technologies anticipated by the EPA would do little to impact emissions or be impractical for distributors in short haul delivery environments. This is also true for the trailer requirements which generally rely on streamlining improvements which provide little benefit when used over shorter driving distances. As a result, distributors could be forced to pay for technologies that result in little real emissions reductions in their operations. [EPA-HQ-OAR-2014-0827-1258-A1 p.2]

**Response:**

The agencies developed ten tractor and nine vocational subcategories in addition to specialty chassis subcategories that acknowledge that trucks operate under many different conditions and with different driving patterns. We also have included three different drive cycles, ARB transient and cruise cycles at 55 and 65 mph with grade, to cover the range of operation of trucks. On top of this, the agencies also adopted provisions that require manufacturers to meet the standards on average using a suite of technologies and allow the manufacturers to bank and trade credits, along with carry-over credit deficits for three years. Each of these design elements of the program were developed to allow manufacturers to produce products that meet the needs of their customers. In addition, the agencies are adopting provisions in Phase 2, and have existing provisions in Phase 1 (EPA's 40 CFR 1037.630 and NHTSA's regulation at 49 CFR 523.2), that allow low-roof tractors intended for intra-city pickup and delivery, such as those that

deliver bottled beverages to retail stores to be treated as vocational vehicles. The vocational vehicle standards are predicated on drive cycles with distance-based weighting factors of 20, 54, or 90 percent transient cycle depending on the type of vocational operation (see 40 CFR 1037.510). The transient cycle is representative of the type of driving cited by the commenter – short haul operations with multiple stops per day.

With respect to the portion of the comment dealing with trailers, the agencies believe the majority of box vans will experience CO<sub>2</sub> and fuel consumption reductions with use of the technologies encouraged by this rulemaking. We also believe many of the box vans that operate at lower speeds will have work-performing equipment (e.g., side platforms, rear lift gates) that will allow manufacturers to designate these trailers as partial-aero or non-aero vans. Partial-aero standards are based on adoption of a single aerodynamic device, and non-aero vans have design standards that require installation of tire technologies only with no aerodynamic requirements. A small fraction of the box van industry may not qualify for a partial- or non-aero designation, yet still operate at lower speeds. These vans may not achieve the real-world benefits that their compliance results would suggest or that similar vans experience because they frequently travel at higher speeds. However, we believe that they will still benefit from the technologies, even in urban operation. In RIA Chapter 2.10.2.1.1, we show that even trailers operating under 100% transient conditions will experience a small benefit from use of trailer skirts, and trailers that spend any time at speeds of 55-mph or greater will achieve benefits of at least 1% during that time, compared to operating without skirts.

**Organization:** Lubrizol Corporation

Higher-performing lubricants will play an important role in helping the OEMs comply with the Phase 2 Rule. Indeed, as shown in Figure 1 below, many of the technologies and strategies that will be used by the OEMs will require HPLs to operate cleanly, efficiently, and without compromising equipment performance and durability. [EPA-HQ-OAR-2014-0827-1325-A1 p.2]

[Figure 1 can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1325-A1]

**Response:**

The agencies' assessment of axle improvements, including the use of high performing lubricants, found that axles built in the Phase 2 timeline could be 2 percent more efficient than a 2017 baseline axle.

**Organization:** Meritor, Inc.

#### **Define Drive Axle Disconnect and Resolve with 6x2 Default FE Credit**

Meritor is supportive of the 2.5 percent credit for a constant 6X2 configuration. Our internal testing plus vehicle testing in real-world conditions supports this level of efficiency improvement. [EPA-HQ-OAR-2014-0827-1254-A1 p.9]

On a related note, Meritor believes that the 2.5 percent FE benefit in the proposed rule is excessive and over-credits the technology because it will not be engaged for the amount of time assumed in the model. For example, under the current proposal, a Linehaul Sleeper Cab with a Detachable Tandem would receive an effective credit of 2.38 percent which is nearly identical to the 2.5 percent granted to a permanent 6X2-truck configuration. Meritor does not believe the data support this large credit due to the limitations on the duty cycle. In addition to the transient cycles, the detached axle will be engaged for

certain percentage of the population based on load conditions at 55 mph and 65 mph. For example, a fully loaded tractor trailer cannot disengage one of its axles without a significant impact to grade performance and the life of the engaged axle. This latter point can be countered by upgrading the constantly engaged drive axle to an axle used for a 6X2 configuration, however, this solution has the drawback of additional cost which may not be accepted in the marketplace and the upgraded axle is less efficient than its 6X4 counterpart. Therefore, Meritor recommends that a fuel efficiency benefit of 2.0 percent be assigned to the disengageable tandem for the 55 mph and 65 mph drive cycles to account for the more limited use. [EPA-HQ-OAR-2014-0827-1254-A1 p.11]

Meritor is also supportive of regulations that encourage investment in technologies that disengage a tandem-drive axle. Although this technology is in its infancy, activity in international markets illustrates the potential for this technology to migrate to North America within the regulatory timeframe, therefore, disengageable tandem-drive axles should be included in the proposed regulation. We have some concerns, however, about the proposed rule as it is currently written. [EPA-HQ-OAR-2014-0827-1254-A1 p.9-10]

First, the technology is not well defined in the proposal. It is referred to several times within the Proposal and Regulatory Impact Analysis by different names such as 6X4 “Axle Disconnect,” a 6X2 configuration “that may be engaged only during some types of vehicle operation,” “6x2 axle disconnect” and “part time 6X2.” To ensure clarity and provide consistent definitions, we advocate the use of one name: “DISENGAGEABLE TANDEM” be used along with a definition. [EPA-HQ-OAR-2014-0827-1254-A1 p.10]

Meritor defines DISENGAGEABLE TANDEM as a tandem-drive axle that provides two modes of operation: 1) a “standard” drive mode whereby torque from the transmission is transferred to both axles of the tandem, and 2) a “disengaged” drive mode whereby torque from the transmission is transferred to only one axle of the tandem. Each drive mode is selected based on the vehicle’s operating condition (load, grade, speed, etc.) per the axle manufacturer’s application guidelines. [EPA-HQ-OAR-2014-0827-1254-A1 p.10]

Even with this established definition, there are several possible configurations of DISENGAGEABLE TANDEM, each with a significantly different impact on fuel efficiency: [EPA-HQ-OAR-2014-0827-1254-A1 p.10]

**BASIC DISENGAGEABLE TANDEM** - In the most basic configuration, the disengaged axle is disconnected from the powertrain input. There are minimal torque-related losses in the disengaged axle but the disengaged axle’s gearset is still connected to the wheels via the axle shafts and remains spinning inside the axle. Therefore, there is still oil churning losses in the disengaged axle and the resulting axle efficiency benefit of this configuration is less than the benefit of a 6x2-axle configuration. Oil churning losses vary greatly, as much as 2 percent depending on the amount of oil in the axle, the type of oil in the axle, the rotational speed of the gearset, and the vertical location of the gearset. [EPA-HQ-OAR-2014-0827-1254-A1 p.10]

**ENHANCED DISENGAGEABLE TANDEM** - In a more complex disengageable tandem configuration, the axle gear set is disconnected from both the axle input and the wheel input rendering the gears stationary and eliminating the resulting churning losses. This is in addition to the minimal torque-related losses realized in the BASIC configuration. In the ENHANCED configuration, the efficiency benefit as compared to a conventional 6X4 will be close to the benefit of a 6x2 axle configuration while a drive axle is disconnected. [EPA-HQ-OAR-2014-0827-1254-A1 p.10]

LIFTABLE/DISENGAGEABLE TANDEM - In a yet more complex disengageable tandem configuration, the disconnected axle may also be lifted off of the ground to both eliminate churning losses but also bearing friction and tire rolling resistance. In this configuration, the efficiency benefit will be close to that of a 4X2-axle configuration. [EPA-HQ-OAR-2014-0827-1254-A1 p.10-11]

[Chart, 'Axle Configuration Efficiency', can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Meritor's recommendation is to define DISNENGAGEABLE TANDEM in the final rule as described above in 2) Enhanced Disengageable Tandem as it is the only configuration that warrants a fuel efficiency credit at this time. [EPA-HQ-OAR-2014-0827-1254-A1 p.11]

### **Expand and Update Weight Reduction Technologies**

As with Phase 1, Meritor supports the inclusion and expansion of weight reduction technologies in the proposed regulation as well as the methodology of implementation via the GEM model. We also agree with NHTSA and EPA that weight reduction in the tractor sector should not be included in the anticipated Technology Adoption Rate given the high cost-to-benefit ratio in this segment. We believe weight reduction has a more substantial role to play in the vocational sector and when weight reduction technologies are implemented, the resulting fuel efficiency credits should be acknowledged. Therefore, Meritor is requesting the expansion of weight reduction technologies to include the following: [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

Aluminum Axle Carrier – Apples-to-apples comparisons between steel and aluminum carriers illustrate consistent weight reductions of 60 pounds for the rear-front-drive axle, 35 pounds for the rear-rear-drive axle and therefore 95 pounds for the tandem. In addition, this technology has been proven in the market and is available with very limited penetration. [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

AL Carrier (Tandem Front-Drive Axle) = 60 pounds [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

AL Carrier (Tandem Rear- Drive Axle) = 35 pounds [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

Aluminum Drum Brake Bracket – The brake bracket which is the main structural component between the air brake actuator and the cam. We anticipate the availability of an aluminum version of this bracket in the timeframe of the regulation which will provide a calculated per vehicle weight savings of 36 pounds for a 6X4 configuration. [EPA-HQ-OAR-2014-0827-1254-A1 p.12]

[Brake Bracket picture can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Finally, Meritor believes that weight savings should be credited for the use of single-piece drivelines in excess of 86.” Today, most drivelines in excess of 86” are two piece. A single-piece driveline greater than 86” eliminates a u-joint and center bearing assembly. In addition, it requires the use of a stiffer driveline tube which can be achieved with a larger OD driveline tube made of steel, aluminum or composite. It is relatively straightforward to calculate the weight savings for a typical 110” driveline in each of the three materials listed above: [EPA-HQ-OAR-2014-0827-1254-A1 P.13]

[Chart, 'Driveline Weights @ 110', can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

[Chart, 'OEM Class 8 Driveline Length Distribution', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Per the above tables, Meritor requests that the weight savings technology list include options for one-piece drivelines in Class 8 Tractors per the table below. [EPA-HQ-OAR-2014-0827-1254-A1 p.14]

Meritor would also like to correct the current credits for high strength steel drums. The proposed rule currently grants an 8-pound weight savings for non-drive High Strength Steel Drums and 11 pounds for high strength steel drums for Class 8 Drive Axles per vehicle. [EPA-HQ-OAR-2014-0827-1254-A1 p.14]

[Table, 'Proposed Vocational Weight Reduction Technologies', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Our data for currently available drum technologies indicate that a larger weight-reduction credit be awarded. [EPA-HQ-OAR-2014-0827-1254-A1 p.14]

[Table, of drum weight and configuration, can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

Based on this data, Meritor recommends that a 42-pound weight savings be credited per tractor for using High-Strength Steel Drums on the Steer (non-drive) axle and 74-pound per vehicle for 6X4 Drive-Axle applications. [EPA-HQ-OAR-2014-0827-1254-A1 p.15]

Below is a table representing our recommendation for weight reduction technologies and associated values: [EPA-HQ-OAR-2014-0827-1254-A1 p.15]

[Table, 'Meritor's Recommended per Vehicle Weight Reduction Technology Values', can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1254-A1]

### **Improve Automatic Tire Inflation Definition and Correct Misstatements about the Market.**

The definition of automatic tire inflation systems (ATIS) listed in Subpart 1, Definitions & Other Reference Information, is not consistent with the historical industry definitions. The Technology Maintenance Council, (TMC), of the American Trucking Association, in their Recommended Practice, RP239A (most recently updated in 2014) uses the following widely accepted definition of ATIS: [EPA-HQ-OAR-2014-0827-1254-A1 p.15]

Automatic Tire Inflation Systems maintain tire pressure at a single preset level and are pneumatically or electronically activated. These systems eliminate the need to manually inflate tires. [EPA-HQ-OAR-2014-0827-1254-A1 p.15]

The current definition included in the rulemaking states: [EPA-HQ-OAR-2014-0827-1254-A1 p.15]

ATIS means a system installed on a vehicle to keep each tire inflated to within 10% of the target value with no operator input. [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

Assigning an arbitrary number of 10 percent is not consistent with the manner in which these systems are used in practice. Tire pressure increases by 15 – 20 percent when the tire is hot and running on a fully loaded vehicle at 75 mph on asphalt roads on a sunny day. Tires cool back down to the specified tire

pressure after a few hours. The reduced fuel economy and increased greenhouse gas emissions are due to tire under inflation. ATIS systems assure that tires will always be running at the recommended cold tire inflation pressure. [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

**Response:**

*6x2*

The agencies reassessed the effectiveness of 6x2 axles and disengageable tandem axles. The agencies' assessments of these technologies show that the reductions are in the range of 1 to 3 percent. For the final rule, the agencies are simulating 6x2, 4x2, and disengageable axles within GEM instead of providing a fixed value for the reduction. This approach is more technically sound because it will take into account future changes in axle efficiency and accounts for the fact that the technologies will have different effectiveness depending on the drive cycle. See generally RIA section 2.4.5.

Consistent with the comments, EPA has defined a disengageable axle configuration as 6x4D. EPA defines this in 40 CFR 1037.520 as an axle that can automatically switch between 6x2 and 6x4 configuration. When the axle is in the 6x2 configuration the input and output of the disconnectable axle must be mechanically disconnected from the drive shaft and the wheels to qualify.

*Weight Reduction*

The agencies are adopting an expanded list of weight reduction options which could be input into the GEM by the manufacturers to reduce their certified CO<sub>2</sub> emission and fuel consumption levels. As at proposal (and as endorsed by this commenter), the agencies view weight reduction as a technology with a high cost that offers a small benefit in the tractor sector. For example, our estimate of a 400 pound weight reduction will cost \$2,050 (2012\$) in 2021MY, but offers a 0.3 percent reduction in fuel consumption and CO<sub>2</sub> emissions. Therefore, we did not premise the Phase 2 tractor standards on a technology package that included weight reduction.

The agencies are updating the weight reduction value in the table included in 40 CFR 1037.520 for brake drums and adding values for single piece drivelines. The agencies, however, are not including weight reduction for the axle carrier because we cannot be certain that this weight reduction value has not already been included in the weight reduction value of the axle. Manufacturers will continue to have the option in Phase 2 to request for approval weight reduction components not included in the tables of 40 CFR 1037.520.

*ATIS*

Consistent with this comment, EPA has revised the definition of ATIS in 40 CFR 1037.801 to mean a pneumatically or electronically activated system installed on a vehicle to maintain tire pressure at a single preset level. These systems eliminate the need to manually inflate tires.

**Organization:** Michelin North America, Inc.

**Distinguishing New Generation Wide-Base Single (NGWBS) Tire Technology for the GHG and FE Standards for Medium- and Heavy-Duty Vehicles and Engines**

**Clarification to assure distinguishing the NGWBS tire technology**



New generation single wide tires, which were first introduced in 2000, are designed to replace a set of dual tires on the drive and/or trailer positions. They are designed to be interchangeable with the dual tires without any change to the vehicle. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

Clarification is needed here to distinguish the technology of the 'super single' or 'wide base single (WBS)', e.g. 385, 425, and 445/65R22.5, drive and trailer tires from the 'new generation wide base single (NGWBS)' tires, e.g. 445/50, 455/55R22.5. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

Referring to the DOT Regulatory Impact Statement (RIS), Michelin is not aware of a New Generation Wide Base Single tire dimension known as 435/50R22.5. Also the availability of the 455/55R22.5 dimension is not included in the DOT RIS. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

#### **Availability of stud-piloted wheels for vehicle fitments of NGWBS tires**

In addressing the DOT RIS statement that 'if the vehicle does not have hub-piloted wheels, there may be a need to retrofit axle components', stud piloted 22.6)(14' wheels have been available for retrofit on vehicles which are not equipped with hub-piloted axle ends. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

This information will assist users in their considerations for NGWBS tire conversions. [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

#### **Additional information on the NGWBS tire technology on rolling resistance, an environmental Life Cycle Analysis, and summary of the attributes**

The NGWBS 445/50- and 455/55R22.5 tires were introduced to be direct replacements for the conventional long haul dual tire sets, e.g. 275/80 or 295/75R22.5, and the 11R22.5, respectively, and offer LRR advantages as defined by the EPA/DOT NPRM Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles —Phase 2. [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

The NPRM defines 'Low rolling resistance tire' as follows: [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

- A tire on a vocational vehicle with a tire rolling resistance level (TRRL) of 7.7 kg/metric ton or lower.
- A steer tire on a tractor with a TRRL of 7.7 kg/metric ton or lower.
- A drive tire on a tractor with a TRRL of 8.1 kg/metric ton or lower.

See the following chart of 'Drive Tire RR vs Time' comparing 'Best Dual' vs 'Best NGWBS' as an example of the NGWBS tire LRR technology development. [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

[Chart can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

#### **Additional support of the NGWBS tire technology performance and use**

The Department of Transportation Volpe Center's 2015 report titled 'Review and Analysis of Potential Safety Impacts and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles' summarizes research and analysis findings on potential safety issues associated with both the diverse alternative fuels (natural gas-CNG and LNG, propane, biodiesel, and

power train electrification), and the specific FE technologies recently adopted by the MD/HDV fleets. [EPA-HQ-OAR-2014-0827-1286-A1 p.6]

- These include Intelligent Transportation Systems (ITS) and telematics, speed limiters, idle reduction devices, **tire technologies (single-wide tires**, and tire pressure monitoring systems-TPMS and Automated Tire Inflation Systems-ATIS), aerodynamic components, vehicle light-weighting materials, and Long Combination Vehicles (LCVs). [EPA-HQ-OAR-2014-0827-1286-A1 p.7]
- The key finding from the literature review and Subject Matter Experts (SME) interviews is that there appear to be no major safety hazards preventing the adoption of FE technologies, or the increased use of alternative fuels and vehicle electrification. [EPA-HQ-OAR-2014-0827-1286-A1 p.7]

With respect to the NGWBS tire technology, the following studies further support the aspects of NGWBS tire technology performance and use. [EPA-HQ-OAR-2014-0827-1286-A1 p.7]

- 'Objective Analysis of the Stability of an Extra-Legal Weight Tractor Trailer Combination during a Rapid Air Loss (RAL) Event' Jeff Anderson and Ryan Pawlowski Michelin Americas Research Company, Greenville, SC 31st Annual Meeting and Conference on Tire Science and Technology Cleveland, OH, September 19, 2012 [EPA-HQ-OAR-2014-0827-1286-A1 p.7]
- 'Heavy Truck Driver Workload Investigation using conventional and NGWBS tires for quantifying driver workload for a heavy truck driver through the measurement of muscle activity during four maneuvers' Ryan Pawlowski Tire Society Sept. 2013 [EPA-HQ-OAR-2014-0827-1286-A1 p.7]

### **Tire Technology Costs**

[Table, 'Class 7 and 8 Tractor Technology Incremental Costs in the 2021 Model Year Preferred Alternative vs. the Less Dynamic Baseline', can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

From the NPRM Table III-15 above, Michelin believes that the current estimates of additional cost (per vehicle) for the improved RRc tires are underestimated, e.g. from \$9 to \$81 depending on vehicle class. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

We would estimate that an appropriate value, taking into account the appropriate recuperation of indirect costs (R&D and Industrialization) would be above \$25/tire and, therefore, \$250 per truck (tractor 10 tires). [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

Referencing the draft Regulatory Impact Analysis [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

- Given that the stated R&D investment of most tire manufacturers varies between 2% and 3.5% of revenues and that a new product line can take between 5 to 10 years of development (especially if it requires new building bricks) and that the initial payback should be expected within 5 years, it would not be unreasonable to use a premium of 2% to 7% (2% R&D \*5 years development 15 years payback = 2%, and 3.5% R&D \* 10 years development 15 years payback = 7%).
- Applying this to an average cost per tire of \$300 to \$400, the premium value would range from \$6/tire to \$28/tire or \$60/truck to \$280/truck for a 6X4 or 6X2 tractor.

Michelin agrees with the values proposed except for the last one from EPA/DOT for drive tires (@ \$121 per truck for 8 tires or \$15/tire. This value is too low, however, most importantly; these numbers do not appear to match with the above Table III-15. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

Recent studies done on over 400 tires (Michelin and others) are showing a conversion rate which appears slower than the assumption made, i.e. all below SmartWay before 2027, unless SmartWay made provisions for vocational applications (on/off, urban, refuse). [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

Today we find that 60% to 70% of all tire tread patterns sold (not weighted) would still be above the 6.5, 6.6, and 5.1 limits for steer, drive and trailer respectively. Many of these are vocational offers that are not yet affected by the California requirements. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

Despite the above comment, we do not believe that the assumption is too severe and can still be maintained as an important input parameter in setting the ambitions, and, therefore, no change requested. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

We agree that the development of future generation LRR tires with minimal or no compromise on other important performance characteristics will require significant R&D and industrialization investments. Such additional costs are not current properly reflected in the current Regulatory Impact Analysis (RIA). [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

The actual assumption on adoption rates by vocation and proportion of vocation by vehicle class would be useful. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

We believe that the current estimates of additional cost (per vehicle) for the improved RRc tires are underestimated, i.e. from \$9 to \$81 depending on class. [EPA-HQ-OAR-2014-0827-1286-A1 p.11]

We would estimate that an appropriate value, taking into account the appropriate recuperation of indirect costs for R&D and Industrialization would be above \$25/tire and therefore \$250 per 10 tire truck tractor. [EPA-HQ-OAR-2014-0827-1286-A1 p.12]

The values proposed for potential evolution of RR by product category (steer and drive) appears reasonable for the drive (even though the 4.5 kg/ton would require a significantly higher adoption rate of the new generation wide base single (NGWBS) tires). [EPA-HQ-OAR-2014-0827-1286-A1 p.12]

However, the value of 4.3 kg/ton for steer is highly unlikely. A more reasonable number based on current evolution, North American sizes and fundamental research conducted would be 5.0 kg/ton. [EPA-HQ-OAR-2014-0827-1286-A1 p.12]

**Response:**

The agencies appreciate the clarification regarding NGWBS.

The agencies considered the dual and NGWBS rolling resistance information provided by Michelin in developing the rolling resistance considered in the technology packages to demonstrate the feasibility of the final rule standards. Specifically, the agencies have evaluated this comment and find it persuasive. We have accordingly increased the coefficient of rolling resistance for Level 3 tires in the technology packages used to determine the stringency of the final rule standards based on the comments and the certification data. The Level 3 steer tire CRR increased from 4.3 kg/ton in the NPRM to 4.9 kg/ton in the

final rule. The Level 3 drive tire CRR increased from 4.5 kg/ton in the NPRM to 5.0 kg/ton in the final rule. See Section III.D.1.b.iii of the Preamble to the final rules.

The agencies discuss the 2015 report in Section IX.N of the Preamble to the final rule.

We have estimated the cost of lower rolling resistance tires based on an estimate from TetraTech of \$30 (retail, 2013\$). We also have applied a “medium” complexity markup value for the more advanced low rolling resistance tires. We expect that, when replaced, the lower rolling resistance tires would be replaced by equivalent performing tires throughout the vehicle lifetime. As such, the incremental increases in costs for lower rolling resistance tires would be incurred throughout the vehicle lifetime at intervals consistent with current tire replacement intervals.

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Modify Credits, Operation Time and Fuel Consumption Rate for Idle Reduction Technologies**  
[EPA-HQ-OAR-2014-0827-1274-A1 p.5]

There are several aspects regarding idle reduction technologies’ credit in the GEM for the Class 7 and 8 tractor vehicle category. Since the agencies are proposing to carry over the Phase 1 credit into Phase 2, MEMA reiterates our original comments relating to the agencies’ Phase 1 supporting analysis for the idle reduction technology credits.<sup>4</sup> MEMA recommends the agencies modify the credit based on the merit of the individual idle control technology, clarify the definition of “other” and revise the operation time and fuel consumption rates for idle reduction technologies. [EPA-HQ-OAR-2014-0827-1274-A1 p.5-6]

Modify the GEM Credit – The proposed Phase 2 carries over the Phase 1 credit for all idle reduction devices for Class 7 and 8 sleeper cabs, which is 5 percent.<sup>5</sup> This 5 percent was based on Phase 1 Draft Regulatory Impact Analysis of idle control technologies that included: auxiliary power units (APUs); fuel operated heaters (FOHs); battery air conditioning systems (BACs); and, thermal storage air conditioning systems (TACs).<sup>6</sup> The analysis assumed that all idle reduction devices use 0.2 gallons of fuel per hour (gal/hr). However, MEMA urges the agencies to give each idle reduction technology credit based on the fuel consumption and emissions of that technology and assume that all devices consume 0.2 gal/hr. This approach would be consistent with the different levels of credit given to different types of aerodynamics and tires. The various idle control technologies listed in the agencies’ Phase 2 Draft RIA have fuel consumption from the battery APU of almost zero to the diesel engine APU of approximately 0.3 gal/hr fuel consumed and also emit different amounts of GHG. [EPA-HQ-OAR-2014-0827-1274-A1 p.6]

MEMA submitted proposed modifications to the Phase 1 DRIA Table 2-22: Idle Credit Calculation. Below is an excerpted version of MEMA’s original proposed modifications for the agencies’ reference. It shows the recommendation for credit based on the fuel consumption and GHG emissions of each technology. Using middle-idle figures in the table below, MEMA re-submits the following recommendation (also see the Appendix): [EPA-HQ-OAR-2014-0827-1274-A1 p.6]

[Table, excerpt from MEMA’s original proposed modifications to the idle credit calculations, can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1274-A1]

Also, in the NPRM’s Table III-7 Proposed Phase 2 Technology Inputs, the agencies present a weighting factor percent reduction of 5 percent for APUs with automatic engine shutoff (AES) and of 7 percent for “Other” idle reduction. This appears to be an acknowledgement by the agencies that some idle reduction devices reduce GHGs more than others. MEMA proposes that perhaps an additional incentive could be given to trucks that have idle reduction technologies factory-installed as a way to assure the technology

benefit will be realized. MEMA presumes that “Other” may include idle reduction technologies such as battery powered units. However, since it is not exactly clear in the NPRM, MEMA asks the agencies to clarify and define what is intended to be covered as “Other.” [EPA-HQ-OAR-2014-0827-1274-A1 p.6-7]

Revise Operation Time and Consumption Rate Assumptions – MEMA supports the agencies’ proposal that, in order to qualify for credits, it is mandatory that the truck is equipped with an AES. Five-minute mandatory engine shutdown will support increased annual hours of operation for idle reduction equipment. In the supporting analysis from the Phase 1 RIA, the agencies assumed Class 8 sleeper cab spends 1,800 hours in extended idle per year and travels about 250 days per year. MEMA recommends that the agencies use 2,500 annual hours for APUs and 1,250 annual hours for FOHs to better reflect real-world application and experiences. Additionally, the agencies’ analysis assumed that the main engine consumes about 0.8 gal/hr during idling. However, based on our analysis, MEMA recommends that 0.87 gal/hr fuel consumed by the main engine during idle be used in the calculations for credit. [EPA-HQ-OAR-2014-0827-1274-A1 p.7]

Please view the Appendix attached to MEMA’s comments for supporting details. It shows the recommendation for credit based on the recommended hours of operation and fuel consumption rate for various APUs, FOHs and combination units. [EPA-HQ-OAR-2014-0827-1274-A1 p.7]

**Extend Idle Reduction Credit to Class 7 and 8 Day Cab Tractors** [EPA-HQ-OAR-2014-0827-1274-A1 p.7]

The agencies asked for comments in the Phase 2 NPRM about whether or not the proposed vocational idle reduction approach should be extended to Class 7 and 8 day cab tractors. Increasingly, companies that operate day cabs are implementing requirements to reduce their idle time in drive cycles that have a lot of stop-and-go. Examples of these type of drive cycles are operations where the vehicle is making several local/regional deliveries and/or waiting in long lines for pick-up/drop-off and not being allowed to leave the truck at idle, such as at loading docks, container yards or ports. Restrictions on idling impact day cab operators in a very direct way. More and more trucking operations are moving to a more regionalized system to accommodate driver preferences and customer needs, which may result in an increased demand for Class 7 and 8 day cab tractors. Consequently, utilization of day cabs – and associated idling – will likely increase. As the agencies are aware, restrictions on idling are on the rise throughout the country. Examples of limiting idle time include: SmartWay partner shippers do not allow idling on their property; cities, municipalities and regions that face non-attainment of air quality standards enforce strict idling restrictions; and, sustainability practices and company policies of fleet operators. [EPA-HQ-OAR-2014-0827-1274-A1 p.7]

Therefore, MEMA supports extending the sleeper cab neutral idle and stop-start weighting factors to day cab tractors. MEMA recommends that Class 7 and 8 day cabs be credited with 35 percent of the credit given to Class 8 sleeper cabs when equipped with comparable technology. Offering credits for day cabs equipped with idle reduction technologies will result in reduced idling of these vehicles and achieve the desired result of reduced fuel consumption and emissions for the full slate of vehicles in the combination tractor category. [EPA-HQ-OAR-2014-0827-1274-A1 p.7-8]

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4 EPA-HQ-OAR-2010-0162-1752, MEMA Comments + Appendix B, January 31, 2011

5 See Section 2.4.8.1.1, Phase 2 – Draft Regulatory Impact Analysis, EPA-420-D-15-900, June 2015.

6 See Section 2.5.4.1, Draft Regulatory Impact Analysis, EPA-420-D-10-901, October 2010

**Response:**

*Idle Reduction Technology Effectiveness*

After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS. Details and calculations regarding the effectiveness of the menu of technologies are included in RIA Chapter 2.4.8.1.1.

*Hours of Idle Operation*

The agencies reviewed this and other studies to quantify idling operation. The 2010 NAS study assumes between 1,500 and 2,400 idling hours per year.<sup>71</sup> Gaines uses 1,800 hours per year.<sup>72</sup> Brodrick, et al. assumes 1,818 hours per year (6 hours per day for 303 days per year) based on an Argonne study and Freightliner fleet customers.<sup>73</sup> An EPA technical paper states between 1,500 and 2,400 hours per year.<sup>74</sup> Kahn uses 1,830 hours as the baseline extended idle case.<sup>75</sup> Based on the literature, the agencies are finalizing as proposed the use of 1,800 hours per year as reasonably reflecting the available range of information.

*Day Cab Idle*

The agencies considered the comments, both supporting and raising concerns over idle reduction in day cabs. The agencies determined that neutral idle for automatic transmissions is an appropriate technology for use in tractors, and are predicating the standards for day cabs based on a technology package that includes neutral idle. Therefore, the agencies are adopting provisions in Phase 2 to recognize neutral-idle in automatic transmissions as an input to GEM. Our analysis shows that neutral idle effectiveness is approximately 0.8 to 1 percent over the composite day cab tractor cycles, as shown in RIA Chapter 2.8.2.6. The agencies will also include neutral idle as a GEM input for sleeper cabs, though the effectiveness is very low.

In terms of stop-start technologies in tractors, the agencies are not including it as a technology input to GEM because we believe the technology needs further development. If this technology is developed in the future for tractors, then manufacturers may consider applying for off-cycle technology credits. Since the agencies are not predicating the Phase 2 standards on adoption of start-stop technologies, the agencies are also not including this technology as a GEM input.

**Organization:** National Association of Manufacturers (NAM)

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<sup>71</sup> National Academy of Science. Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles. March 2010. Page 124.

<sup>72</sup> Gaines, L., A. Vyas, J. Anderson. Estimation of Fuel Use by Idling Commercial Trucks. 2006. Page 6.

<sup>73</sup> Brodrick, C., T.Lipman, M. Farshchi, H. Dwyer, S. Gouse III, D.B. Harris, and F.King, Jr. Potential Benefits of Utilizing Fuel Cell Auxiliary Power Units in Lieu of Heavy-Duty Truck Engine Idling. 2001. Page 3.

<sup>74</sup> Lim, Han. Study of Exhaust Emissions from Idling Heavy-Duty Diesel Trucks and Commercially Available Idle-Reducing Devices. EPA420-R-02-052. 2002. Page 2.

<sup>75</sup> Kahn,ABM, N. Clark, G. Thompson, W.S. Wayne, M. Gautam, and D. Lyons. Idle Emissions from Heavy-Duty Diesel Vehicles: Review and Recent Data. 2006. Journal of Air and Waste Management Association. Page 1405.

Several NAM members have expressed sharply different opinions on the potential penetration rates for various technologies covered in the proposed rule, and the NAM recommends that the EPA and NHTSA revisit these assumptions as they craft a final rule. For instance, a 60 percent penetration of 6x2 Drive Axle Type may be overly optimistic given that six state laws limit tire and axle loading in such a way that 6x2s cannot be used as intended, and other states are not uniform in their regulations. A 40 percent Tire Inflation Systems assumption may not adequately take into account the viability of alternatives such as tire pressure monitoring systems, which provide similar benefits at a lower cost. Baseline assumptions on widespread use of Low Rolling Resistance (LRR) Tires may not sufficiently take into account the uneven conditions that many medium- and heavy-duty vehicles must face (including sloped loading docks, unpaved and uneven trailer lots, and harsh weather conditions). And a 90 percent penetration rate assumption for tamper-proof idle shut down timers may be overly optimistic when viewed through the lens of current consumer conduct. [EPA-HQ-OAR-2014-0827-1323-A2 p.2]

**Response:**

*6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>76</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>77</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.<sup>78</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

*Idle Reduction Technologies*

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<sup>76</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>77</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>78</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." January 2014. Page 19.

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found less of a difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

**Organization:** National Automobile Dealers Association (NADA)

#### CLASS 7 AND 8 COMBINATION TRACTORS

Working off a Phase I structure which tailors specific standards based on a tractor's weight class, roof height, and cab type (sleeper or day), the Phase 2 proposal aims to increase the stringency for this vehicle group by 24 percent overall, starting in MY 2021, ratcheting up in MY 2024, and fully phased in with MY 2027. This is in addition to the 7-20 percent reduction in GHG emissions and fuel consumption the Phase 1 rule seeks to achieve for these tractors over a 2010 baseline. NHTSA and EPA estimate that the costs per vehicle to comply with these new combination tractor standards will be offset by potential fuel savings and will result in a 2 year average payback period. Of course, many customers will actually pay significantly higher costs and will face a longer payback periods. [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

The Phase 2 proposal contemplates that engine and chassis manufacturers will achieve compliance through improvements in engine, transmission, driveline, and aerodynamic design, and through greater use of lower rolling resistance tires and idle reductions technologies. The market penetration rates (MPRs) of various technologies or strategies are critical to the proposal's effectiveness. Unfortunately, several of the proposal's tractor-related MPRs appear unrealistic. As noted above, tractor customers are risk averse and simply will not buy or lease equipment until it is proven to be appropriate for their



operations, to be cost-effective, and to be reliable. And if customers don't buy or lease new equipment, the rule fails. [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

Auxiliary Power Units (APUs) and Automatic Engine Shutdown Devices (AESDs) [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

APUs and AESDs are proven technologies which reduce engine idling, resulting in lower fuel use, engine wear, and emissions. A wide-variety of idle reduction options exist in the marketplace, not all of which involve the use of APUs and AESDs. Curiously, the proposal appears to assume that up to 90 percent of MY2027 sleepers will have an APU/AESD onboard. [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

AESDs are also widely available and often purchased by new tractor (and truck) customers. But these are almost universally “programmable” devices designed to accommodate different operating conditions and driver needs. Importantly, first purchasers view AESD programmability is a critical vehicle resale value issue, recognizing that second and third purchasers likely will have different idle control needs. Clearly, a vehicle’s residual/resale value is an important total-cost-of-ownership criterion. [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

The Phase 2 program should recognize and encourage a wide variety of idle reduction strategies. Idle reduction is not now and will not in the future be a “one-size-fits-all” strategy. [EPA-HQ-OAR-2014-0827-1309-A1 p.6]

For example, customers especially sensitive to weight or space constraints will gravitate toward non-APU technologies. Note that NADA/ATD is not suggesting that a lower MPR be set for idle reduction. Instead, NADA/ATD suggests that all legitimate idle reduction strategies “be counted,” not just those involving APUs and nonprogrammable AESDs. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

Automatic Tire Inflation Systems (ATISs)

The Phase 2 proposal overvalues automatic tire inflation systems while undervaluing tire pressure monitoring systems (TPMSs). TPMSs can provide comparable benefits at a lower cost. The extra fuel consumption and other problems associated with underinflated tires are well recognized, but it is estimated that only 1 percent of tractors presently are equipped with ATISs. Given the lower cost of TPMSs, the Phase 2 rule should treat them the same (or close to the same) as ATISs. Assuming TPMSs are considered to be appropriate tire inflation control strategies, NADA/ATD can support a 40 percent tractor MPR for MY 2027. If not, NADA/ATD submits that a MY2027 tractor MPR of 10% would make sense. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

Low Rolling-Resistance Tires (LRRT)

Current LRRT tractor MPRs are low and are not expected to increase significantly any time soon unless significant improvements in design are forthcoming. Moreover, there is no realistic means of ensuring that customers (or subsequent owners) will continue to use LRRTs. While LRRTs can be very effective, their cost, useful life, maintenance, and appropriateness vary widely depending on a customer’s duty-cycle and needs. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

6x2 Axle Configurations

The 6x2 tractor axle MPR also appears to be unreasonable, given that current sales rates range around 2 percent. The low uptake of this technology reflects state-by-state legal issues, practical highway use

limitations, a low acceptance in the secondary market, traction and tire wear concerns, and low driver acceptance. Given these constraints, NADA/ATD suggests that the proposal's MY 2027 tractor MPR for be revised downward from 60 to 20 percent. [EPA-HQ-OAR-2014-0827-1309-A1 p.7]

**Response:**

*Idle Reduction Technologies*

We agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments (including the comment summarized above), the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

*Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS. Consistent with the comment, we determined that the effectiveness of TPMS is 1%, while ATIS is 1.2%, in tractors. We believe that TPMS will be slightly less effective because it is dependent on operator intervention.

*Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found steer tires with rolling resistance as low as 4.9 kg/ton and drive tires with rolling resistance as low as 5.1 kg/ton. The average tire rolling resistance that we used in the technology packages to derive the final rule standards are higher than the lowest rolling resistance tires made today.

We also note that the certification data analysis shows that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the drive tires on high roof sleeper cabs. We found less of a difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

*6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of

implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>79</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>80</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>81</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

**Organization:** Navistar, Inc.

The bin structure and baseline proposed for Tractors is unworkable and must be changed for the Proposed Rule to be successful. The bin structure sets the buckets each tested vehicle is placed in and, then, sets the aerodynamic score in GEM. It is thus a key component of the compliance structure since the bin in which each tractor is placed directly determines its GEM input and thus the vehicle’s modeled emissions. The baseline impacts the bin structure, since it sets the beginning point, from which expected future improvements are set. [EPA-HQ-OAR-2014-0827-1199-A1 p.24-25]

- The aerodynamic baselines in the Proposed Rule must be adjusted to accurately reflect the actual baseline for aerodynamics and the bin structure must be corrected accordingly. [NHTSA-2014-0132-0094-A1 p.2]

As a baseline, the Proposed Rule uses a theoretical tractor to represent the average tractor compliant to the phase 1 standard. The Phase 1 aerodynamic CdA did not include an adjustment for wind average drag and the reference trailer did not include trailer skirts. The average CdA for a MY17 tractors in Class 8 Sleeper High and Class 8 Daycab High categories are summarized below using the RIA from the Phase 1 regulation (Table 3). These values were then adjusted for wind average drag using the assumption in the Phase 2 regulation and the average delta for a trailer skirt from EPA’s SWRI data for coast-down (Table 4). [EPA-HQ-OAR-2014-0827-1199-A1 p.25]

The calculated baseline differs from EPA’s assumption of the aero baseline for Phase 2 by a full BIN or 6-9% higher CdA. In addition, EPA tested 3 tractors with sleepers that represent the industry’s best configurations versus the average configuration being sold. From this data, EPA incorrectly assumed in

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<sup>79</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>80</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>81</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

the RIA that “most tractors today would qualify for Bin III.” We estimate that most sleepers would test on average in bin 2. Also it was found through analysis of the provided Southwest Research Institute data that the coastdown method is sensitive to the range of the high speed segment which is being processed. The proposed CFR changes specify a range of 72-58 mph, while RIA contains CdA values that appear to be based on the vehicle speed range of 70-56mph. This is estimated to report about a 2% lower value than it should be and as a result misplace the proposed baseline vehicle. Baseline must be reviewed and adjusted accordingly as the current proposal is as much as a bin off of the 2017 actual baseline. [EPA-HQ-OAR-2014-0827-1199-A1 p.25]

In fact, the SuperTruck program, a cooperative effort by the manufacturers and the Department of Energy, shows the extent of this issue. SuperTruck is intended to identify the most efficient possible tractor configurations, with a 50% increase in efficiency. Navistar is a participant in the SuperTruck program. Our analysis shows that the SuperTruck program vehicle would test at best in bin 5 with the current test trailer. Bin 6 and bin 7 are unachievable targets with the current test trailer. Many of the aero improvements achieved on SuperTruck are a result of the improved integration of the tractor and trailer, which will not be represented in the Phase 2 coastdown as the trailer selected for testing is a standard trailer with trailer skirts only. In addition, SuperTruck is designed to be the best configuration (sleeper only) and real world requirements will drive some enablers to be removed reducing the aero performance for that vehicle. [EPA-HQ-OAR-2014-0827-1199-A1 p.25]

SuperTruck is a sleeper program only and did not account for day cabs. Day cabs in general have less opportunity for improvement, due to the shorter length and therefore less surface area for optimization. Day cabs are a more diverse fleet, with lower adoption of aero devices since many work regional applications at lower speeds and are more sensitive to weight or damage to devices (e.g. skirts). Despite these facts, the current Phase 2 proposal expects the same percentage of improvement from a day cab as a sleeper. This is an incorrect assumption and needs to be revised. [EPA-HQ-OAR-2014-0827-1199-A1 p.26]

With an incorrect aero baseline and unachievable targets, this alone would make the Proposed Rule infeasible. The Proposed Rule should be modified to reflect the true baseline for MY17 and to set an appropriate and achievable bin structure. [EPA-HQ-OAR-2014-0827-1199-A1 p.26]

Before we comment on the proposed emission standards for tractors, we must again note our issues with the baseline. The baseline is critical to judging the stringency, because if the baseline is wrong, the emission standard stringency is also wrong. To know how far we are being asked to run, we need to know the location of starting line. [EPA-HQ-OAR-2014-0827-1199-A1 p.28]

The feasibility of the standards must be judged by the underlying assumptions as to technology penetration. For the rule to be feasible, the technologies on which it is based must be adopted by customers at the rates assumed by the agencies. We have a number of concerns with various elements underlying the proposed emission standards:[EPA-HQ-OAR-2014-0827-1199-A1 p.28]

Navistar believes that the penetration of tire pressure management systems (auto inflation) is overstated. Fleets adopt tire pressure monitoring systems to perform essentially the same function as a tire pressure management system. The driver alert is simpler and sufficient to ensure tire inflation in commercial applications. This is a significant difference between light and heavy duty. In heavy duty, a professional driver has both the incentive and the knowledge to keep tires adequately inflated, neither of which may necessarily be the case with light duty. Tire pressure monitoring systems are also significantly lower cost to purchase and operate than automatic inflation systems. GEM should recognize monitoring systems as well as management, since monitoring systems are preferred by fleets and effectively perform the same

function. These monitoring systems are often linked to the fleet telematics devices, so that warnings are provided to the driver as well as the fleet service department. [EPA-HQ-OAR-2014-0827-1199-A1 p.28]

Navistar believes that the assumed 6x2 axle penetration rate in the RIA is also too high. Operator concerns with traction loss and tire wear are significant hurdles to overcome for the adoption of this technology. Moreover, the 6x2 configuration is simply not legal in all states.<sup>29</sup> We also disagree with the RIA cost estimates, which we believe understates the costs involved with 6x2. We fully agree with the EMA comments in this regard. [EPA-HQ-OAR-2014-0827-1199-A1 p.28]

For tractors, the adoption of Level 2 and 3 tires for day-cabs, especially 4x2, should not follow the same trends as sleepers as these applications typically purchase tires for traction and durability versus fuel economy. These assumed penetrations underlying the standard are flawed and must to be revisited. [EPA-HQ-OAR-2014-0827-1199-A1 p.29]

Similarly, tamper-resistant idle control systems face acceptance challenges. Although the phase 1 rule predicted 100% penetration of tamper resistant idle systems in Class 8 sleepers there is no acceptance of tamper resistant idle shutdown within fleets.<sup>30</sup> In fact, industry experience has been an adoption rate of zero or near zero. Resale concerns remain a significant issue for customers. The concern is that the existence of a tamper-resistant idle shutdown or extended idle system negatively impacts resale value of the vehicle, since a subsequent user may have different needs than the original purchaser which do not allow for the use of an idle control system. The agencies should provide credit for the currently used programmable idle shutdown solution. Fleets owners select this to be set on their vehicles at the time of purchase and often never change this setting. The driver is unable to change these settings as this is a fleet strategy for improving fuel economy. [EPA-HQ-OAR-2014-0827-1199-A1 p.29]

These flawed assumptions in the assumed adoption rates directly impact the feasibility of the tractor standard. The emission standards should be adjusted to reflect more realistic adoption rates throughout the period addressed by the Proposed Rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.29]

We are concerned that GEM does not fully capture all of the potential accessory improvements. The Proposed Rule provides a credit for “electrically powered pumps for engine cooling.” This should be revised to include “electronically controlled variable speed coolant pumps” to align with the Preamble descriptions and technology under development as part of the SuperTruck program. Shifting to fully electronic on this pump creates reliability concerns and adds additional complexity due to the size of the necessary pumps (2+ hp). In addition, the increased power load will require a larger alternator and upgraded wiring. [EPA-HQ-OAR-2014-0827-1199-A1 p.29-30]

In addition to a fully electric pump, Dual Displacement power steering should also be included as an accessory improvement. This technology reduces parasitic loads by applying power proportional to steering demand. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

The benefits included in the regulation for electrified A/C compressor are understated. Our estimates are closer to 1.5% when in use which will be during the use of A/C and during defrost; therefore, the effective benefit should be 1%. Also, these accessory improvements should each be available for the vocational vehicles as well. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

Navistar feels the following are key areas the agencies must address:[NHTSA-2014-0132-0094-A1 p.2]

- The emission standards must reflect the technology packages customers will actually purchase and use.[NHTSA-2014-0132-0094-A1 p.2]

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29 EMA comments lay out a state-by-state comparison of restrictions related to 6x2 configuration.

**Response:**

*Aerodynamics*

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2. The aerodynamic performance of the tractors tested by EPA were recalculated for the final rule using the final aerodynamic test procedures (including the 72-58 mph high speed range noted by the commenter). See RIA Chapter 3.2.1. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. See RIA Chapter 3.2.1.2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

In consideration of these comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). The agencies' assessment for the final rule is that only Bins I through V are achievable with known aerodynamic technologies, but that Bins VI and VII have less known technology paths. Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . See RIA Chapter 2.8.2.2. These aerodynamic improvements have been demonstrated within the program on two vehicles in 2015. In the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing these aerodynamic technologies as early as 2021 MY on a limited scale. We adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time. The agencies phased-in the aerodynamic technology adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies. For example, in the 2021 MY technology package, the agencies have assumed that 10 percent of high roof sleeper cabs will have Bin V aerodynamic performance. This phase-in structure is consistent with the normal manner in which manufacturers introduce new technology to manage limited research and development budgets as well as to allow them to work with fleets to fully evaluate in-use reliability before a technology is applied fleet-wide. The agencies believe the phase-in schedule will allow manufacturers to complete these normal processes.

The agencies recognize that SuperTruck only include high roof sleeper cabs, one of ten tractor subcategories. We took similar steps in adjusting the adoption rates in the high roof day cab subcategories, such that the high roof day cab had higher adoption rates in lower bins than high roof

sleeper cabs. The aerodynamic adoption rates used to develop these standards for the other tractor regulatory subcategories (low and mid roof tractors) are less aggressive than for the Class 8 sleeper cab high roof tractors. Aerodynamic improvements through new tractor designs and the development of new aerodynamic components is an inherently slow and iterative process. The agencies recognize that there are tractor applications that require on/off-road capability and other truck functions which restrict the type of aerodynamic equipment applicable. We also recognize that these types of trucks spend less time at highway speeds where aerodynamic technologies have the greatest benefit. The 2002 VIUS data ranks trucks by major use.<sup>82</sup> The heavy trucks usage indicates that up to 35 percent of the trucks may be used in on/off-road applications or heavier applications. The uses include construction (16 percent), agriculture (12 percent), waste management (5 percent), and mining (2 percent). Therefore, the agencies analyzed the technologies to evaluate the potential restrictions that will prevent 100 percent adoption of more advanced aerodynamic technologies for all of the tractor regulatory subcategories. In addition, the agencies also accordingly reduced the adoption rates in the highest bins for low and mid roof tractors to follow the change made to the high roof subcategories because we neither proposed nor expect the aerodynamics of a low or mid roof tractor to be better than a high roof tractor.

### *Baseline*

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the APU adoption rate of 30 percent used in the Phase 1 baseline for the Phase 2 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>83</sup> Therefore, the agencies are projecting that 9 percent of the baseline sleeper cab tractors will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will have tamper-proof AESS. Additional changes to the baseline for the final rule are discussed in Preamble Section III.D.1.a.

### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS. The effectiveness value in GEM is less for TPMS, reflecting the need for driver interaction.

### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of

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<sup>82</sup> U.S. Department of Energy. *Transportation Energy Data Book*, Edition 28-2009. Table 5.7.

<sup>83</sup> North American Council for Freight Efficiency. *Confidence Report:Idl- Reduction Solutions*. 2014. Page 13.

implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>84</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>85</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>86</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found steer tires with rolling resistance as low as 4.9 and drive tires with as low as 5.1 kg/ton. The average tire rolling resistance that we used in the technology packages to derive the final rule standards are higher than the lowest rolling resistance tires made today. With respect to the comment about assuming that customers will continue to demand low rolling resistance tires, we set performance-based standards that allow the manufacturers to produce a wide variety of products.

We also note that during the certification data analysis, we found that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. We found less of a difference in rolling resistance of the steer tires between the tractor subcategories. We did not find a difference in average rolling resistance levels between Class 7 (4x2) and Class 8 tractor subcategories, as suggested by the commenter. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

#### *Idle Reduction Technologies*

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow

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<sup>84</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>85</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>86</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.



adjustable (or programmable) AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS. This change in the technology package to adjustable AESS removes the concern about resale noted by the commenter.

#### *Accessories*

In response to the comments, the agencies evaluated a set of accessories that can be designed to reduce accessory losses. Due to the complexity in determining what qualifies as an efficient accessory, we are maintaining the proposed language for accessories for tractors which provides defined effectiveness values for only electric air conditioning compressors and electric power steering pumps and coolant pumps. The agencies did not revise the electric coolant pump definition to include “electronically controlled variable speed coolant pumps.” We believe the type of technology suggested by the commenter could be captured during the measurement of the engine fuel map. Manufacturers have the option to apply for off-cycle credits for the other types and designs of high efficiency accessories, such as dual displacement power steering pumps.

**Organization:** North American Die Casting Association (NADCA)

While NADCA does not endorse a specific weight reduction amount, die castings represent a clear opportunity to help achieve improved fuel efficiency and weight standards. As noted in the NPRM, ‘some materials work better than others for particular vehicle components,’ and NADCA believes regulators should provide manufacturers with the ultimate flexibility to meet realistic standards. [EPA-HQ-OAR-2014-0827-1283-A1 p.2]

NADCA believes that die castings are a central part of any effort to improve fuel efficiency and performance of all vehicles, whether light, medium, or heavy-duty. As demonstrated above, the die casting industry is capable of helping achieve significant efficiency improvements, however, the Association cannot speak directly to questions surrounding the overall feasibility raised by OEMs and others. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

As demonstrated in Phase I and reinforced in the Phase II proposal, regulators clearly see that aluminum, and therefore cast parts, are an integral component to weight reduction and energy efficiency. We urge the EPA and NHTSA to explore the opportunities metal castings provide. Through its direct research and partnerships with industry and universities, NADCA has a demonstrated track record securing energy and cost savings. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

#### **Response:**

The agencies have provided weight reduction tables in the regulations that allow vehicle manufacturers to demonstrate compliance with the CO<sub>2</sub> emissions and fuel consumption standards with technology packages that include weight reduction in addition to other technologies. For components that are not included in the weight reduction tables, manufacturers have the option of pursuing off-cycle credits.

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

**The full-vehicle standard should be stronger.**

Commensurate with increased engine stringency, the tractor standards should be strengthened to ensure that manufacturers utilize the full suite of appropriate complementary technologies, in addition to engine improvements. [EPA-HQ-OAR-2014-0827-1221-A1 p.3][[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.138.]]

**Response:**

The final Phase 2 *engine* standards will lead each manufacturer to achieve reductions of over 5 percent in 2027 MY relative to the Phase 1 baseline. For the final Phase 2 rule, we recognize that it could be possible to achieve greater reductions than those included in the engine standard by designing entirely new engine platforms. Unlike existing platforms, which are limited with respect to peak cylinder pressures (precluding certain efficiency improvements), new platforms can be designed to have higher cylinder pressure than today's engines. New designs are also better able to incorporate recent improvements in materials and manufacturing, as well as other technological developments. Considered together, it is possible that a new engine platform could be 6 percent more efficient without WHR than Phase 1 engines and 8 percent more efficient than Phase 1 if 50 percent of these engines have WHR. We project in 2024 MY, that a limited number of engine platforms would be redesigned, and therefore have pulled ahead the reduction expected from the proposed 2027 MY engine standards into the *vehicle* standards for 2024 MY. In addition, we project that 50 percent of tractor engines in 2027 MY will be redesigned engines (i.e. engines reflecting redesigned engine platforms, again based on existing engine platform redesign schedules within the industry) achieving a 6 percent reduction for day cabs and an 8 percent reduction in fuel consumption in sleeper cabs beyond Phase 1. This means the average 2027 MY tractor engine would be 5.4 and 6.4 percent more efficient than Phase 1 for day and sleeper cabs respectively. We have factored these levels into our analysis of the vehicle efficiency levels that will be achievable in MY 2027. These additional engine improvements make more stringent vehicle standards feasible, and the final standards are structured so that these improved engines are not able to generate windfall credits, but rather that their projected performance is reflected in the stringency of the final tractor vehicle standard.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

OEMs have voiced very significant concerns regarding the proposed emission standards, which was a significant point in their joint testimony during the Long Beach Public Hearing. These noteworthy concerns included: [EPA-HQ-OAR-2014-0827-1244-A1 p.17]

- The agencies recommendation that the 2017 aero baseline utilizes the *best* aero trucks available rather than the average, this has an effect of increasing stringency about 2.5%. [EPA-HQ-OAR-2014-0827-1244-A1 p.18]
- The baseline assumes 30% or more sleeper tractors are equipped with non-programmable idle shutdown timers when, in fact, very few customers take this feature. This increases stringency about 1.5% (30% of 5%). [EPA-HQ-OAR-2014-0827-1244-A1 p.18]
- Cab aerodynamic expectations (Bins V, VI, and VII) cannot be achieved with the specified test trailer. This means vehicle OEMs must try to find about 4.5% more fuel economy elsewhere. [EPA-HQ-OAR-2014-0827-1244-A1 p.18]
- The compliance margins for aerodynamic bins have been removed. In contrast, Phase 1 allowed a full bin margin. This means that OEMs would have to declare worse aero performance to

ensure passing an audit, with as much as 5% impact on declared fuel economy that they would need to make up somehow. [EPA-HQ-OAR-2014-0827-1244-A1 p.18]

- No compliance margin is provided for engine fuel map audits, compared to the 3% margin allowed in Phase 1 for engine efficiency. This would require that OEMs declare worse engine efficiency than their certification measurement to ensure passing an audit, considering production and test variability. [EPA-HQ-OAR-2014-0827-1244-A1 p.18]
- In summary, these test and protocol issues add as much as 17% greater reduction in fuel consumption than the proposed rule estimates. [EPA-HQ-OAR-2014-0827-1244-A1 p.18]

When combined, these issues create an impossible challenge that could not be met with any reliable, cost-effective technology, which will negatively affect the owner-operators, professional truck drivers, and the general public that the agencies are hoping to serve. In conversations with EPA staff, OOIDA has been assured that the agencies are working to resolve many of these issues, and that meetings have taken place between respective teams of engineers to resolve them. This will be especially crucial because of the agencies seeming reliance on new technology. The testing methods and protocols must be accurate to avoid an overly stringent regulation which can have several unintended consequences. Without these corrections, this rulemaking will force OEMs to specify a truck optimized for simulated duty cycles which EPA has chosen rather than meet the needs of consumers operating in the real-world, which would ultimately lead to increased fuel consumption and GHG emissions. If these concerns are not adequately addressed, this further endangers the goal of this NPRM and puts the livelihoods of hard working individuals at a grave risk for failure. [EPA-HQ-OAR-2014-0827-1244-A1 p.18-19]

### **APU's**

Auxiliary power units (APUs) can be used instead of idling the main engine of the truck to provide both power and climate control for the driver. While APU's unquestionably offer multiple benefits, an adoption rate of 90% that the agencies are estimating by MY 2024 is completely unreasonable. Additionally, while many carriers purchase sleeper cabs because they are the most versatile choice, this does not mean that a driver will routinely be sleeping in the cab of the truck. Depending on the operation and length of haul, a driver might only spend one to two nights a week in the cab. In these types of situations an APU is merely 400 lbs. of extra and unneeded weight and maintenance. [EPA-HQ-OAR-2014-0827-1244-A1 p.21]

Ironically, while the agencies' NPRM hopes to reduce the weight of a truck, a typical APU adds approximately 400 lbs. to the weight of a truck. Whereas most states allow a 400 lb. exemption for trucks equipped with an APU, the following states do not: CA, DC, HI, KY, MA, NC, and RI. If the agencies mandate the installation of an APU on a truck which operates in one of these states, then the potential income for that carrier will be reduced. This issue was not addressed by the NPRM. [EPA-HQ-OAR-2014-0827-1244-A1 p.22]

### **Automatic Engine Shutoff**

OOIDA is concerned that installing automatic engine shutoff (AES) in a class 8 vehicle may compromise safety in different circumstances. Overall, AES can easily produce negative consequences for long-haul drivers who frequently visit new facilities (warehouses, shippers, receivers, etc.). These facilities rarely have similar check-in procedures, which can be problematic. For example, a driver might leave the truck believing that it will only take a few moments for him or her to access the check-in area and then return. However, this is not always the case and delays can easily ensue. While this might not be an issue for a single truck driver, it can create a safety hazard for team driving operations, if a co-driver was left asleep in the sleeper berth and the truck shut off, he or she could be left out in extreme weather

conditions, which could interrupt the driver's valuable sleeping time and thus increase fatigue. Additionally, this situation could be especially harmful for drivers with certain medical conditions, such as those who have experienced a heat stroke in the past. [EPA-HQ-OAR-2014-0827-1244-A1 p.22]

According to OOIDA Foundation's Member Profile Surveys, 16% of OOIDA members indicate that they have a pet with them in their truck. This leads to the same concerns as those presented above. However, a pet will not have the ability to turn the truck back on. Such areas of concern were not a part of the agencies analysis and subsequent costs. [EPA-HQ-OAR-2014-0827-1244-A1 p.22]

### **Automatic Tire Inflation**

Automatic tire inflation technology is among the agencies' list of approved technologies in order for OEMs to achieve compliance goals. The agencies have projected as part of the NPRM that 50 percent of dry van and refrigerated trailers will have automatic tire inflation (ATI) systems installed to maintain optimal tire pressure by MY 2018. This penetration rate is far too high, as many owner-operators would prefer to purchase tire pressure monitoring (TPM) systems rather than ATI systems because of the reduced cost and complexity while achieving similar savings. It is important that ATI systems are not forced onto consumers by assuming such high adoption rates. [EPA-HQ-OAR-2014-0827-1244-A1 p.23]

It is well-accepted that poorly inflated tires decrease a truck's fuel economy, and that proper tire pressure is essential to avoiding blow outs. Tire failure for an owner-operator is a costly expense, as the driver will both lose productivity while waiting for a replacement tire and will incur costs to purchase the replacement tire. This alone is a proper incentive for owner-operators to ensure that tires are inflated to the proper pressure. While ATI systems are capable of monitoring tire pressure, they are often expensive and unreliable, whereas TPM systems are much less expensive and can be utilized to achieve the same results. [EPA-HQ-OAR-2014-0827-1244-A1 p.23]

### **Low Rolling Resistance Tires**

Lower Rolling Resistance Tires can be a useful technology which reduces the energy needed in order to move a truck, but it is important to understand that they do not work for all types of truck operations. Low rolling resistance (LRR) tires are designed to improve fuel efficiency of a tractor pulling a trailer by minimizing its rolling resistance, which consists of energy lost as heat within the rubber itself, as well as aerodynamic drag of the tire, and friction between the tire and the road and between the tire and the rim when the tire is rolling under load; rolling resistance is expressed as the energy consumed per unit distance as the tire rolls under load.<sup>23</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.23-24]

According to the EPA SmartWay program, for every 5 percent reduction in tire rolling resistance, a 1 percent reduction in fuel savings might be attained. Tests have confirmed that most LRR tires have a long stopping distance at high speeds and lack grip in the corners, both of which could ultimately lead to an accident.<sup>24</sup> Sheldon Brown, an executive program manager at the Toyota Technical Center, has said, "There have been significant trade-offs with this type of tire, namely wear performance and stopping distance."<sup>25</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.24]

Regardless of the higher cost of LLR tires and the concerns of its effectiveness in fuel savings, the tire is not designed for all types of operations. An owner-operator running routes in mountainous terrain does not want a tire that has less friction and less traction equipped on their tractor-trailer, especially while driving in extreme weather conditions. The LRR tire may be beneficial on flat terrain, but it is a safety concern in many geographical regions. Steven Bixler, an OOIDA Board Member, who frequently

operates in winter conditions and mountainous terrain, stated “Asking me to run LRR’s would be like asking someone to walk up and down Lombard Street in San Francisco in a pair of smooth soled penny loafers on an inch of ice.” [EPA-HQ-OAR-2014-0827-1244-A1 p.24]

By the very nature of their job, truckers must be prepared for just about any possible situation at all times, whether it is foreseeable or not. In the course of a single day, a truck driver can be faced with many varying situations and scenarios, and a large part of being properly prepared is choosing the right equipment and accessories for a job that can change as quickly as the weather. Understanding this fact is vital because making a poor equipment choice can have dire consequences. The tires on a tractor-trailer are not only a significant financial investment, but can be the difference between safely completing a trip, or not. A LRR tire achieves much of its potential fuel savings benefit by reducing the very component of friction or resistance that a truck driver needs to have faith in, which is not an option for many owner-operators. [EPA-HQ-OAR-2014-0827-1244-A1 p.24-25]

When a truck driver is navigating a curve, static friction is the main force that keeps the truck on the pavement. If an owner-operator is running a route over a mountain pass such as California’s Interstate 5, which is infamously known for its curves as the unforgiving Grapevine, they must be equipped with the proper tire. The heavily traveled Grapevine is part of the Tejon Pass located in the Tehachapi Mountains. The peak reaches over 4,100 feet and has a steep grade of up to 6 percent. In addition, on any given day a driver may encounter conditions such as rain, snow, ice, fog, and condensation. If the static friction is reduced, the driver has a much greater possibility of encountering kinetic friction, or in other words a skid, which may result in a crash. [EPA-HQ-OAR-2014-0827-1244-A1 p.25]

For another example, the Eisenhower-Johnson Memorial Tunnel in Colorado is one of the highest vehicular tunnels in the world with a maximum elevation of 11,158 ft. However, if an owner-operator is transporting hazardous materials, they are not allowed to use the tunnel. Instead, the driver must travel on top of the mountain across Loveland Pass, which is almost another 1,000 ft. higher. For the two routes mentioned, LRR tires are simply not an option. The small fuel saving benefit associated with LRR tires is greatly outweighed by the potential loss of friction that may cause an accident. [EPA-HQ-OAR-2014-0827-1244-A1 p.25-26]

While a much more mundane situation than an accident, without proper traction a truck can get stuck. Unladen truck suspensions do not lend themselves to good traction, even when equipped with tires which have a more aggressive tread depth. The towing bill for a class 8 truck is costly and being extracted is time-consuming. [EPA-HQ-OAR-2014-0827-1244-A1 p.26]

## **6x2’s**

It is obvious that the agencies have not properly researched 6x2 axle configurations, as 6x2’s are not safe for all operations, nor are they legal in all 50 states and Canada. When considering the purchase of a truck, it is imperative for an owner-operator that the vehicle is able to legally operate in all states and provinces. A truck which is not able to do so is not desirable and thereby can have a dramatic effect upon the resale value of the vehicle. EPA should include in its cost and benefit analysis the negative impact on the resale value, as well as the potential for increase tire wear and costs associated with the 6x2 axles. While a 6x2 configuration can lead to fuel savings, a market penetration rate of 60% by 2027 does not appear to be a realistic estimate when considering the potential limitations. [EPA-HQ-OAR-2014-0827-1244-A1 p.26]

## **Speed Limiters**

In the NPRM, the agencies proposed to permit the use of speed limiters in order to grant credits to OEMs as a way to improve fuel economy. However, OOIDA strongly cautions that the agencies must fully consider the significant negative consequences of speed limiters. Julie Cirillo, a former Assistant Administrator and Chief Safety Officer of the Federal Motor Carrier Safety Administration (FMCSA), stated in a sworn affidavit, “it is my opinion that the Speed Limiter Legislation does not increase safety, and in fact decreases safety on the highways travelled by those heavy trucks and can cause dangerous situations to arise.<sup>26</sup>” Specifically, these dangerous situations arise from a differential in speed limits. Mrs. Cirillo also stated, “Jurisdictions responsible for ensuring the safety of the travelling public should not take any action that could result in creating an unsafe situation. Included in these actions would be the establishment and enforcement of differential speed limits for passenger cars and commercial vehicles. Adherence to differential speed limits creates a situation where a significant percentage of traffic is operating more slowly than general traffic.” [EPA-HQ-OAR-2014-0827-1244-A1 p.26-27]

In 1964, David Solomon wrote a report entitled Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle published by the Bureau of Public Roads (predecessor to the Federal Highway Administration). In order to define the relationship between speeds, characteristics of drivers and vehicles, and accidents, Solomon collected data from 11 cooperating states on 600 miles of main rural highways. The study recorded 10,000 drivers across 2-lane and 4-lane highways, and discovered vehicles travelling 10-15 mph less than the average speed of all traffic had a much greater chance of being involved in a crash. Solomon presented his findings in a distinguished “U-shape” curve, which has now become famous.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.27]

In fact, Solomon wrote that regardless of the average speed on the highway, the more a driver deviates from the average speed, the greater his or her chance of being involved in an accident. Low speed drivers are more likely to be involved in accidents than high-speed drivers are, as 80% of rear-end collisions involving a large truck and a car resulting in a fatality, the passenger vehicle rear-ended the truck.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.27-28]

Additional research studies have been published through the years that support Solomon’s conclusions, such as the Interstate System Accident Research Study II published by the Bureau of Public Roads (now the FHWA) and the Commercial Motor Vehicle Speed Control Devices published in 1991 by the National Highway Traffic Safety Administration (NHTSA). Both studies confirmed the “U-shape” curve established initially by Solomon. [EPA-HQ-OAR-2014-0827-1244-A1 p.28]

In 2005 Dr. Steven L. Johnson of the University of Arkansas conducted a study entitled Cost-Benefit Evaluation of Large Truck-Automobile Speed Limit Differentials on Rural Interstate Highways which found that differentiating speeds were shown to produce more interactions between vehicles. Moreover, Dr. Johnson found that as the speed of an individual vehicle deviates from the mean traffic speed on a roadway, the number of interactions between vehicles increases and the potential for being involved in accidents increases. The frequency of interactions with other vehicles by a vehicle traveling 10-mph below the posted speed limit is 227% higher than moving at traffic speed.<sup>29</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.28]

In similar fashion, in 1993 the Transportation Research Board of the National Research Council published a study by John E. Baerwald, which found that vehicles travelling at or about the same speed minimized the need for overtaking, passing and lane changes and, as a result, caused fewer accidents.<sup>30</sup> This too was supported recently by the United Kingdom, which in April 2015, increased the national speed limit for heavy goods vehicles from 40-mph to 50-mph in order to reduce risky overtakes by frustrated car drivers.<sup>31</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.28-29]

When a truck is artificially limited to a lower speed than other traffic, this will create an obstruction in the traffic flow. As other vehicles approach from behind in traffic there will invariably be situations where they will need to reduce speed before passing. The vehicle will then have to regain their cruising speed. This will cause the vehicle to use more fuel than it would if it could have maintained cruising speed. While this type of interaction will occur in any traffic flow situation, it will occur more frequently if VSLs are mandated. [EPA-HQ-OAR-2014-0827-1244-A1 p.29]

The agencies are correct to note that reducing the speed of all trucks will lead to a greater number of trucks being necessary to haul the same amount of freight. With an artificial reduction in freight capacity, due to a loss in total miles operating within the allowed hours of service, more trucks and drivers would be needed to compensate. This would also require more truck parking spaces, which are already in shortage (cite Jason's law study) and come with their own GHG footprint. A larger amount of trucks on the road would also add to congestion which would increase GHG emissions. [EPA-HQ-OAR-2014-0827-1244-A1 p.29]

OOIDA is opposed to the utilization of speed limiters as a way for OEMs to receive credits in order to comply with the Phase II fuel efficiency and GHG emission standards. A technology which has been proven to decrease highway safety is completely and utterly inappropriate, and should not be included in any form as part of the proposed rule. [EPA-HQ-OAR-2014-0827-1244-A1 p.29-30]

#### Weight Reduction

The Notice proposes that heavy duty vehicles would save fuel and lower emissions if trucks were redesigned to use less mass, possibly using lighter, higher strength materials. Before such standards are created, however, OOIDA has and continues to encourage NHTSA to establish a rule for the crash-worthiness of trucks. Without a baseline standard for the forces that a truck and its components must withstand in a crash, what guidelines would truck manufacturers follow to ensure that mass reduction designs do not compromise the safety of the truck driver? [EPA-HQ-OAR-2014-0827-1244-A1 p.31]

In the academic world, the idea of reducing the vehicle weight sounds like a good way to tackle fuel inefficiency in CMVs. However, this is a frightening concept for a truck driver. The goal of better fuel efficiency is a noble one, but it is not worth the expense of a weaker and lighter cabs. Currently, the United States does not have any cab crashworthiness standards for vehicles with a gross vehicle weight rating over 10,000 pounds. [EPA-HQ-OAR-2014-0827-1244-A1 p.31]

In 2009, Carl VanWasshova, an OOIDA member from Port Orange, FL, was killed in a low-speed crash after his day cab collapsed around him. According to the Federal Motor Carrier Safety Administration, approximately 700 truck drivers have died annually the past 10 years in single or multi-vehicle crashes. Accidents involving truck rollovers are among the most deadly as they account for approximately 63 percent of fatal injuries to truck occupants. While millions are being spent to develop new technologies, basic and common sense features such as air bags and truck cab crashworthiness are being left behind. [EPA-HQ-OAR-2014-0827-1244-A1 p.31]

In response to a 20 percent increase of truck occupant deaths in 2011, OOIDA released a statement saying, "What is wrong with this picture? NASCAR drivers walk away from collisions at 200 miles per hour but truck drivers are losing their lives at 30 miles per hour. Families are being destroyed because we are making cabs lighter and lighter while efforts persist to make the loads heavier. Accidents will happen – period. We won't be able to outsmart that."<sup>32</sup> Reducing the weight of CMVs in order to improve fuel efficiency should not be a compromise for safety. [EPA-HQ-OAR-2014-0827-1244-A1 p.32]

Section 32201 of the Moving Ahead for Progress in the 21st Century Act (MAP-21) directed the Secretary of Transportation to conduct a comprehensive analysis of the need for crashworthiness standards for property carrying commercial motor vehicles with a gross vehicle weight rating or gross vehicle weight of 26,001 pounds involved in interstate commerce including an evaluation of the need for roof strength, pillar strength, air bags, and other occupant protections standards, and frontal and back wall standards. NHTSA contracted with the University of Michigan Transportation Research Institute to conduct a study on heavy truck fatal and injury crashes. After breaking down the crash data from TIFA, GES, and the LTCCS, and researching SAE's Recommended Practices, UMTRI identified four primary countermeasures. However, the research team stated that an assessment of the countermeasures' effectiveness to reduce truck occupant injury and death in crashes was beyond the scope of the study. The countermeasures included: [EPA-HQ-OAR-2014-0827-1244-A1 p.32]

- Measures to increase seat belt usage. These may include the installation of enhanced seat belt warning systems that activate a visual and audible warning when truck drivers and other vehicle occupants fail to use their seat belt. [EPA-HQ-OAR-2014-0827-1244-A1 p.33]

- Increasing the integrity and robustness of cab structures and the protection of cabs particularly with respect to rollover. [EPA-HQ-OAR-2014-0827-1244-A1 p.33]

- The installation of side curtain air bags to prevent occupant ejection through the side windows and head trauma. [EPA-HQ-OAR-2014-0827-1244-A1 p.33]

- Increasing occupant head space during rollover events through installation of automatic pull-down seats. [EPA-HQ-OAR-2014-0827-1244-A1 p.33]

UMTRI also recommend that since SAE's Recommended Practices and standards were formed over a decade ago with the cooperation of manufacturers and associations from various countries, that SAE reassess and update their Recommended Practices. NHTSA has stated that they will closely follow and participate in this work. OOIDA feels this issue needs to be addressed before other regulations are initiated. [EPA-HQ-OAR-2014-0827-1244-A1 p.33]

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23 Final Regulation Order: Tractor-Trailer Greenhouse Gas Regulation, CARB (2011) pg. 5.

24 Eric Loveday, "Range-Increasing Low-Rolling Resistance Tires Falling Out of Favor with Drivers," Inside EVs, <http://insideevs.com/range-increasing-low-rolling-resistance-tires-falling-out-of-favor-with-drivers/>

25 Stuart F. Brown, "More Traction for Fuel-Efficient Tires," The New York Times (2013), [http://www.nytimes.com/2013/02/17/automobiles/more-traction-for-fuel-efficient-tires.html?\\_r=0](http://www.nytimes.com/2013/02/17/automobiles/more-traction-for-fuel-efficient-tires.html?_r=0).

26 Affidavit of Julie Cirillo

27 David Solomon, Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle, Bureau of Public Roads (1964), pg. 1.

28 Transport Topics, "Trucker Driver Fault: What are the Odds?" Transport Topics (April 22, 2013), <http://www.ttnews.com/articles/basetemplate.aspx?storyid=31803&page=2> (accessed April 22, 2013)



29 Steven L. Johnson, Cost-Benefit Evaluation of Large Truck-Automobile Speed Limit Differentials on Rural Interstate Highways, Mack-Blackwell Transportation Center, University of Arkansas (2005), pg. 98.

30 Affidavit of Julie Cirillo, Fair Fax County, Virginia, 8 September 2011.

31 “Faster HGVs could cut dangerous overtakes,” Spalding Guardian Lincolnshire Free Press, <http://www.spaldingtoday.co.uk/news/latest-news/faster-hgvs-could-cut-dangerous-overtakes-1-6674323>

32 Jami Jones, “Truck occupant fatalities up 20 percent,” Land Line Magazine (2012), <http://www.landlinemag.com/Story.aspx?StoryId=24533>

### **Response:**

The agencies’ responses to OOIDA’s specific comments from the Long Beach Public Hearing are included in each of the subsections below. In general in the final rule, the agencies have revised the aerodynamic test procedures to reduce variability, adjusted baseline tractor configurations, and developed new compliance approaches to alleviate the need for compliance margins. We also have made other revisions, such as the road grade profile, to better match the in-use operation of heavy-duty vehicles. We believe we are adopting accurate test methods and that the trucks designed to meet the Phase 2 standards will also perform well in the real world because we recognize the importance of this issue.

#### *Idle Reduction Technologies*

Baseline: In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>87</sup> Therefore, the agencies are projecting for the Phase 2 baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will include tamper proof AESS.

APU Mandate: There is a misconception of the proposed Phase 2 program where some stakeholders thought that the agencies were mandating use of APUs. This is incorrect. The Phase 1 and Phase 2 tractor standards are performance standards. The agencies projected an adoption rate of up to 90 percent for tamper-proof AESS in our analysis for determining the stringency level of the proposed standard. We did not propose to differentiate between the various idle reduction technologies in terms of effectiveness and only used the diesel powered APU in terms of determining the cost and effectiveness.

Adoption Rate: The agencies received numerous comments on our proposed adoption rates of tamper-proof AESS. We generally agree with this commenter (and others) that the agencies should consider other types of idle reduction technologies because an automatic engine shutdown system (or an APU) may not be the optimum choice for every tractor. For the final rule, we now differentiate effectiveness based on the specific idle reduction technology installed by the tractor manufacturer. This change is consistent with the commenter’s concern that APUs would not benefit all operators or may lead to a

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<sup>87</sup> North American Council for Freight Efficiency. Confidence Report:Idle- Reduction Solutions. 2014. Page 13.

concern regarding weight in some operations. The agencies note that all but five states and the District of Columbia provide weight exemptions between 400 and 550 pounds for APUs.<sup>88</sup> Thus, we have set the maximum diesel powered APU adoption rate at 40 percent in MY 2027 in the technology package for the final rule. This maximum adoption rate conservatively recognizes that diesel-powered APUs may impact the payload capacity of tractor-trailers traveling in only those five states and only when those tractor-trailers are traveling at maximum GCW of 80,000 pounds (which is estimated to be approximately 30 percent of the miles travelled).<sup>89</sup> For the states with an APU weight exemption and all of the tractor-trailers traveling at less than maximum GCW, the addition of 400 pounds to an 80,000 pound tractor-trailer will only have an impact of on direct fuel consumption of approximately 0.1 percent, and no impact on payload capacity.<sup>90</sup> Additionally, the potential positive implications of other weight reduction efforts could partially or fully offset concerns from added weight of APUs, including the additional fuel use. For the final rule, we recognize a variety of idle reduction technologies –including automatic engine shutdown systems, fuel operated heaters, automatic stop/start systems, and diesel powered APUs. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

Safety: The regulations already provide AESS override criteria that includes ambient temperature if it reaches a level below or above which the cabin temperature cannot be maintained for health and safety of the operator (40 CFR 1037.660(b)(3)). These override allowances are directly related to the concerns raised by the commenter.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies agree with this commenter and believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS.

#### *Low Rolling Resistance Tires*

The agencies recognize that different tractor operations (such as the California Interstate 5 and the Loveland Pass mentioned by the commenter) require different tires. For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data.<sup>91</sup> We found that high roof sleeper cabs are certified today with steer tire rolling resistance levels that ranged between 4.9 and 7.6 kg/ton and with drive tires ranging between 5.1 and 9.8 kg/ton. In the same analysis, we found that high roof day cabs are certified with rolling resistance levels ranging between 4.9 and 9.0 kg/ton for steer tires and between 5.1 and 9.8 kg/ton for drive tires. This range spans the baseline through Level 3 rolling

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<sup>88</sup>Dills, Todd. Overdrive. “APU Weight-Exemption Guide, State by State.” June 9, 2016. <http://www.overdriveonline.com/apu-weight-exemption-guide-state-by-state/>

<sup>89</sup> M.J. Bradley & Associates. Setting the Stage for Regulation of Heavy-Duty Vehicle Fuel Economy and GHG Emissions: Issues and Opportunities. February 2009. Page 35. Analysis based on 1992 Truck Inventory and Use Survey data, where the survey data allowed developing the distribution of loads instead of merely the average loads.

<sup>90</sup> Reinhart, Thomas. Southwest Research Institute. “Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #1.” May 2015. Page 53. Scaled the 2200 pound reduction at 65 mph at 100% payload.

<sup>91</sup> Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. Docket EPA-HQ-OAR-2014-0827.

resistance performance levels. Therefore, for the final rule we took an approach similar to the one taken in Phase 1 and proposed in Phase 2 that considers adoption rates across a wide range of tire rolling resistance levels to recognize that operators may have different needs. 76 FR 57211 and 80 FR 40227.

Also in our analysis of the Phase 1 certification data, we found that the drive tires on low and mid roof sleeper cab tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found only a minor difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. This is also consistent with the approach that we took in setting the Phase 1 tractor standards. 76 FR 57211. In addition, the final rule reflects a reduction in Level 3 adoption rates for low and mid roof tractors from 25 percent in MY 2027 used at proposal (80 FR 40227) to zero percent adoption rate. The technology packages developed for the low and mid roof tractors used to determine the stringency of the MY 2027 standards in the final rule do not include any adoption rate of Level 3 drive tires to recognize the special needs of these applications, consistent with the comments noted above raising concerns about applications that limit the use of low rolling resistance tires.

The agencies continue to stand behind the low rolling resistance tire research conducted to date, which includes the Department of Transportation Volpe Center's 2015 report titled "Review and Analysis of Potential Safety Impacts and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles," along with any research supporting the development, and maintenance, of FMVSS No.121. In addition, DOT's Federal Motor Carrier Safety Administration and NHTSA sponsored a test program conducted by Oak Ridge National Laboratory to explore the effects of tire rolling resistance levels on Class 8 tractor-trailer stopping distance performance over a range of loading and surface conditions. The objective was to determine whether a relationship exists between tire rolling resistance and stopping distance for vehicles of this type. The overall results of this research suggest that tire rolling resistance is not a reliable indicator of Class 8 tractor-trailer stopping distance. The correlation coefficients (R<sup>2</sup> values) for linear regressions of wet and dry stopping distance versus overall vehicle rolling resistance values did not meet the minimum threshold for statistical significance for any of the test conditions. Correlation between CRR and stopping distance was found to be negligible for the dry tests for both loading conditions. While correlation was higher for the wet testing (showing a slight trend in which lower CRRs correspond to longer stopping distances), it still did not meet the minimum threshold for statistical significance. In terms of compliance with Federal safety standards, it was found that the stopping distance performance of the vehicle with the four tire sets studied in this research (with estimated tractor CRRs which varied by 33 percent), were well under the FMVSS No. 121 stopping distance requirements. The agencies agree, though, that continuing research will be important as new tire technologies enter the marketplace, and like the extensive rolling resistance testing conducting to support the Phase 1 regulation and, in part, this final rule, the agencies will continue to monitor developments in the tire supply marketplace through the EPA Smartway program and other, potential, research. NHTSA notes that FMVSS No. 121 will continue to play a role in ensuring the safety of both current and future tire technologies.

#### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as

noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>92</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>93</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.<sup>94</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

With respect to OOIDA's general comment about safety of 6x2 axles, the agencies considered NACFE's confidence report on 6x2 axles that identifies a potential benefit of 6x2 axles because they add stability when operating on slippery roads, and possibly prevent jack-knife conditions.<sup>95</sup> Also noted in the NACFE report, technologies such as load shifting can increase the weight over the drive axle to improve traction at low speed to alleviate that concern.

### *Vehicle Speed Limiters*

The agencies are not premising these final Phase 2 standards on use of VSL. However, we are continuing to allow VSL as an input to the GEM simulations. The Department of Transportation Volpe Center's 2015 report titled "Review and Analysis of Potential Safety Impacts and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles" summarizes research and analysis findings on potential safety issues associated with both the diverse alternative fuels (natural gas-CNG and LNG, propane, biodiesel, and power train electrification), and the specific FE technologies recently adopted by the MD/HDV fleets.<sup>96</sup> These include Intelligent Transportation Systems (ITS) and telematics, speed limiters, idle reduction devices, tire technologies (single-wide tires, and tire pressure monitoring systems-TPMS and Automated Tire Inflation Systems-ATIS), aerodynamic components, vehicle light-weighting materials, and Long Combination Vehicles (LCVs). The safety findings from literature review pertaining to the specific FE technologies implemented to date in the

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<sup>92</sup> Fleet Owner, "Meritor Expects to offer new tandem axle in 2013," <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>93</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>94</sup> North American Council for Freight Efficiency. "Confidence Findings on the Potential of 6x2 Axles." January 2014. Page 19.

<sup>95</sup> North American Council for Freight Efficiency. Confidence Findings on the Potential of 6x2 Axles. 2014. Pages 30-33.

<sup>96</sup> Brecher, A., Epstein, A. K., & Breck, A. (2015, June). *Review and analysis of potential safety impacts of and regulatory barriers to fuel efficiency technologies and alternative fuels in medium- and heavy-duty vehicles*. (Report No. DOT HS 812 159). Washington, DC: National Highway Traffic Safety Administration.

MD/HDV fleet found that both experience abroad and the cited US studies of trucks equipped with active speed limiters indicated a safety benefit, as measured by up to 50 percent reduced crash rates, in addition to fuel savings and other benefits, with good CMV driver acceptance. Any negative aspects were small and avoidable if all the speed limitation devices were set to the same speed, so there will be less need for overtaking at highway speeds.

### *Weight Reduction*

The Department of Transportation Volpe Center's 2015 report titled "Review and Analysis of Potential Safety Impacts and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles" summarizes research and analysis findings on potential safety issues associated with both the diverse alternative fuels (natural gas-CNG and LNG, propane, biodiesel, and power train electrification), and the specific FE technologies recently adopted by the MD/HDV fleets.<sup>97</sup> These include Intelligent Transportation Systems (ITS) and telematics, speed limiters, idle reduction devices, tire technologies (single-wide tires, and tire pressure monitoring systems-TPMS and Automated Tire Inflation Systems-ATIS), aerodynamic components, vehicle light-weighting materials, and Long Combination Vehicles (LCVs). The scenario-based hazard analysis, based on the literature review and experts' inputs, indicates that MD/HDVs equipped with advanced FE technologies and/or using alternative fuels have manageable potentially adverse safety impacts. The findings suggest that the potential safety hazards identified during operation, maintenance, and crash scenarios can be prevented or mitigated by complying with safety regulations and voluntary standards and industry best practices. The study also did not identify any major regulatory barriers to rapid adoption of FE technologies and alternative fuels by the MD/HDV fleet

### *Aerodynamics Baseline*

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The baseline was not determined by or declared to be the average results of the vehicles tested, as some commenters maintained. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

### *Aerodynamics*

The agencies' assessment is that the best aerodynamic tractor tested by EPA in 2015 achieved Bin IV performance. This vehicle did not include all of the possible aerodynamic technologies, such as wheel

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<sup>97</sup> Brecher, A., Epstein, A. K., & Breck, A. (2015, June). *Review and analysis of potential safety impacts of and regulatory barriers to fuel efficiency technologies and alternative fuels in medium- and heavy-duty vehicles*. (Report No. DOT HS 812 159). Washington, DC: National Highway Traffic Safety Administration.

covers or active aerodynamics like a grill shutter or front air dam. Thus, the agencies' assessment is that Bin V is achievable with known aerodynamic technologies, as discussed in RIA Chapter 2.4, but agree with the manufacturers that Bins VI and VII have less known technology paths. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2 program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so. In consideration of the comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the *proposed* Bin V level of  $C_dA$ . The changes required for Bin V and better performance reflect the kinds of improvements projected in the Department of Energy's SuperTruck program. That program assumes that such systems can be demonstrated on vehicles by 2017. In this case, the agencies are projecting that truck manufacturers will be able to begin implementing these demonstrated aerodynamic technologies as early as 2021 MY on a limited scale. Accordingly, we adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the NPRM, the actual aerodynamic technology being projected is very similar to what was projected at the time of NPRM.

With respect to the comments related to the aerodynamic test procedures, please see the agencies' response to the EMA comments in Section 4.5 of this response to comments document.

#### *Compliance Margin/SEA*

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing. EPA developed a different structure for conducting SEAs to evaluate tractor aerodynamics and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility. Additional discussion is included in Section III.E.2.a of the Preamble to the final rule.

See the agencies' response to engine fuel map compliance margins in the Response to Comments Section 3.7.

**Organization:** PACCAR, Inc.

### **Recent Trends for Technology Development and Acceptance Dictate the Emission Levels and Timing in Alternative 3**

During the past 10 years a number of significant new technologies have been developed and introduced into PACCAR brand trucks. These technologies are aimed at improving performance, fuel efficiency, and reducing emissions and include: automatic engine shutdown (AES); selective catalytic reduction (SCR); low rolling resistance tires; hybridization; aerodynamic improvements; our new MX-13 engine and our soon to be introduced MX-11 engine. What PACCAR has experienced with customers with the implementation and growth of each of these technologies aligns with the time frame that it will take to reach the full implementation of Alternative 3. [EPA-HQ-OAR-2014-0827-1204-A1 p.2]

In essence, what PACCAR has found is that its customers – most of which are commercial businesses – need to become comfortable with technologies before they will adopt them on a widespread basis. For example, when diesel particulate filters (DPF) were introduced, customers paced their purchases of new trucks to assure themselves that the trucks would provide the same performance and could be maintained in a reasonable manner. What this led to was slow initial sales that have increased gradually over the past 5-7 years. PACCAR's experience with our new MX-13 engine followed a similar path. This is an excellent engine that was, and continues to be, highly regarded in its European configuration. Regardless of this, our customers needed time to assure themselves that this engine would meet their needs in the applications for the vehicles and engine reliability and performance levels did not cause undue disruption to their business. Our customers have also moved slowly regarding adoption of aerodynamic improvement changes and low rolling resistance tires. Again, they have examined their business needs to determine when adopting these technologies make sense for them, given their unique circumstances. The penetration rate for Automatic Engine Shutdown (AES) is discussed in greater detail in Section II below. The penetration rate has been significantly lower than the agencies anticipated in Phase I, regardless of the fuel savings and emission reduction. Although AES is widely offered and available, the slow adoption is largely due to customer expectations and needs, as well as the perceived expense of the needed auxiliary systems to provide heating, cooling, and electrical power to the driver during mandated rest periods, and the associated pay-back period. [EPA-HQ-OAR-2014-0827-1204-A1 p.2-3]

What PACCAR's decades of experience in the heavy-duty truck and engine market demonstrates is that customers consider many factors in their vehicle purchases. Clearly, fuel efficiency is high on their list, but it is not the only factor. They also want to ensure that new technologies meet their duty cycle demands, not cause undue disruption to maintenance protocols, and not significantly more expensive without offering payback within a reasonable period of time. Customers want higher residual prices to offset the initial cost increases for new technologies. [EPA-HQ-OAR-2014-0827-1204-A1 p.3]

PACCAR believes the challenges set out in meeting the standards within the time frame for Alternative 3 are considerable, but provide the greatest likelihood for a successful program. [EPA-HQ-OAR-2014-0827-1204-A1 p.3]

### **Revisions to Several Aspects of the Alternative 3 Standards are Needed to Make the Final Standards Challenging but Achievable and to Reflect the Current and Expected Rates of Technology Penetration**

#### **The Aerodynamics Assessments Must Be Revised**

The agencies have proposed a number of changes to aerodynamic assessment in Phase 2 including, increase the number of aerodynamic bins for all roof heights, testing methodologies, data assessment approaches, wind averaged drag versus zero yaw drag determination, and notably increasing the

aerodynamic performance for stringency calculations. PACCAR does agree with the agencies' approach to increase the number of bins but has identified several issues related to the aerodynamics assumptions used by the agencies that must be addressed. The aerodynamics baseline is incorrect, contributing to aerodynamic stringencies that are unachievable even with the best of currently-available aerodynamic technologies. The proposed aerodynamics testing provisions also must be revised in order to bring the testing process more closely in line with real-world conditions. [EPA-HQ-OAR-2014-0827-1204-A1 p.7]

### **Bin Assignments Based on CdA are too High**

The agencies have proposed to narrow and make more stringent the aerodynamic bins to which trucks must be certified under the Phase 2 program. Currently, all of PACCAR's vehicles fall into Phase 2 Bin I and Bin II when using zero degree yaw CFD values and applying the regulatory formula  $CdAwad = (CdACFD * F_{alt-aero}) + 0.80$ . This is inconsistent with the baseline the agencies established for Phase 2. [EPA-HQ-OAR-2014-0827-1204-A1 p.7]

The agencies' bin penetration rates for the baseline and stringency setting fail to take into account that the Phase 2 wind-averaged drag approach on the very best aerodynamic high-roof vehicles in Phase 1 will push some configurations of these vehicles lower down in the bin structure—to the bottom of Bin II, if not into Bin I. These higher aerodynamic drag configurations are the ones that will often be the high-roof equivalent of low- / mid-roof vehicles that are operating with flatbed, tanker, low-boy, or other non-box van trailers. The proposed regulation would then assign these less aerodynamic models into the Phase 2 low- and mid-roof Bin I. The NPRM does not include any Bin I penetration in the stringency setting for these roof heights, which causes concern based on the assessment of current vehicle production using the Phase 2 methodologies. [EPA-HQ-OAR-2014-0827-1204-A1 p.7]

Also, for 2027 stringency, the agencies anticipate a greater percentage of Bin IV low-and mid-roof vehicles than are expected in the "equivalent" high-roof category, Bin VII. The proposal is based on 10% Bin IV low- and mid-roof vehicle penetration, compared for 5% for the high-roof category. PACCAR requests the agencies reconsider the penetration rates for low- and mid-roof tractors. [EPA-HQ-OAR-2014-0827-1204-A1 p.7-8]

Across the board, the low- and mid-roof penetration rates should be concentrated lower in the bin structure (higher CdA values) than the high-roof bins because the low-and mid-roof vehicle configurations cannot use all the same aerodynamic improvement technologies like full length chassis fairings or side extenders. Therefore, these vehicles cannot reach the lower CdA values of the better performing high-roof vehicles for determining the placement in the low- / mid-roof bin structure. PACCAR recommends a change to these penetration rates to better reflect the vehicle configurations that are required by customers in these segments. [EPA-HQ-OAR-2014-0827-1204-A1 p.8]

In addition, the agencies should review the proposed Phase 2 Bin designations for the range of vehicles being offered by OEMs, particularly how baseline vehicles and the concept SuperTrucks would be classified. As currently proposed, the Peterbilt SuperTruck would be placed in Phase 2 Bin IV when assessed with the Phase 2 standard trailer, despite being one of the most advanced aerodynamic vehicles. PACCAR's understanding is that the Freightliner SuperTruck, also an advanced vehicle in terms of aerodynamic improvements, would be classified as Phase 2, Bin IV or maybe as high as Bin V with the Phase 2 trailer. Once the Peterbilt SuperTruck production opportunity is evaluated, however, it may become clear that not all of the demonstrated aerodynamic improvements can be implemented for real-world use, or that some technologies may not achieve the expected benefits or do not work as well as anticipated in combination with other technologies. PACCAR therefore believes that the proposed vehicle Bin designations are unnecessarily stringent and recommends that the agencies revise the aerodynamic



cut-offs for each bin so that the best-performing SuperTruck is designated as Phase 2, Bin VI. Revising the Bin designations in this manner would reflect the best-available technologies expected to be offered under the Phase 2 program, while also leaving open Bin VII as a target for even greater technological advancement on aerodynamics if they can be developed. PACCAR also makes this recommendation based on our understanding of current aerodynamic technology penetration rates and consumer acceptance patterns, which are discussed more fully below. [EPA-HQ-OAR-2014-0827-1204-A1 p.8]

It is recommended that vehicles maintain their zero-degree yaw Phase 1 aerodynamic bin placement in Phase 2, as one of the agencies' test vehicles, the Kenworth T700, is shown to do in the image below. To assist in the proper definition of the new aero bins, it is also recommended that the DOE SuperTruck tractors, when assessed with the Phase 2 reference trailer, should be placed in the upper portion of aero Bin VI. The vehicle placement and bin boundaries should use the agencies default wind-average drag factor of 0.80 m<sup>2</sup>. [EPA-HQ-OAR-2014-0827-1204-A1 p.8]

[Graphics, showing proposed aerodynamic bins, can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1204-A1]

For day cab vehicles, PACCAR believes the agencies have dramatically overestimated the baseline penetration rates, stringency setting bin penetration rates, and assumptions on aerodynamic improvements that are possible. The day cab aero CdA chart below for MY2016 shows that the day cab version of the most aerodynamic sleeper cab models cannot attain Bin IV levels in Phase I, let alone Bin V in Phase 2. Day cabs do not have the same aerodynamic enhancement capabilities that sleeper cabs do so the Phase 2 aerodynamic bin structure must be established to reflect this reality. [EPA-HQ-OAR-2014-0827-1204-A1 p.9]

PACCAR also has concerns about the ability to plan for compliance without knowing how the agencies intend to finalize the Bin designations. If the agencies revise the Bin cut-offs to be aligned with actual current and future vehicle aerodynamic performance, as recommended above, then PACCAR believes the standards will be challenging but potentially achievable, depending on the aerodynamic bin penetration rates. However, if the agencies retain the Bin designations from the proposed rule, compliance will be all but impossible. PACCAR requests that the agencies provide additional information about the intended final Bin cut-offs to enable additional compliance planning and provide the opportunity to provide feedback regarding any changes. [EPA-HQ-OAR-2014-0827-1204-A1 p.9-10]

### **The Technology Baselines and Adoption Rates Used in Developing the Proposed Standards are Overly Optimistic and Should Be Revised**

The agencies' baseline technology assumptions are too high, particularly as they apply to automatic engine shutdown (AES) for sleepers. EPA and NHTSA have also over-estimated the rate at which manufacturers will be able to offer, and customers will adopt, new emission-reduction technologies. While PACCAR sees this as an issue with regard to Alternative 3 standards, this would be an even greater problem if Alternative 4 were to be adopted. [EPA-HQ-OAR-2014-0827-1204-A1 p.13-14]

### **The Agencies Overestimate the Current Use of GHG-Compliance Automatic Engine Shutdown Systems in the Marketplace**

In the proposal, the agencies developed technology baseline and adoption rates for AES systems based on the current rate of auxiliary power units (APUs) installed in vehicles in-use. The agencies are likely correct that approximately 30% of in-use vehicles have APUs installed, none of which are installed at the manufacturing factories under PACCAR direction. Virtually all tractors in the field have an automatic

shutdown programmed in their engine; however, less than 1% of PACCAR vehicles sold in recent years have fully GHG-compliant AES systems that are triggered in less than five minutes and cannot be reprogrammed for 1.259 million miles. Both of these requirements must be met in order for the AES system to receive full credit under the Phase 1 and Phase 2 GHG programs. Additional PACCAR vehicles have partial-credit AES systems that cannot be reprogrammed for 500,000 miles, but the total of full-credit and partial-credit is still under 1% of all vehicles sold since the start of Phase I in MY2014. [EPA-HQ-OAR-2014-0827-1204-A1 p.14]

The agencies estimate that 80% of all sleeper-cab vehicles would be required to have 1.259 million mile-certified systems by model year 2021 in order to meet the Phase 2 standards. For 2024-27 model years, that percentage increases to 90% of all sleeper-cab vehicles. These are extremely ambitious and unachievable targets considering that less than 1% of current PACCAR sleeper-cab production includes these GHG-compliant AES systems. EMA discussions indicate a similar limited penetration for other OEMs. [EPA-HQ-OAR-2014-0827-1204-A1 p.14]

In addition, many customers do not want 1.259 million mile AES systems, either because of the short time at idle before the AES is triggered or because this technology also requires the use of a diesel or battery APU in order to avoid undesirable sleeping conditions for the driver during Hours of Service required off-duty time. The cost of a diesel or battery-based APU is \$8,570 to \$11,263 for each chassis that requires this technology, which is much higher than the APU total cost (TC) of \$4,899 that EPA estimated for 2021 in RIA Table 2-172 (shown below). The cost of the diesel APU increases by approximately \$3,200 if a diesel particulate filter is added to meet the regulatory requirements of California. [EPA-HQ-OAR-2014-0827-1204-A1 p.14]

[The table, Costs for Auxiliary Power Units (APU) Sleeper Cab Tractors, can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1204-A1]

The agencies also vastly underestimated financial impact to vehicle owners by averaging the compliance costs across the entire industry. These estimates do not adequately demonstrate the full costs to individual owners. Each individual customer who must purchase an AES/APU system will have to pay the full cost of that system and not the average cost that the agencies have included in the RIA calculation. This cost will be incurred for every new sleeper cab tractor that is purchased since APUs stays with the old vehicles when they are sold by the original owner. [EPA-HQ-OAR-2014-0827-1204-A1 p.15]

As was stated previously, nearly all tractors with sleepers utilize an automatic engine shutdown system. The technology adds benefit but the requirement to lock it to a 5-minute or less shutdown for 1.259 million miles devalues the vehicle in the resale market. Since the technology is being used and is infrequently changed by the first owner, PACCAR requests the agencies consider partial credit for AES systems that are programmed to a 5-minute or sooner shutdown but are not tamper-resistant to changes by an owner. PACCAR will work with the agencies to determine the proper credit value based on the fuel savings associated with non-tamper-resistant AES systems. [EPA-HQ-OAR-2014-0827-1204-A1 p.15]

PACCAR urges the agencies to reconsider the expected penetration rate of 1.259 million mile AES systems, based on the number of such systems currently in use, and establish more realistic adoption rates with the current baseline in mind. PACCAR also recommends that the agencies reevaluate the costs of such systems and to recognize that each individual customer purchasing an AES/APU system must bear the full cost of that system. [EPA-HQ-OAR-2014-0827-1204-A1 p.15]

### **The Drive Tire Rolling Resistance Values Should be Tailored to Each Market Subcategory as in Phase 1**

The proposal establishes an industry-wide drive tire rolling resistance value without differentiating between types of vehicles, markets, and location of use. The agencies should revise these values to reflect the reality that different market subcategories require different types of tires with different rolling resistance. A single value for all tractor regulatory subcategories does not fit this industry. Tractors with low- and mid-roof configurations have different tire requirements than tractors hauling trailers down the highway at 55-to-65 miles per hour. Customers with low- and mid-roof configurations typically operate more in urban areas where tires must withstand the abuse of curbs and other obstacles. The tires for these vehicles are designed with additional side wall protection and generally have a higher coefficient of rolling resistance. Also, these vehicles are operated in more on/off road conditions that are typical for flatbed, tanker, and low-boy operations, which use the low and mid-roof configuration vehicles. Because of these two operational needs, the tire rolling resistance penetration values for stringency calculation should be adjusted to reflect the realities and needs of the market. Below is a table showing the rolling resistance change for low- and mid-roof families as compared to the equivalent high roof regulatory subcategory. Individual owners also have preferences about tire rolling resistance, particularly for use in colder, snowier, and icier conditions. [EPA-HQ-OAR-2014-0827-1204-A1 p.15-16]

[The table, Tire Crr Value Differences - High Roof vs. Low and Mid Roof, can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1204-A1]

### **The Agencies' Expectations for Developments in Advanced Transmission Technologies are Overly Optimistic**

The agencies' proposed rule indicates that they expect dual-clutch transmissions to be available in MY2021. However, PACCAR and other OEMs do not currently have heavy-duty dual-clutch transmission prototypes in development, much less close to production for use in MY2021. As with all new technologies, adoption rates differ between vehicles and uses. Some advanced transmissions are likely to be adopted more quickly in some categories of vehicles and more slowly in others. Different types of new transmission technologies are also likely to be implemented at various rates, depending on how much of an advantage the technology offers, the cost, and the payback period for customers. PACCAR recommends that the agencies take a more detailed approach to assessing transmission advances and revise the agencies' estimate to reflect technologies that are already under true consideration for use in production powertrains. [EPA-HQ-OAR-2014-0827-1204-A1 p.16]

### **Use of 6x2 Axle Configuration is not Appropriate for All Vehicles in All Circumstances**

In the proposal, the agencies assume a broad shift from 6x4 chassis to 6x2 axle configuration and a corresponding GHG reduction/fuel efficiency increase due to the decreased tire drag. However, not all vehicles operating in all conditions can switch to 6x2 axles due to performance considerations. Some jurisdictions also prohibit 6x2 axles in certain areas or under certain operating conditions. A full list of restrictions by state and province can be located as an appendix of the Truck and Engine Manufacturers Association comments. [EPA-HQ-OAR-2014-0827-1204-A1 p.17]

Customers also have preferences regarding 6x4 or 6x2 axles and are likely to resist being pushed toward using the latter for all type vehicles in many locations or driving conditions. PACCAR recommends that the agencies reevaluate the assumptions made about the rate at which the industry can shift to 6x2 axles and take into account the lower penetration rate when establishing the overall stringency of the GHG emission and fuel efficiency standards. PACCAR supports EMA's comments on this issue. [EPA-HQ-OAR-2014-0827-1204-A1 p.17]

Also, the definition of “composite” should be broadened to include materials other than thermoplastics. PACCAR recommends EPA broaden the materials to thermoplastics, thermosets, and fiber reinforced plastics. [EPA-HQ-OAR-2014-0827-1204-A1 p.31]

### **Speed Limiters**

The Agencies should provide partial credit for speed limiter devices that are set below 65 MPH even if these are not tamper-resistant. PACCAR and its customers’ experience is that drivers cannot change these devices once they are in place and customers make changes, up or down, only if it increases the overall efficiency of the vehicle and the fleet or is required to complete the assigned task within the required time. PACCAR will work with the Agencies to determine the proper credit value based on the fuel savings associated with lower speeds. [EPA-HQ-OAR-2014-0827-1204-A1 p.24]

### **Tire Pressure Monitoring**

The feedback PACCAR has received from its customers is that vehicle operators pay attention to tire pressure monitoring systems (TPMS) and like them. These customers’ maintenance practices allow them to gain the same or near same benefits from a tire pressure monitoring system as they do from a more expensive automated tire inflation system. As is stated in the NPRM, proper tire pressure helps optimize fuel efficiency and reduce GHG emissions. In addition to GHG reduction benefit in GEM for the automated tire inflation system, PACCAR joins EMA in requesting credit in GEM for the TPMS technology. PACCAR will work with the Agencies to develop the proper credit amount. [EPA-HQ-OAR-2014-0827-1204-A1 p.24]

### **Response:**

#### *Alternative 3 Timing*

The agencies considered all of the general comments associated with the proposed Alternative 3 and Alternative 4 tractor standards. We believe there is merit in many of the detailed comments received regarding technologies and lead time. Instead of merely choosing from among the proposed alternatives, the agencies have developed a set of final tractor standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies. In general, the final Phase 2 tractor standards are similar in overall stringency as the levels proposed in Alternative 3, but have been determined using new technology packages that reflect consideration of all of the technology comments, and in several respects reflect greater stringency than the proposed Alternative 3. In addition, the agencies are fully aware, and agree with, the commenter’s statement that fleet owners do not rush in to purchase new technologies but need a period to assure themselves of a new technology’s efficacy and reliability. The final standards are structured with this phenomenon in mind. Thus, the initial 2021 standards reflect very modest penetration rates for advanced technologies, with greater penetration in MY 2024, and with aggressive penetration rates generally deferred until MY 2027.

#### *Aerodynamics*

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. EPA conducted coastdown

testing of the four major tractor manufacturer's (including one produced by PACCAR) high roof sleeper cab tractors. We tested each in two configurations – (1) using a Phase 1 standard trailer without skirts and the Phase 1 data analysis approach and (2) using a Phase 2 standard trailer with skirts and the Phase 2 data analysis approach. The agencies note that we are not adopting the default 0.8 m<sup>2</sup> conversion from zero degree yaw to wind average drag for the final rule because the agencies are adopting a surrogate angle (4.5 degree) approach to reduce the testing burden. Therefore, the default value no longer would serve the purpose of reducing test burden. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for the Phase 2 NPRM. The aerodynamic performance of the tractors tested by EPA were recalculated for the final rule using the final aerodynamic test procedures. See RIA Chapter 3.2.1. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and standard trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. See RIA Chapter 3.2.1.2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin C<sub>d</sub>A values.

The agencies' assessment is that the best aerodynamic tractor tested by EPA in 2015 achieved Bin IV performance. This vehicle did not include all of the possible aerodynamic technologies, such as wheel covers or active aerodynamics like a grill shutter or front air dam. Thus, the agencies' assessment is that Bin V is achievable with known aerodynamic technologies, as discussed in RIA Chapter 2.8.2.2, but agree with the manufacturers that Bins VI and VII have less known technology paths. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2 program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so.

In Phase 1, the agencies determined the stringency of the tractor standards through the use of a mix of aerodynamic bins in the technology packages. For example, we included 10 percent Bin II, 70 percent Bin III, and 20 percent Bin IV in the high roof sleeper cab tractor standard. The weighted average aerodynamic performance of this technology package is equivalent to Bin III. 76 FR 57211. In consideration of the comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of C<sub>d</sub>A, as discussed above and in RIA Chapter 2.8.2.2. Consequently, the final standards are not premised on any adoption of Bin VI and VII technologies. Accordingly, we determined the adoption rates in the technology packages developed for the final rule using a similar approach as Phase 1 - spanning three aerodynamic bins and not setting adoption rates in the most aerodynamic bin(s) - to reflect that there are some vehicles whose operation limits the applicability of some aerodynamic technologies. We set the MY 2027 high roof sleeper cab tractor standards using a technology package that included 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors that we project could successfully apply these aerodynamic packages with this amount of lead time. The weighted average of this set of adoption rates is equivalent to a tractor aerodynamic performance near the border between Bin IV and Bin V. We believe that there is sufficient lead time to develop aerodynamic tractors that can move the entire high roof sleeper cab aerodynamic performance to be as good as or better than today's SmartWay designated tractors.

The agencies phased-in the aerodynamic technology adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these

technologies. The changes required for Bin V performance reflect the kinds of improvements projected in the Department of Energy's SuperTruck program. That program has demonstrated tractor-trailers in 2015 with significant aerodynamic technologies. For the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing some of these aerodynamic technologies on high roof tractors as early as 2021 MY on a limited scale. For example, in the 2021 MY technology package, the agencies have assumed that 10 percent of high roof sleeper cabs will have aerodynamics better than today's best tractors. This phase-in structure is consistent with the normal manner in which manufacturers introduce new technology to manage limited research and development budgets as well as to allow them to work with fleets to fully evaluate in-use reliability before a technology is applied fleet-wide. The agencies believe the phase-in schedule will allow manufacturers to complete these normal processes. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the NPRM, the actual aerodynamic *technologies* being projected are very similar to what was projected at the time of NPRM (however, these vehicles fall into Bin V in the final rule, instead of Bin VI and VII in the NPRM). Importantly, our averaging, banking and trading provisions provide manufacturers with the flexibility (and incentive) to implement these technologies over time even though the standard changes in a single step.

With respect to the other tractor subcategories, the agencies recognize that there are tractor applications that require on/off-road capability and other truck functions which restrict the type of aerodynamic equipment applicable. We also recognize that these types of trucks spend less time at highway speeds where aerodynamic technologies have the greatest benefit. The 2002 VIUS data ranks trucks by major use.<sup>98</sup> The heavy trucks usage indicates that up to 35 percent of the trucks may be used in on/off-road applications or heavier applications. The uses include construction (16 percent), agriculture (12 percent), waste management (5 percent), and mining (2 percent). Therefore, the agencies analyzed the technologies to evaluate the potential restrictions that will prevent 100 percent adoption of more advanced aerodynamic technologies for all of the tractor regulatory subcategories and developed standards with new penetration rates reflecting that these vehicles spend less time at highway speeds. For the final rule, the agencies evaluated the certification data to assess how the aerodynamic performance of high roof day cabs compare to high roof sleeper cabs. In 2014, the high roof day cabs on average are certified to one bin lower than the high roof sleeper cabs.<sup>99</sup> Consistent with the public comments, and the certification data, the aerodynamic adoption rates used to develop the final Phase 2 standards for the high roof day cab regulatory subcategories are less aggressive than for the Class 8 sleeper cab high roof tractors. In addition, the agencies are also accordingly reducing the adoption rates in the highest bins for low and mid roof tractors to follow the changes made to the high roof subcategories because we neither proposed nor expect the aerodynamics of a low or mid roof tractor to be better than a high roof tractor.

The agencies also note that we held several discussions with the aerodynamic specialists within the tractor manufacturers between the NPRM and FRM.<sup>100</sup> The primary purposes of these discussions were to develop robust aerodynamic test procedures and improve the understanding of the aerodynamic bin development process between all of the involved parties.

#### *Idle Reduction Technologies*

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<sup>98</sup> U.S. Department of Energy. *Transportation Energy Data Book*, Edition 28-2009. Table 5.7.

<sup>99</sup> U.S. EPA. Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. See Docket EPA-HQ-OAR-2014-0827.

<sup>100</sup> U.S. EPA. Memo to Docket. Aerodynamic Subteam Meetings with EMA. See Docket EPA-HQ-OAR-2014-0827.

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>101</sup> Therefore, the agencies are projecting for the Phase 2 baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS for consideration in the baseline, and none will have a tamper-proof AESS.

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable (programmable) systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS. The agencies agree with the commenter that nearly all sleeper cabs can utilize an automatic engine shutdown system, and our adoption rates reflect this.

EPA considered the comments and more closely evaluated NHTSA's contracted TetraTech cost report found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking.

The comment regarding the "averaging vehicle costs across the industry" versus the vehicle equipped with a specific device or devices is an interesting take on our analysis. However, in aggregate, the average cost estimated in our analysis is the best and most meaningful measure of the projected cost of the new standards. We do not expect that a "maximum" or a "minimum" technology tractor will be built. Instead, we estimate that, on average, tractors will gradually improve fuel consumption and decrease GHG emissions such that a variety of prices and performance characteristics will continue to be available. Just because every vehicle is not "average" does not mean that we are underestimating costs, nor are we overestimating costs. In addition, our payback analysis represents the "average" vehicle but in reality some purchasers may experience payback periods that are shorter (or longer) than the average depending on the individual technologies purchased and the operation of the specific vehicle.

#### *Low Rolling Resistance Tires*

For the proposal, the agencies used the same level of tire rolling resistance across all tractor subcategories. In our analysis of the Phase 1 certification data for the final rule development, we found that the drive tires on low and mid roof sleeper cab tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs.<sup>102</sup> This finding aligns with the commenter's concerns raised that low and mid roof tractors require a different mix of tire attributes (fuel efficiency, wear, durability, side wall protection, cost, etc.). But we found only a minor difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our

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<sup>101</sup> North American Council for Freight Efficiency. Confidence Report:Idle- Reduction Solutions. 2014. Page 13.

<sup>102</sup> Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. Docket EPA-HQ-OAR-2014-0827.

own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. This is also consistent with the approach that we took in setting the Phase 1 tractor standards. 76 FR 57211. In addition, the final rule reflects a reduction in Level 3 tire (the lowest CRR) adoption rates for low and mid roof tractors from 25 percent in MY 2027 used at proposal (80 FR 40227) to zero percent adoption rate. The technology packages developed for the low and mid roof tractors used to determine the stringency of the MY 2027 standards in the final rule do not include any adoption rate of Level 3 drive tires to recognize the special needs of these applications, consistent with the comments noted above raising concerns about applications that limit the use of low rolling resistance tires.

DOT's Federal Motor Carrier Safety Administration and NHTSA sponsored a test program conducted by Oak Ridge National Laboratory to explore the effects of tire rolling resistance levels on Class 8 tractor-trailer stopping distance performance over a range of loading and surface conditions. The objective was to determine whether a relationship exists between tire rolling resistance and stopping distance for vehicles of this type. The overall results of this research suggest that tire rolling resistance is not a reliable indicator of Class 8 tractor-trailer stopping distance. The correlation coefficients (R<sup>2</sup> values) for linear regressions of wet and dry stopping distance versus overall vehicle rolling resistance values did not meet the minimum threshold for statistical significance for any of the test conditions. Correlation between CRR and stopping distance was found to be negligible for the dry tests for both loading conditions. While correlation was higher for the wet testing (showing a slight trend in which lower CRRs correspond to longer stopping distances), it still did not meet the minimum threshold for statistical significance. In terms of compliance with Federal safety standards, it was found that the stopping distance performance of the vehicle with the four tire sets studied in this research (with estimated tractor CRRs which varied by 33 percent), were well under the FMVSS No. 121 stopping distance requirements. The agencies agree, though, that continuing research will be important as new tire technologies enter the marketplace, and like the extensive rolling resistance testing conducting to support the Phase 1 regulation and, in part, this final rule, the agencies will continue to monitor developments in the tire supply marketplace through the EPA Smartway program and other, potential, research. NHTSA notes that FMVSS No. 121 will continue to play a role in ensuring the safety of both current and future tire technologies.

#### *Advanced Transmissions*

The agencies evaluated various types of transmissions. Volvo put into production in 2014 a DCT in Europe for heavy-duty tractors.<sup>103</sup> For the final rule, the agencies projected 5% adoption rate of DCTs in 2021 and 10% in 2024. However, the effectiveness of DCTs is equal to the effectiveness of AMTs (2%). Therefore, if the HD manufacturers do not develop/bring a DCT to the U.S. market during the Phase 2 timeframe, the difference in stringency could be offset by installing an AMT instead, which is currently offered by all HD tractor manufacturers.

#### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used

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<sup>103</sup> Volvo Trucks Global. The World's First Dual-Clutch Transmission for Trucks. October 15, 2014. <http://mag.volvotrucks.com/global/global/article/?art=4009&ref=1>. See Docket #EPA-HQ-OAR-2014-0827.



to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>104</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>105</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>106</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

With respect to PACCAR’s general comment about the acceptance of 6x2 axles, the agencies considered NACFE’s confidence report on 6x2 axles that identifies a potential benefit of 6x2 axles because they add stability when operating on slippery roads, and possibly prevent jack-knife conditions.<sup>107</sup> Also noted in the NACFE report, technologies such as load shifting can increase the weight over the drive axle to improve traction at low speed to alleviate that concern.

### *Weight Reduction*

The agencies are not broadening the definition of thermoplastics in the Weight Reduction tables included in 40 CFR 1037.520. The values in the table are specific to thermoplastics. Manufacturers have the option to request approval for off-cycle technologies that include weight reduction of components manufactured out of other types of materials.

### *Speed Limiters*

The agencies considered DOT’s upcoming actions with respect to mandatory vehicle speed limiters for heavy-duty trucks, but could not take it into account in this Phase 2 rulemaking because that rule is not final yet. The existing Phase 1 VSL flexibilities provide opportunities for manufacturers to account for the impact of VSLs on reducing GHG emissions and fuel consumption, while still allowing the settings to change after an “expiration” time determined by the manufacturer or to include a soft top. At this time, we believe that the Phase 1 flexibilities sufficiently balance the desire to encourage technologies that

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<sup>104</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>105</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>106</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

<sup>107</sup> North American Council for Freight Efficiency. Confidence Findings on the Potential of 6x2 Axles. 2014. Pages 30-33.

reduce GHG emissions and fuel consumption while minimizing the compliance burden of trying to accommodate changes throughout the useful life of the vehicle. Therefore, the agencies are not adopting any new VSL provisions for Phase 2.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies agree with this commenter and believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS.

**Organization:** Plastics Industry Trade Association (SPI)

#### The Impact of Aerodynamics and Fuel Efficiency

Class 8 tractor-trailers, the target of this rule making, can exhibit significant energy savings and better fuel efficiency by improving aerodynamics. [EPA-HQ-OAR-2014-0827-1225-A1 p.3]

The main causes of aerodynamic drag of a tractor-trailer, as noted in the draft Regulatory Impact Analysis, are: [EPA-HQ-OAR-2014-0827-1225-A1 p.4]

- Stagnation pressures at front end [EPA-HQ-OAR-2014-0827-1225-A1 p.4]
- Turbulent in-flows at the tractor trailer gap [EPA-HQ-OAR-2014-0827-1225-A1 p.4]
- Underside flow; and, [EPA-HQ-OAR-2014-0827-1225-A1 p.4]
- Wake at the rear of the trailer [EPA-HQ-OAR-2014-0827-1225-A1 p.4]

Roof fairing of sleeper cabs and day cabs has been shown to reduce stagnation pressure at the front end of Class 8 vehicles. Computational fluid dynamics modelling in the industry has shown that optimization of day cab roof fairing designs are possible.<sup>7</sup> We encourage the agencies to provide incentive for these types of innovative technologies. [EPA-HQ-OAR-2014-0827-1225-A1 p.4]

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3 RIA, p. 3-16.

<sup>4</sup> Institute for Internal Combustion Engines and Thermodynamics, *Evaluation of fuel efficiency improvements in the heavy-duty vehicle (HDV) sector from improved trailer and tire designs by application of a new test procedure*, Report No. I-24/2011 Hb-Em 18/11/679 (2011).

<sup>7</sup> Pereira, C. et al., *Drag Reduction through Optimization of an Aerodynamic Day Cab Roof Fairing*, SAE 2015 Commercial Vehicle Engineering Congress, October 6-8, 2015, 15CVA-0026 2015-01-2892 PPRES.

#### **Response:**

The agencies are adopting Phase 2 tractors standards based on technology packages that include significant aerodynamic improvements of tractors.

**Organization:** Rubber Manufacturers Association (RMA)

**V. Automatic Inflation Tire System (ATIS) and Tire Pressure Monitoring System (TPMS)**

The NPRM proposes that Class 8 tractors and the trailers towed will include the technology of the Automatic Tire Inflation System (ATIS) as inputs into the Greenhouse Gas Emissions Model P2 v1.0. The NPRM GEM input for ATIS will provide a 1.0% and 1.5% CO<sub>2</sub> and fuel consumption (FC) reduction for the tractor and trailer, respectively. The agencies solicit comment on whether GEM should also offer a credit for the installation of a Tire Pressure Monitoring System (TPMS). RMA supports a GEM credit for TPMS systems, similar to the credit being proposed for ATIS systems. [EPA-HQ-OAR-2014-0827-1304-A1 p.28-29]

In support of this GEM input credit for ATIS, The NPRM references the 2013 North American Council for Freight Efficiency “Tire Pressure Systems - Confidence Report” which states that tractor-trailers operating with all tires under-inflated by 10 psi have been shown to increase fuel consumed by up to 1 percent. ATIS and TPMS technologies have evolved since the time of the 2003 Federal Motor Carrier Safety Administration “Commercial Vehicle Tire Condition Sensors” report. [EPA-HQ-OAR-2014-0827-1304-A1 p.29]

The NPRM states that the ATIS can maintain tire pressure at a single preset level. They eliminate the need to check tire pressure manually and allow a vehicle to remain in-service despite small air leaks in one or more of its tires. Constant tire inflation systems have no involvement from the driver. They automatically sense the pressure in the tires and inflate as necessary when they lose air. However, the technology of the Tire Pressure Monitoring System (TPMS) for medium-duty and heavy-duty trucks is also another viable tool for alerts and maintenance requirements on tire inflation pressure. Properly used TPMS systems may also achieve equal results as ATI systems. Some modern systems actually notify the fleet central office if an underinflated tire is not dealt with by the vehicle operator in a timely fashion. [EPA-HQ-OAR-2014-0827-1304-A1 p.29]

In the case of TPMS for light duty vehicle tires, the environmental and safety benefits are well documented. In 2011, NHTSA conducted a review of the effectiveness of FMVSS 138, which mandates TPMS systems be installed as original equipment in all passenger cars, multipurpose passenger vehicles and trucks and buses a gross vehicle weight rating (GVWR) of 10,000 pounds or less and manufactured on or after September 1, 2007.<sup>31</sup> The TPMS system must be capable of detecting any combination of tires that is/are at least 25 percent underinflated. Prior to the compliance date, some vehicles met the requirements of FMVSS 138, either voluntarily or according to the phase-in schedule included in FMVSS 138. In its study, NHTSA studied vehicles of model years 2004-2007 and found that the presence of a TPMS system led to a 55.6 percent reduction in the likelihood that a vehicle would have one tire that is significantly underinflated (25 percent or greater).<sup>32</sup> In addition, NHTSA found TPMS to be effective in reducing moderate under inflation (at least 10 percent, under 25 percent), which was reduced by 35.3 percent.<sup>33</sup> For light trucks and vans, the effectiveness rates were even higher, with TPMS reducing severe under inflation by 61.2 percent and moderate under inflation by 37.7 percent. NHTSA found that in 2011, the TPMS systems save \$511 million in fuel costs across the vehicle fleet.<sup>34</sup> [EPA-HQ-OAR-2014-0827-1304-A1 p.29-30]

Anticipated improvements in the incidence of under inflation and fuel savings would likely be greater for Class 8 trucks than for light duty vehicles. Since most Class 8 tractors and trailers are managed by professional fleets, tires typically are treated as a valuable commodity and managed as company assets. In addition, since fuel is the largest single cost for a fleet, conserving fuel can mean significant cost savings.

Due to the larger fuel economy contribution made by tires of Class 8 tractor and trailers, TPMS will spur action more quickly than by a light duty vehicle owner. [EPA-HQ-OAR-2014-0827-1304-A1 p.30]

The choice of using the ATIS or TPMS provides the tools to assure tire inflation pressure maintenance and service requirements beyond the visual and manual tire inspections. [EPA-HQ-OAR-2014-0827-1304-A1 p.30]

Providing efficiency benefits to only ATIS technology neglects the benefits of correctly using TPMS. In addition, both ATIS and TPMS should carry the same benefit in terms of CO<sub>2</sub> and fuel consumption reduction. TPMS can also provide the applications to the other Class 2b – 6 medium- and heavy-duty vehicles encompassed in the proposed Phase 2 fuel efficiency standards, in addition to the overall tire performances. [EPA-HQ-OAR-2014-0827-1304-A1 p.30]

In anticipation of the evolution of the TPMS, ATIS, and Central Tire Inflation System (CTIS) technologies, SAE International developed and published proactively, the first of their kind, three (3) standards: [EPA-HQ-OAR-2014-0827-1304-A1 p.30]

- J2848/1\_201004 - Tire Pressure Monitoring Systems - For Medium and Heavy Duty Highway Vehicles
- J2848/2\_201106 - Tire Pressure Systems - Maintenance (ATIS) Type For Medium and Heavy Duty Highway Vehicles
- J2848/3\_201202 - Tire Pressure Systems – Management (CTIS) Type for Medium and Heavy Duty Highway Vehicles

Recently, the ISO (International Standardization Organization) TC22 Working Group 15 has initiated development of “ISO 18633 Road Vehicles – Safety enhancement in conjunction with tire inflation pressure monitoring & automatic tire inflation – Commercial vehicles.” Therefore, both ATIS and TPMS should be considered in the Phase 2 rule and carry the same benefits, i.e. input into the GEM, in terms of CO<sub>2</sub> and fuel consumption reduction and offer the industry a choice in the technologies, especially if the Class 2b – 6 vehicles are included. [EPA-HQ-OAR-2014-0827-1304-A1 p.31]

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31 Sivinski, Robert (2012). Evaluation of the Effectiveness Of TPMS in Proper Tire Pressure Maintenance. (Report No. DOT HS 811 681), Washington, DC, National Highway Traffic Safety Administration.

<sup>32</sup> Id. at 13.

<sup>33</sup> Id. at 18.

<sup>34</sup> Id. at 28.

**Response:**

*Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various

technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS. The agencies appreciate the additional studies related to TPMS provided by the commenter.

**Organization:** Schneider National Inc.

EPA is suggesting various technologies which, while appropriate in some applications, are inappropriate on a fleet-wide basis. Among these technologies:

6x2 Axle Configurations. We recognize the benefits of reduced weight and fuel savings which 6x2 axle configurations may provide. There are, however, a number of issues related to this configuration. Some relate to cost. For example, this configuration presents issues related to diminished resale value, tire cost and life. Other issues are less about costs than other impediments. This configuration may not be legally operated in all jurisdictions. As importantly, it is not appropriate for operation in all geographies as the configuration provides noticeably less traction than the standard 6x4 axle configuration. While manufacturers have offered electronic based traction solution, none are as effective as 6x4 axle configurations in providing traction either in the yard or over the road in inclement conditions. Drivers who operate in four season geographies strongly prefer 6x4, and the preference is strong enough to impact driver retention and attraction for hiring. When all costs are considered, the overall cost is unfavorable except for vehicles which are restricted to southern climates without snow and ice. [EPA-HQ-OAR-2014-0827-1201-A1 p.2]

6x2 Axle Configurations. The cost should include loss on resale value, increased tire wear, and cost for electronic technology to improve traction. [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

Auxiliary Power Units ('APUs'). Our entire sleeper fleet is equipped with diesel fired heaters, and electric APUs are primarily used in southern climates where drivers are required to sleep in extreme temperatures. The APUs are heavy, expensive, and require significant maintenance. The payback for even the lowest cost APU is unfavorable for a five year tractor life. While APUs are an appropriate approach when dealing with vehicles manufactured prior to 2014, they are not appropriate with more recently manufactured vehicles. Diesel engines produced after 2014 produce a suitable vehicle cab temperature by idling at very low RPMs, consuming .75 gallon per hour of idle, and produce few emissions. Mandating APUs in the context of newer vehicles would reduce vehicle payloads, add the cost of a potentially unreliable APU, and not materially improve air quality or overall energy consumption. [EPA-HQ-OAR-2014-0827-1201-A1 p.2]

APU — An electronic APU will have an initial cost of at least \$5,000 plus maintenance of \$500/year. Engine powered APU are 2-3x the electric costs, and must also add maintenance costs. [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

Wide Base Single Tires ('WBS'). The fleet uses low rolling resistance tires ('LRR') on dual wheels for the majority of the standard fleet while using wide-based single ('WBS') tires for weight sensitive portions of the fleet. Regulations should not, in Schneider's estimation, force the use of WBS based solely on rolling resistance advantages without considering the overall performance. Key disadvantages of WBS tires include their wear rate and limited recapping capacity as contrasted to dual tires. Broader use of WBS tires will increase waste, the number of scrapped tire casings and landfill requirements. In addition, WBS tires increase costs as a result of an increase in required service calls and increased downtime when a flat tires is experienced, as well as diminished resale value. LRR dual tires are very comparable to WBS tires

in fuel efficiency while providing better overall operating and economic efficiency. [EPA-HQ-OAR-2014-0827-1201-A1 p.2-3]

WBS Tires — tire costs must include additional service costs, cost of reduced tire life, increased replacement tire costs due to recaps not available, and reduced resale value. [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

For the reasons stated above, the listed technologies should not be required to be adopted on a fleet-wide basis. [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

**Response:**

*6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>108</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>109</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>110</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

With respect to Schneider’s comment about the of 6x2 axles in all geographies, the agencies considered NACFE’s confidence report on 6x2 axles that identifies a potential benefit of 6x2 axles because they add stability when operating on slippery roads, and possibly prevent jack-knife conditions.<sup>111</sup> Also noted in

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<sup>108</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>109</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>110</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

<sup>111</sup> North American Council for Freight Efficiency. Confidence Findings on the Potential of 6x2 Axles. 2014. Pages 30-33.

the NACFE report, technologies such as load shifting can increase the weight over the drive axle to improve traction at low speed to alleviate that concern.

The agencies considered the maintenance impact of 6x2 axles. As noted in the NACFE Confidence Report on 6x2 axles, the industry expects an overall reduction in maintenance costs and labor for vehicles with a 6x2 configuration as compared to a 6x4 configuration.<sup>112</sup> Among other savings, the reduction in number of parts, such as the interaxle drive shaft, will reduce the number of lubrication procedures needed and reduce the overall quantity of differential fluid needed at change intervals. The agencies have taken an approach to the maintenance costs for the 6x2 technology where we believe that the overall impact will be zero. In addition, the agencies reviewed the NACFE confidence report in terms of resale value. NACFE found in their surveys that some fleets have experienced no issues with resale of tractors with 6x2 axles, while other still believe that it may impact resale. NACFE also noted many believed “that the resale value of 6x2s is rising as the technology is better understood and the industry becomes better educated on its limitations.”<sup>113</sup>

#### *Idle Reduction Technologies*

There is a misconception of the proposed Phase 2 program where stakeholders thought that the agencies were mandating APUs. This is incorrect. The tractor standards are performance standards. The agencies merely *projected* an adoption rate of up to 90 percent for tamper-proof AESS in our analysis for determining the proposed standard. We did not propose to differentiate between the various idle reduction technologies in terms of effectiveness and only used the diesel powered APU in terms of determining the cost and effectiveness. Also, because the standards are performance standards, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed one potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies (including diesel fired heaters and battery powered APUs) and only projected adoption of idle reduction technologies with adjustable AESS.

The agencies added maintenance costs for diesel powered APUs, battery powered APUs, and diesel fired heaters into the cost analysis for the final rulemaking, as described in RIA Chapter 7.2.3. We have estimated the cost of the battery powered APU technology at \$6400 retail price. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking.

#### *Wide Base Single Tires*

The agencies have not mandated any use of WBS tires in either the NPRM or the final rule. We have projected technology packages that include lower rolling resistance tires, but at levels that could be achieved with dual tires.

We expect that, when replaced, the lower rolling resistance tires would be replaced by equivalent performing tires throughout the vehicle lifetime. As such, the incremental increases in costs for lower rolling resistance tires would be incurred throughout the vehicle lifetime at intervals consistent with current tire replacement intervals. A recent study conducted by ATA’s Technology and Maintenance

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<sup>112</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” 2014.

<sup>113</sup> Ibid. Page 36.

Council found through surveys of 51 fleets that low rolling resistance tires and wide base single tires lasted longer than standard tractor tires.<sup>114</sup> Due to the uncertainty regarding the life expectancy of the LRR tires, we conservatively maintained the current tire replacement intervals in our cost analysis.

**Organization:** Truck & Engine Manufacturers Association (EMA)

In addition, the proposed standard trailer that is to be used during coastdown testing is configured in such a way that it will actually preclude certification to the more stringent aerodynamic “Bins” incorporated into the Proposed Phase 2 Standards (i.e., Bins V-VII). That, in turn, will preclude “certified” attainment with many of the assumed improvements in aerodynamics and drag, thereby rendering infeasible one of the key premises for the proposed Phase 2 fuel efficiency standards for heavy-duty vehicles. That is a critical issue, which, in essence, undermines a foundational cornerstone of the Proposed Phase 2 Standards for heavy-duty tractors. Later in these comments, EMA describes the necessary revisions to the aerodynamic “baseline” and to the process for certifying aerodynamic improvements and accounting for those improvements in the implementation of the Phase 2 standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.4]

#### Aerodynamic Baseline, Bins and Stringency

Simply stated, the Proposed Phase 2 Standards assume unachievable aerodynamic performance. Since the Phase 2 proposal includes adjustments to the aerodynamic test trailer (adding a skirt) and to the aerodynamic certification process (utilizing wind-averaged drag), the “baseline” drag area coefficient (“CdA”) also must be adjusted for Phase 2. As it stands, the assumption in the draft Regulatory Impact Analysis (“RIA”) that all tractors would qualify for Bin III or better in Phase 2 is incorrect. In fact, it appears that the majority of current tractors may only qualify for Bin II. Even the best anticipated future-technology “SuperTruck” tractor configurations likely would only qualify for Bin IV or possibly Bin V, leaving Bins V, VI and VII largely infeasible and unachievable, which stands in stark contrast to the NPRM’s 2027 projected aerodynamic penetration-rate targets of 35% for Bin V, 20% for Bin VI, and 5% for Bin VII. The agencies’ significant over-estimation of the relevant aerodynamic baseline and performance capabilities must be corrected and accounted for before the agencies finalize any Phase 2 tractor standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.6]

As explained below, the agencies’ use of an over-estimated baseline will result in infeasible aerodynamic standards. For example, EPA and NHTSA assume an average CdA of 6.23 for a “Sleeper High-Roof” vehicle. The RIA states that “most tractors today would qualify for Bin III with varying degrees of opportunity to move into improved bins.” As support for this assumption, the agencies cite to data from three sleeper vehicles tested at Southwest Research Institute (“SwRI”). But those vehicles were not “average” vehicles, as the agencies assert. Rather they were closer to the best vehicle configurations for each manufacturer. The average configuration is much more likely to fall into Bin II (or even into Bin I) for Phase 2 based on the agencies’ proposed aerodynamic test procedures and new requirements for utilizing wind-average drag. Indeed, a conversion of the baseline from Phase 1 (CdA of 6.4) to Phase 2 (with wind-average drag and trailer skirts) falls into Phase 2 Bin II. Consequently, the agencies’ assumed baseline of Bin III for Phase 2 is off by a full Bin. This 1-Bin overestimation would necessitate, on average, an 8.7% improvement in aerodynamic performance just to reach the defined “baseline,” which, in turn, would render it infeasible to meet the more stringent requirements included in the Proposed Phase 2 Standards. Moreover, the Proposed Standards are set based on assumed significant penetrations of Bins III through VII for the 2021-2027 phase-in period. However, as noted, initial analyses of the performance

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<sup>114</sup> Truckinginfo. TMC Survey Reveals Misinformed View of Fuel-Efficient Tires. March 2015.



of the best configurations from the “SuperTruck” development program do not show attainment with Bin VI or Bin VII aerodynamic performance, with the net result being that the proposed aerodynamic targets are not achievable. [EPA-HQ-OAR-2014-0827-1269-A1 p.6-7]

The following figures depict the manner and extent to which the agencies have overestimated the assumed aerodynamic baseline for “sleeper high-roof” vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.7]

[Figure, 'Sleeper: GHG Phase I to Phase II Baseline Analysis', can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

In addition, it appears that the agencies have overstated the results obtained from the SwRI testing. As noted, the tractors that SwRI tested were “best” configurations, not average configurations. Moreover, while the SwRI report calculated the CdA coastdown results for 3 sleeper tractors as ranging between 5.76-6.37, the agencies have stated those results in the R1A, without any detailed explanation, as ranging between 5.4-5.6 (Bin III). (See Table 3-21, below). [EPA-HQ-OAR-2014-0827-1269-A1 p.8]

[Table, '3-21: Baseline Justification', can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

Other analyses confirm that the upper bins of the proposed aerodynamic standards would not be attainable. In particular, it appears that Bins V-VII will remain out-of-reach with the proposed Phase 2 test trailer, which will only include the addition of side skirts and so will not facilitate high-end aerodynamic performance. The detail of this analysis with respect to sleeper-high tractors is shown below. [EPA-HQ-OAR-2014-0827-1269-A1 p.8]

[Figure, 'Aero Improvements for Sleeper High', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

- Bin VI & Bin VII are unachievable with the Phase 2 trailer [EPA-HQ-OAR-2014-0827-1269-A1 p.9]

- Bin V is only potentially achievable with mirror-less designs (not currently allowed) and is not possible without the inclusion of a compliance margin [EPA-HQ-OAR-2014-0827-1269-A1 p.9]

The agencies’ incorrect assumption that average high-roof vehicles will fall into Bin III instead of Bin II also will result in the corollary mid- and low-roof vehicles being included in an over-estimated Bin for the baseline as well. (See Table 5 to Proposed § 1037.520, reproduced below). Accordingly, the necessary corrections of the agencies’ over-estimation of the aerodynamic baseline will need to consider the “Mid” and “Low” roof baselines as well, in addition to the “Average” for the “High-Roof” baseline. [EPA-HQ-OAR-2014-0827-1269-A1 p.10]

[Figure, High and Mid/Low bins, can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

[Table 5, 'Bin determinations for Phase 2 Low- and Mid-Roof Tractors Based on Equivalent High-Roof Tractors', can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

In addition, the NPRM asserts that by calendar year 2020 (model year (“MY”) 2021 for heavy-duty vehicles), all new high-roof vehicles will be certified to Phase 1 Bin IV or higher, and low- and mid-roof

vehicles will be in Bin II, corresponding to high-roof Bins III and IV, which essentially would require the installation of the entire suite of SmartWay-verified technologies. However, EPA's Bin penetration rates fail to take into account that the Phase 2 wind-averaged drag approach, even when applied to the very best aerodynamic high-roof vehicles in Phase 1, will push some configurations of those vehicles lower down in the Bin structure to the bottom of Bin II, if not into Bin I. Those higher aero-drag configurations are the same ones that will be the high-roof equivalent of low-/mid-roof vehicles operating with flatbed, tanker, low-boy, or other non-box van trailers. Consequently, the proposed Phase 2 regulation would actually force those aerodynamic models into low- and mid-roof Bin I. Significantly, and incorrectly, the NPRM does not include any Bin I penetration in the assessed stringency for those vehicle types. [EPA-HQ-OAR-2014-0827-1269-A1 p.11]

For the proposed 2027 stringencies, the agencies are assuming a greater percentage of Bin IV low- and mid-roof vehicles - 10% - than is expected in the high-roof category - 5%. That is illogical and incorrect. The low- and mid-roof penetration rates must be concentrated lower down in the Bin structure (with higher CdA values) than the high-roof Bins, because the low- and mid-roof vehicle configurations cannot use all of the assumed aerodynamic improvement technologies, such as full-length chassis fairings or side extenders, and therefore cannot reach the lower CdA values of the better-performing high-roof Bins [EPA-HQ-OAR-2014-0827-1269-A1 p.11]

With respect to day-cab vehicles, the agencies' baseline penetration rates, stringency-setting Bin penetration rates, and assumptions regarding potential aerodynamic improvements are all dramatically overestimated. As evidenced by the day-cab aerodynamic CdA chart set forth below for MY2016 day-cabs, even the day-cab version of the most aerodynamic sleeper-cab models cannot attain Bin IV levels in Phase 1, let alone Bin V. Day-cabs simply do not have the same aerodynamic enhancement capabilities as sleeper-cabs. The Phase 2 aerodynamic Bin structure must be amended to reflect this reality. [EPA-HQ-OAR-2014-0827-1269-A1 p.11]

[Chart, 'Day Cab CdA Values', can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

In light of the foregoing, it follows that the day-cab vehicle configurations are impacted even more severely by the agencies' overestimation of the aerodynamic performance baseline, as depicted below: [EPA-HQ-OAR-2014-0827-1269-A1 p.14]

[Chart, 'Daycab Baseline Walk Phase 2', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

The salient fact is that the day-cab version of even the most aerodynamic vehicle model is still only in Bin III. Consequently, as depicted below, it is inherently unreasonable for the agencies to assume that day-cab models will be able to achieve similar improvements in aerodynamic performance as those envisioned for sleeper-cab models. [EPA-HQ-OAR-2014-0827-1269-A1 p.14]

[Chart, 'Aero Improvements for Daycabs', can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

- Bins V, VI and VII are unachievable for daycabs [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

- The Aerodynamic Baseline is significantly off [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

- The agencies' assumed percent reduction for daycabs matches that for sleepers, even though daycabs have less opportunity for aero improvements [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

- SuperTruck capabilities are sleeper-focused, not daycab-focused [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

In sum, the agencies have over-estimated in fundamental ways the potential improvements in vehicle aerodynamic performance. Consequently, the Proposed Phase 2 Standards are infeasible to the extent that they have been derived from those fundamental overestimations. The agencies will need to incorporate correct and significantly revised assessments of aerodynamic performance in any final Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

#### Aerodynamics

- The assumptions that Class 7 and Class 8 high-roof vehicles will achieve a 35% penetration rate into Bin V, a 20% penetration rate into Bin VI, and a 5% penetration rate into Bin VII are grossly overstated and unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

The assumed aerodynamic performance improvements to be achieved by daycab and mid and low-roof vehicles are over-estimated by at least one Bin, and so are inherently unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

#### Automatic Engine Shutdown (AES) Systems

The assumptions that 90% of Class 8 sleeper cabs and 90% of long-haul tractor trailers will utilize APUs to achieve extended idle emission reductions is based on grossly underestimated cost estimates and is unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

The agencies have confused the use of an APU with the use of locked-idle technologies in assessing the baseline for the Proposed Phase 2 Standards. Specifically, a 30% penetration rate by APUs is not the same as a 30% penetration rate by locked-idle systems. The assumed baseline is incorrect in that regard.

In the Phase 2 proposal, EPA has developed technology baselines and adoption rates for AES systems based on the current rate of auxiliary power units (APUs) installed in vehicles in-use. In that regard, EPA is correct that approximately 30% of in-use vehicles have APUs installed.<sup>4</sup> While virtually all tractors have an automatic shutdown programmed in their engine, less than 1% of vehicles sold in recent years have GHG-compliant AES systems (i.e., systems that are triggered in less than five minutes and that cannot be reprogrammed for 1.259 million miles). Nonetheless, both of those requirements must be met in order for the AES system to receive full credit under the Phase 1 and Phase 2 GHG/FE programs. [EPA-HQ-OAR-2014-0827-1269-A1 p.53]

EPA estimates that 80% of all sleeper-cab vehicles would be required to have the 1.259 million mile-certified AES systems by 2021 in order to meet the Phase 2 standards. For 2024/2027, that percentage increases to 90% of all sleeper-cab vehicles. Those targets, however, are likely unachievable considering that less than 1% of current sleeper-cab production vehicles include those types of GHG-compliant AES systems. [EPA-HQ-OAR-2014-0827-1269-A1 p.53]

In addition, many customers do not want 1.259 million-mile AES systems, either because of the short time at idle before the AES is triggered, or because this technology also requires the use of a diesel or battery APU in order to avoid unhealthy "hours of service" and to provide acceptable off-duty sleeping

conditions for the driver. In that regard, the direct per-chassis cost of a diesel APU is approximately \$8,500-\$10,100 (the cost is even higher, approximately \$11,300, for battery/electric APUs), much higher than the \$2,000 per-chassis direct cost that EPA has estimated. Moreover, EPA has vastly underestimated the financial impact to vehicle owners by averaging the compliance costs (also underestimated, as noted) across the entire industry. Those estimates do not adequately represent the full costs to individual owners. While the average cost may be lower than \$3,000 per vehicle using the NPRM cost figures, each individual customer who must purchase an AES/APU system will have to pay the full cost for that system and cannot average that cost across other vehicles that do not utilize those devices. [EPA-HQ-OAR-2014-0827-1269-A1 p.54]

As noted, nearly all tractors with sleepers utilize an automatic engine shutdown system. That technology adds benefit, but the requirement to permanently program it to a 5-minute or less shutdown time devalues the vehicle in the resale market. At the same time, since AES technologies are being used and are infrequently changed by the first owner, EMA requests that EPA consider partial credit for AES systems that are programmed to a 5-minute or sooner shutdown, but are not permanently locked against changes by an owner for the full 1.259 million miles. EMA will work with the agencies to determine the proper credit value based on the fuel savings associated with such non-tamper-resistant AES systems. [EPA-HQ-OAR-2014-0827-1269-A1 p.54]

EMA also urges EPA to reconsider the expected penetration rate of 1.259 million mile AES systems, based on the number of such systems currently in use and their actual costs, and to establish more realistic adoption rates with the current baseline and actual full costs in mind. [EPA-HQ-OAR-2014-0827-1269-A1 p.54]

#### Assumed Penetration of “6x2” Axles

For example, “6x2” axle systems cannot be implemented as the agencies have assumed, since they are not allowed in all localities. Local and state laws pertaining to bridge loads, per-axle weights and tire-patch requirements simply make it impractical to implement “6x2” axle configurations at the rate of penetration that the agencies have forecast. There are similar impracticalities with respect to the agencies’ other forecasted penetration rates as well. As a result, a three-year pull-ahead of already overstated penetration rates would only serve to exacerbate the infeasibility of the proposed vehicle program, cause significant market disruptions, and would result in disproportionately costly and delayed reductions in GHG emissions. [EPA-HQ-OAR-2014-0827-1269-A1 p.55]

The agencies’ assumptions regarding the penetration targets of 6x2 tractors are inconsistent with the laws in the U.S. and Canada, and would lead to the manufacture of tractors that are unusable in many states and provinces during inclement weather. Contrary to the agencies’ projections, manufacturers forecast a 6x2 penetration rate of less than 5%, which is far below the agencies’ assumption of a 60% penetration rate for Class 8 High-Roof Tractors in 2027. [EPA-HQ-OAR-2014-0827-1269-A1 p.62]

In that regard, it is important to remember that going from a 6x4 to a 6x2 tractor configuration is not a clear-cut decision. There are many factors involved, including concerns about (i) the inherent rapid tire wear on the drive axle; and (ii) the practical inability to drive 6x2s in six U.S. states – due to the traction issues, and the limited ability to shift loads onto the drive axle to get enough traction – and in one province, where 6x2s are prohibited at the weights at which heavy-duty vehicles often operate. (See Map below depicting 6x2 axle compliance issues). (See also Appended Survey (“Appendix 2”) of State and Provincial Regulations limiting the design and deployment of 6x2 axles). [EPA-HQ-OAR-2014-0827-1269-A1 p.62]

[Graphic on current status of 6 x 2 & WBS Tire Compliance can be found on p.62 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

- Because heavy-duty vehicles must be designed for cross-country operation in all 50 states and in Canada, the agencies' use of a 60% penetration rate for a technology that cannot be used in more than 10% of the states and provinces is inherently unreasonable. There are numerous issues that need to be resolved before 6x2s can be used in any more than a niche segment of the heavy-duty fleet, and the agencies should not premise regulations on a high penetration rate of a technology that faces such significant obstacles. Accordingly, until the agencies, in particular NHTSA, create an allowance to briefly overload a 6x2's drive axle for traction purposes, and the Canadian government allows 6x2s in all provinces with temporarily shifted weights, the agencies should not predicate any aspect of the Proposed Phase 2 Standards on anything more than a 5% penetration rate for 6x2s. [EPA-HQ-OAR-2014-0827-1269-A1 p.62-63]The assumption that 40% of all Class 7 and 8 vehicles will utilize automated tire inflation systems lacks any factual basis, overlooks the prevalence of tire inflation monitoring systems, and is unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

**Response:**

*Aerodynamics*

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. EPA conducted coastdown testing of the four major tractor manufacturer's high roof sleeper cab tractors. We tested each in two configurations – (1) using a Phase 1 standard trailer without skirts and the Phase 1 data analysis approach and (2) using a Phase 2 standard trailer with skirts and the Phase 2 data analysis approach. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for the Phase 2 NPRM. The aerodynamic performance of the tractors tested by EPA were recalculated for the final rule using the final aerodynamic test procedures and all of the coastdown testing conducted prior to the final rule. See RIA Chapter 3.2.1. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and standard trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. See RIA Chapter 3.2.1.2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

The agencies' assessment is that the best aerodynamic tractor tested by EPA in 2015 achieved Bin IV performance. This vehicle did not include all of the possible aerodynamic technologies, such as wheel covers or active aerodynamics like a grill shutter or front air dam. Thus, the agencies' assessment is that Bin V is achievable with known aerodynamic technologies, as discussed in RIA Chapter 2.8.2.2, but agree with the manufacturers that Bins VI and VII have less known technology paths. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2 program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so.

In Phase 1, the agencies determined the stringency of the tractor standards through the use of a mix of aerodynamic bins in the technology packages. For example, we included 10 percent Bin II, 70 percent Bin III, and 20 percent Bin IV in the high roof sleeper cab tractor standard. The weighted average aerodynamic performance of this technology package is equivalent to Bin III. 76 FR 57211. In consideration of the comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ , as discussed above and in RIA Chapter 2.8.2.2. Consequently, the final standards are not premised on any adoption of Bin VI and VII technologies. Accordingly, we determined the adoption rates in the technology packages developed for the final rule using a similar approach as Phase 1 - spanning three aerodynamic bins and not setting adoption rates in the most aerodynamic bin(s) - to reflect that there are some vehicles whose operation limits the applicability of some aerodynamic technologies. We set the MY 2027 high roof sleeper cab tractor standards using a technology package that included 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors that we project could successfully apply these aerodynamic packages with this amount of lead time. The weighted average of this set of adoption rates is equivalent to a tractor aerodynamic performance near the border between Bin IV and Bin V. We believe that there is sufficient lead time to develop aerodynamic tractors that can move the entire high roof sleeper cab aerodynamic performance to be as good as or better than today's SmartWay designated tractors.

The agencies phased-in the aerodynamic technology adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies. The changes required for Bin V performance reflect the kinds of improvements projected in the Department of Energy's SuperTruck program. That program has demonstrated tractor-trailers in 2015 with significant aerodynamic technologies. For the final rule, the agencies are projecting that truck manufacturers will be able to begin implementing some of these aerodynamic technologies on high roof tractors as early as 2021 MY on a limited scale. For example, in the 2021 MY technology package, the agencies have assumed that 10 percent of high roof sleeper cabs will have aerodynamics better than today's best tractors. This phase-in structure is consistent with the normal manner in which manufacturers introduce new technology to manage limited research and development budgets as well as to allow them to work with fleets to fully evaluate in-use reliability before a technology is applied fleet-wide. The agencies believe the phase-in schedule will allow manufacturers to complete these normal processes. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the NPRM, the actual aerodynamic *technologies* being projected are very similar to what was projected at the time of NPRM (however, these vehicles fall into Bin V in the final rule, instead of Bin VI and VII in the NPRM). Importantly, our averaging, banking and trading provisions provide manufacturers with the flexibility (and incentive) to implement these technologies over time even though the standard changes in a single step.

With respect to the other tractor subcategories, the agencies recognize that there are tractor applications that require on/off-road capability and other truck functions which restrict the type of aerodynamic equipment applicable. We also recognize that these types of trucks spend less time at highway speeds where aerodynamic technologies have the greatest benefit. The 2002 VIUS data ranks trucks by major use.<sup>115</sup> The heavy trucks usage indicates that up to 35 percent of the trucks may be used in on/off-road applications or heavier applications. The uses include construction (16 percent), agriculture (12 percent), waste management (5 percent), and mining (2 percent). Therefore, the agencies analyzed the

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<sup>115</sup> U.S. Department of Energy. *Transportation Energy Data Book*, Edition 28-2009. Table 5.7.

technologies to evaluate the potential restrictions that will prevent 100 percent adoption of more advanced aerodynamic technologies for all of the tractor regulatory subcategories and developed standards with new penetration rates reflecting that these vehicles spend less time at highway speeds. For the final rule, the agencies evaluated the certification data to assess how the aerodynamic performance of high roof day cabs compare to high roof sleeper cabs. In 2014, the high roof day cabs on average are certified to one bin lower than the high roof sleeper cabs.<sup>116</sup> Consistent with the public comments, and the certification data, the aerodynamic adoption rates used to develop the final Phase 2 standards for the high roof day cab regulatory subcategories are less aggressive than for the Class 8 sleeper cab high roof tractors. In addition, the agencies are also accordingly reducing the adoption rates in the highest bins for low and mid roof tractors to follow the changes made to the high roof subcategories because we neither proposed nor expect the aerodynamics of a low or mid roof tractor to be better than a high roof tractor.

The agencies also note that we held several discussions with the aerodynamic specialists within the tractor manufacturers between the NPRM and FRM.<sup>117</sup> The primary purposes of these discussions were to develop robust aerodynamic test procedures and improve the understanding of the aerodynamic bin development process between all of the involved parties.

#### *Idle Reduction Technologies*

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>118</sup> Therefore, the agencies are projecting for the baseline tractor that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will have a tamper proof AESS. This is consistent with the commenter's assessment that "nearly all tractors with sleepers utilize an automatic engine shutdown system."

While the agencies do not necessarily believe that customer reluctance in the initial years of Phase 1 should be considered insurmountable, we do agree with commenters that the agencies should allow adjustable AESS to be a technology input to GEM and should differentiate effectiveness based on the idle reduction technology installed by the tractor manufacturer. Phase 2 will allow a variety of both tamper-proof and adjustable systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS, and none with tamper-proof AESS.

EPA considered the comments and more closely evaluated NHTSA's contracted TetraTech cost report found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking.

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<sup>116</sup> U.S. EPA. Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. See Docket EPA-HQ-OAR-2014-0827.

<sup>117</sup> U.S. EPA. Memo to Docket. Aerodynamic Subteam Meetings with EMA. See Docket EPA-HQ-OAR-2014-0827.

<sup>118</sup> North American Council for Freight Efficiency. Confidence Report: Idle Reduction Solutions. 2014. Page 13.

The comment regarding the “averaging vehicle costs across the industry” versus the vehicle equipped with a specific device or devices is an interesting take on our analysis. However, in aggregate, the average cost estimated in our analysis is the best and most meaningful measure of the projected cost of the new standards. We do not expect that a “maximum” or a “minimum” technology tractor will be built. Instead, we estimate that, on average, tractors will gradually improve fuel consumption and decrease GHG emissions such that a variety of prices and performance characteristics will continue to be available. Just because every vehicle is not “average” does not mean that we are underestimating costs, nor are we overestimating costs.

### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>119</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>120</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>121</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS. Because of this change, the agencies have lowered the adoption rate of ATIS in the final rule, but added adoption rates of TPMS.

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<sup>119</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>120</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>121</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.



**Organization:** TireStamp, Inc.

The proposed Phase 2 of the EPA's and NHTSA's Greenhouse Gas Emissions Standards includes only automatic tire inflation systems as an acceptable technology for maintaining tire inflation pressure in order to reduce rolling resistance, fuel consumption and greenhouse gas emissions. Tire pressure monitoring systems (TPMS) have been totally overlooked. This is most likely because the Federal Motor Carrier Safety Administration (FMCSA) and the Environmental Protection Agency have only tested and/or considered first generation TPMS that were developed over 25 years ago. [EPA-HQ-OAR-2014-0827-1255-A1 p.1]

These older TPMS provide in-cab displays that alert the driver of tire problems when they occur, but no one else is advised. This is a problem for commercial fleets since drivers are paid to deliver goods and most drivers are not interested in being tire technicians as well. If left to their own devices without instruction from their company's dispatch office, most drivers will not care that a tire problem exists until they get to their final destinations, if then. Since maintenance was only infrequently advised of a problem by the driver, commercial fleets did not purchase these systems since their benefits were minimal. [EPA-HQ-OAR-2014-0827-1255-A1 p.1]

However, in the past 5-10 years there has been an incredible move to integrate electronic TPMS with telematics in order to provide fleet managers and technicians with visibility of their tires 24/7 even when they are hundreds of miles away. These systems analyze tire data for all the tires in the fleet and deliver insightful reports, actionable work orders, and immediate tire alerts that empower fleet management, technicians, and outsourced tire service providers to proactively improve tire maintenance rather than simply react to tire alerts. They form the basis of any good tire maintenance program by enabling fleets to measure as well as verify tire maintenance performance. [EPA-HQ-OAR-2014-0827-1255-A1 p.1]

Today's second generation TPMS alerts are e-mailed or texted to anyone the fleet designates who has Internet connectivity on their smartphones, tablets, laptops or desktop computers. Alerts contain much more information than is possible with first generation TPMS such as vehicle location, tractor or trailer the vehicle is hooked to, a description of the alert condition, its severity, and even instructions for properly resolving the issue. Some second generation TPMS products also provide the temperature and pressure of all the other tires on the vehicle, so that the technician can be proactive and adjust pressures on any other tires that haven't triggered an alert but are a few psi off from their target pressure. An example of an alert is to the right. [EPA-HQ-OAR-2014-0827-1255-A1 p.1-2]

If alerts are not cleared right away, technicians can receive a "work order" report that provides a listing of all the vehicles at or near their location that have alert conditions and instructions for resolving their issues. If scheduled to be run in the early morning, technicians can print off this report and address tire problems before the vehicles get on the road thereby preventing tires from running improperly inflated or overheated and reducing enroute, tire-related breakdowns as well. Below is an example of one such report. [EPA-HQ-OAR-2014-0827-1255-A1 p.2]

[Example of Active Issues Report can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1255-A1]

[Example of Daily Service History Report can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1255-A1]

With the information these advanced systems provide, fleet managers can now verify that maintenance was needed and was performed properly by both their in-house technicians and outsourced tire service

providers. The example of the Daily Service History Report shown below lists alerts that were closed and provides the tire condition (temperature or pressure) of the tire before and after service was performed. It also provides the name of the technician, if known, and the location at which the service was performed. With this report the fleet manager can verify that the tire service was needed, performed to the fleet's specifications, and hold people accountable if the service was less than satisfactory. [EPA-HQ-OAR-2014-0827-1255-A1 p.2-3]

Tire pressure monitoring systems that are integrated with telematics also are able to provide fleet management with the tools they need to measure and monitor their tire maintenance programs. Since tire data is stored in a database, these systems can provide a snapshot of the state of tire pressures across the entire fleet. Managers can monitor alert response times in both time and mileage and get at a glance an idea of the vehicles types that are prone to overheating issues. An example of such a report is below: [EPA-HQ-OAR-2014-0827-1255-A1 p.3]

[Example of Fleet Management Survey can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1255-A1]

As can be clearly seen, TPMS integrated with telematics is not your father's tire pressure monitoring system. These systems provide visibility and information that are just not possible with TPMS 1.0 systems. They help fleets ensure that tires are run at their optimal inflation pressures for a much greater percentage of time. And yes, while someone still has to connect an inflation hose to the tire, now many people know it has to be done while in days gone by only the non-communicative driver knew. Today, with the high cost of tires, the need to conserve fuel, and reduce greenhouse gas emissions, fleets are motivated to address tire problems as soon as they can and this technology helps them to do just that. [EPA-HQ-OAR-2014-0827-1255-A1 p.3]

It should be noted that while automatic tire inflation systems (ATIS) provide pressure to tires that are losing air while the trailer runs down the road, there are some distinct disadvantages to them that by pairing second generation TPMS with them can be resolved. The first issue is that when a tire problem occurs on a trailer equipped with ATIS, only the driver is aware that the system is working to pump air to the tire. If he does not inform his vehicle maintenance department or take steps on his own to address the tire issue, no one else knows there is a tire issue. When the trailer is dropped, the tire goes flat until the next driver hooks up to the trailer. As she drives off with the trailer she may notice the light goes on indicating the system is working pumping air to the tire. However, she continues to drive since she knows the ATIS will inflate the tire again. Unfortunately, the tire is dragged flat/underinflated for many miles until it is fully inflated again. With this scenario repeating many times, when the tire is finally removed from the vehicle for low tread depth, the casing is ruined and cannot be retreaded or the tire may fail prematurely from a separation caused by continuing to inflate a punctured tire. This can be avoided by having a TPMS integrated with telematics advise fleet personnel of tire problems. In addition, second generation TPMS will also advise the fleet of the wheel position of the problem tire(s). [EPA-HQ-OAR-2014-0827-1255-A1 p.3-4]

It should be noted that automatic tire inflation systems plumbed through the axle are currently available only for trailers. ATIS for trucks, tractors, and buses must be plumbed externally. Due to their high maintenance and propensity for damage, they are not of interest to U.S. fleets. Advanced TPMS integrated with telematics are ideal for these vehicles. [EPA-HQ-OAR-2014-0827-1255-A1 p.4]

There are several TPMS companies that have either partnered with telematics service providers to transmit tire alerts and data off the vehicle or that have built telematics into their own TPMS products. The world is rapidly adopting telematics to improve safety, performance, and the

environment. TPMS integrated with telematics does all of these things and should be included in the Phase 2 of the Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles. [EPA-HQ-OAR-2014-0827-1255-A1 p.4] Note: Second generation TPMS integrated with telematics are also referred to as TPMS 2.0 systems. For more information on the capabilities of these systems, see: [www.TPMS2.com](http://www.TPMS2.com) [EPA-HQ-OAR-2014-0827-1255-A1 p.4]

**Response:**

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allows manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS, especially when linked with telematics. The agencies appreciate the information related to the latest generation of TPMS provided by the commenter.

**Organization:** Truck Renting and Leasing Association

Stringency is based on a 60% Penetration of 6x2 Drive Axle Type in 2027. There are many complications to such a high penetration of 6x2 drive axle types, most of which are outside of the control of the OEMs, the agencies, the lessor and the customer/lessee. [EPA-HQ-OAR-2014-0827-1140-A1 p.5]

The Agencies' Low Rolling Resistance Tire Assumptions Do Not Reflect Customers' Real-World Needs. While it is true that low rolling resistance tires are currently offered in different configurations (id. at 40216), the agencies merely assume that customers will continue to demand higher performing low rolling resistance tires in the future. Id. at 40221 (“the agencies expect that tire manufacturers will continue to respond to demand for more efficient tires and will offer increasing numbers of tire models with rolling resistance values significantly better than today’s typical ... tires”). That is little more than a guess about future consumer behavior. [EPA-HQ-OAR-2014-0827-1140-A1 p.5]

The Agencies Rely Upon Erroneous Assumptions of Market Penetration of Automatic Engine Shutdown Systems. The agencies estimate that 30% of the tractors in the market today already have GHG-compliant automatic engine shutdown systems (AES). Id. at 40219. That assumption is false. While most tractors do have automatic shutdowns activated on the vehicles, there are very few trucks on the road in the United States with AES options that are compliant to the regulation. The systems today allow owners to reprogram the engine to shut down after longer idling periods than the required five minutes so that different applications and seasons can be properly dealt with. The 30% number that the agencies cite could be accurate for the number of vehicles with APUs but that does not mean the vehicle automatic shutdown system is compliant. These regulated systems are seen by the industry as detrimental to fleet operational flexibilities and they hurt the resale market value of a vehicle if they cannot be reprogrammed by the second owner. [EPA-HQ-OAR-2014-0827-1140-A1 p.5]

**Response:**

*6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as

noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>122</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>123</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>124</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data. We found steer tires with rolling resistance as low as 4.9 and drive tires with as low as 5.1 kg/ton. The average tire rolling resistance that we used in the technology packages to derive the final rule standards are higher than the lowest rolling resistance tires made today, so the technology is feasible. With respect to the comment about assuming that customers will continue to demand low rolling resistance tires, we set performance-based standards that allow the manufacturers to produce a wide variety of products.

We also note that during the certification data analysis, we found that the drive tires on low and mid roof tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. We found less of a difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. The agencies phased-in the low rolling resistance tire adoption rates within the technology packages used to determine the MY 2021 and 2024 standards so that manufacturers can gradually introduce these technologies.

#### *Idle Reduction Technologies*

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent

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<sup>122</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>123</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>124</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>125</sup> Therefore, the agencies are projecting for the Phase 2 baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS for consideration in the baseline, and none will have a tamper-proof AESS.

**Organization:** Union of Concerned Scientists (UCS)

## TRACTOR VEHICLE STANDARDS

The agencies' estimate of vehicle improvements to the tractor is largely in agreement with our estimate of the performance feasible within the timeframe of the rule, with the notable exception of improvements to the powertrain. There are two central issues that will lead to a more stringent tractor standard: 1) powertrain integration; and 2) an improved tractor engine. [EPA-HQ-OAR-2014-0827-1329-A2 p.11]

## POWERTRAIN TESTING

The agencies have chosen to exclude powertrain integration from tractor-trailers, despite noting its strong effectiveness in the vocational vehicle sector. While the duty cycles of tractor-trailer contain significantly less transient operation than vocational vehicles that does not mean powertrain integration is not applicable. In fact, the SmartAdvantage powertrain from Cummins and Eaton that the agencies cite in the vocational section to justify the powertrain integration is designed for tractor-trailers. For this reason, it is a surprising omissions. [EPA-HQ-OAR-2014-0827-1329-A2 p.11]

As much as 1.3- to 2.0-percent savings from tractor-trailers could be added to the current stringency to reflect the true potential from tractor-trailers—this would further incentivize tractor manufacturers to invest in powertrain optimization, particularly since every major manufacturer already offers at least one “integrated powertrain” option in its long-haul fleet. The agencies’ “alternative engine mapping” procedure is another approach that could better capture transient operation and ensure that the regulations reward real-world operational benefits. [EPA-HQ-OAR-2014-0827-1329-A2 p.12]

## IMPROVED TRACTOR ENGINE

An increase in the engine stringency as outlined above will lead to reductions in fuel usage and emissions from the vehicle itself; however, due to differences in test cycle and the agencies' assumptions between the separate engine and vehicle standards, this relationship is not a one-to-one correlation (i.e., a 10.3-percent increase in engine stringency will not directly lead to a 10.3-percent increase in vehicle stringency). Table 3 illustrates the additional improvements to the vehicle we would expect to see based upon the engine improvements outlined in the sections titled Tractor Engine Standards and Powertrain testing. [EPA-HQ-OAR-2014-0827-1329-A2 p.12]

[Table 3, 'Powertrain-related Vehicle Improvements', can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

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<sup>125</sup> North American Council for Freight Efficiency. Confidence Report:Idl- Reduction Solutions. 2014. Page 13.

In particular, the change to the SET cycle that led to improvements on the engine standard will not result in any additional reductions to the fuel consumption or emissions of a vehicle modeled in GEM due to the direct incorporation of the engine map—therefore, we have omitted it as a source of further vehicle reductions. Downspeeding, on the other hand, is only partially captured in the vehicle simulation as it stands currently, since we are proposing a greater level of downspeeding greater than the 16 percent assumed by the agencies—the improvement assessed in Table 3 is calculated by comparing Downspeeding A and B technologies (see Reinhart 2015), since Downspeeding A is the result of 16 percent beyond the baseline DD15 engine, in concert with the agencies’ estimated level of future downspeeding. The other engine improvements are generally applicable across the entire tractor-trailer fleet, with the exception of organic waste heat recovery. While we believe that waste heat recovery is broadly applicable to a range of duty cycles, including regional haul or day cabs, the agencies’ assumed penetration rates do not reflect this assumption. Therefore, we have assumed that improvements to waste heat recovery will be reflected only in the sleeper cab fleet. [EPA-HQ-OAR-2014-0827-1329-A2 p.12-13]

#### OVERALL INCREASE IN TRACTOR EFFICIENCY

Combining the assessment of engine technologies beyond the agencies’ appraisal in the RIA and the use of powertrain testing for long-haul tractors, we estimated an additional 6-percent improvement by 2024 and 7-percent improvement by 2027 from tractor-trailers (Table 3). In calculating this improvement, we have applied the engine improvements as described above and have applied powertrain testing to only 70 percent (35 percent) of the fleet in 2027 (2024), similar to the fractions applicable in the vocational fleet. As mentioned earlier, though the incremental improvement may not be as great for tractor-trailers, the overall reductions in fuel usage will be similar due to increased vehicle mileage, so we would expect a similarly high uptake of integrated powertrains by 2027. [EPA-HQ-OAR-2014-0827-1329-A2 p.13]

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Reinhart, T.E. 2015a. Commercial medium- and heavy-duty truck fuel efficiency technology study - report #1. (Report no. DOT HS 812 146) Washington, DC: National Highway Traffic Safety Administration. Online at <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cape/812146-CommercialMDHD-TruckFuelEfficiencyTechStudy%E2%80%9393Report1.pdf>.

#### **Response:**

##### *Powertrain Testing*

The agencies acknowledge UCS’s comment about increasing the stringency of the tractor program due to the opportunity to further improve powertrain optimization through powertrain testing. For the Phase 2 final rule, we have made several changes that capture much of the improvement potential highlighted by UCS. First, the required use of a cycle average fuel map in lieu of a steady state fuel map for evaluating the transient cycle in GEM will recognize improvements to transient fuel control of the engine. The agencies are including the impact of improved transient fuel control in the engine fuel maps used to derive the final standards. Second, the optional transmission efficiency test will recognize the benefits of improved gear efficiencies. The agencies have built some improvements in transmission gear efficiency into the technology package used to derive the final standards. This leaves only the optimization of the transmission shift strategy, which would need to be captured on a powertrain test. The agencies believe that the opportunity of shift strategy optimization is less for tractors than for vocational vehicles because a significant portion of the tractor drive cycles are at highway speeds with limited transmission shifting. Therefore, we have not included the powertrain optimization portion only recognized through powertrain testing into the standard setting for the final rule.

## *Engines*

The Phase 2 *engine* standards will lead each manufacturer to achieve reductions of 5 percent in 2027 MY. For the final Phase 2 rule, we recognize that it could be possible to achieve greater reductions than those included in the engine standard by designing entirely new engine platforms. Unlike existing platforms, which are limited with respect to peak cylinder pressures (precluding certain efficiency improvements), new platforms can be designed to have higher cylinder pressure than today's engines. New designs are also better able to incorporate recent improvements in materials and manufacturing, as well as other technological developments. Considered together, it is possible that a new engine platform could be 6 percent more efficient without WHR than Phase 1 engines and 8 percent more efficient than Phase 1 if 50 percent of these engines have WHR. We project that by the 2024 MY, a limited number of engine platforms will be redesigned, and therefore have pulled ahead the reduction expected from the proposed 2027 MY engine standards into the vehicle standards for 2024 MY. In addition, we project that 50 percent of tractor engines in 2027 MY will be redesigned engines (i.e. engines reflecting redesigned engine platforms, again based on existing engine platform redesign schedules within the industry) achieving a 6 percent reduction for day cabs and an 8 percent reduction in fuel consumption in sleeper cabs beyond Phase 1. This means the average 2027 MY tractor engine would be 5.4 and 6.4 percent better than Phase 1 for day and sleeper cabs respectively. We have factored these levels into our analysis of the vehicle efficiency levels that will be achievable in MY 2027. These additional engine improvements make more stringent vehicle standards feasible, and the final standards are structured so that these improved engines are not able to generate windfall credits, but rather that their projected performance is reflected in the stringency of the final tractor vehicle standard. We project all vehicle manufacturers will be able to use new platform engines for some of their vehicles. Nevertheless, some may choose not to for business reasons, even though it may be the most cost-effective path. We project that manufacturers that do not achieve this level of engine reduction would be able to make up the difference by applying one of the many other available and cost-effective tractor technologies to a greater extent or more effectively, so that there are multiple technology paths for meeting the final standards.. In other words, a manufacturer that does not invest in updating engine platforms in the Phase 2 time frame (i.e. does not have a scheduled redesign within the Phase 2 period) is likely to be able to invest in improving other vehicle technologies. These reductions will show up in the fuel maps used in GEM to set the Phase 2 tractor stringencies.

## *Overall Increase in Tractor Stringency*

The agencies considered all of the comments associated with the tractor technologies. We believe there is merit in many of the detailed comments received regarding technologies. The agencies have developed a set of final tractor standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies. In general, the final Phase 2 tractor standards are similar in overall stringency as the levels proposed in Alternative 3, but have been determined using new technology packages that reflect consideration of all of the technology comments, and in several respects reflect greater stringency than the proposed Alternative 3.

**Organization:** United Parcel Service (UPS)

Tire Pressure Monitoring Systems should be Given Credit under the Rule

UPS fully supports ATA's position repeated below on this issue. As noted above, UPS prefers TPMS over automatic systems because we are alerted that there is a problem that we can fix. UPS makes heavy use of telematics and the TPMS is compatible with telematics. [EPA-HQ-OAR-2014-0827-1262-A1 p.9]

'TPMS have not historically been included in the EPA's SmartWay program since the agency had no way to determine the effect these systems have on fuel economy unless each requesting fleet provided a clear description of how it would respond to alerts. This information was necessary so that the EPA could calculate the resulting fuel savings. However, much has transpired since the inception of the SmartWay Program. The Federal Motor Carrier Safety Administration ('FMCSA') has studied TPMS since 2006. It found that these systems accurately reported inflation pressure values within 2 to 3 psi of the measured value and accurately warned of low pressure within 2 to 3 psi of the expected threshold. In 2007, the performance and durability of TPMS was examined in a field test using transit buses. This study found that TPMS-equipped buses did not experience increased average tire pressure due to diligent tire pressure maintenance and the location of the TP1VIS display is essential to impact tire maintenance practices, fuel economy, and tire life. [EPA-HQ-OAR-2014-0827-1262-A1 p.9]

'In late 2011 the FMCSA published the results of a field test it conducted over the previous 24 months of tire pressure monitoring and ATISs on two fleets that were considered to have good tire maintenance. The test revealed that both TPMS and ATISs delivered a 1.4% improvement in fuel economy. [EPA-HQ-OAR-2014-0827-1262-A1 p.9]

'Technology has greatly advanced since the tests that FMCSA conducted. Today, TPMS is much more advanced than the first generation of TPMS that was tested by FMCSA which just delivers alerts to the driver in the cab through an in-cab display. Second generation TPMS (TPMS 2.0 systems) are integrated with telematics and GPS so that the tire data and alerts are sent from vehicles and delivered to a fleet's Operations and Vehicle Maintenance Department. By providing the fleet with the location and visibility of its tire problems, dispatch can provide instructions to the driver to handle developing tire problems immediately and Maintenance is aware of the exact nature of these issues when the vehicle arrives at the fleet's location. With the reports these systems provide the fleet, problem tires are ensured to be attended to before the vehicle sets out on its next trip, thereby dramatically reducing enroute breakdowns and optimizing the percentage of time tires are run properly inflated. In essence, a fleet is able to build its entire tire maintenance program around this technology and drastically improve its ongoing tire inflation maintenance. Therefore this technology has an even greater effect on fuel consumption and greenhouse gas emissions than TPMS 1.0 systems which were proven to deliver 1.4% improvement in fuel economy by the FMCSA. [EPA-HQ-OAR-2014-0827-1262-A1 p.9]

'Due to the advances that have been made in TPMS 2.0 systems and the impact they have on fuel economy and greenhouse gas emissions, the Tire & Wheel (S.2) Study Group of ATAs Technology and Maintenance Council ('TMC') requests that TPMS 2.0 systems, tire pressure monitoring systems that are integrated with telematics, be included in the technology options provided under Phase 2. Without inclusion of this technology, there will be no system available in the TMC standard to address tire inflation pressure for powered vehicles since ATISs that are plumbed inside an axle (a market requirement by US fleets) are currently only available for trailers and an advanced technology that can seriously impact GFI emissions will be overlooked.' [EPA-HQ-OAR-2014-0827-1262-A1 p.9-10]

The specific market penetration rates that concern UPS, given our particular fleet, are listed below and UPS strongly recommends reduction of these MPRs: [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

Tire Inflation Systems (40% in 2024)

Phase 2 only permits the use of ATISs as the solution for tire pressure maintenance. Yet, tire pressure monitoring systems ('TPMSs') provide similar benefits of tire inflation systems at a lower cost. In fact UPS in its considerable experience prefers TPMSs over ATISs for two reasons in addition to lower costs. First, TPMSs give the truck owner an affirmative indication that there is a tire pressure problem, so it can



be fixed, whereas the ATIS does not. Second, the ATIS simply keeps adding tire pressure automatically, wasting energy, and the truck owner may never know it. This is the flip side of the concern of some that TPMSs require user interaction — user interaction ensures the truck owner can address the underlying problem. We support ATA's comments on tire inflation systems: [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

'A recent study on truck and tire inflation systems indicates that both ATISs and TPMSs are being utilized in fleet operations.<sup>1</sup> As of 2012, approximately 33% and 10% of surveyed fleets utilize ATISs and TPMSs respectively on their trailers. Roughly 1% of tractors used ATISs. Operators are well aware of the increased fuel consumption, maintenance costs, downtime, and safety concerns associated with operating heavy-duty vehicle with under-inflated tires. These concerns over time have been significant given the historic volatility of diesel prices, the competitive nature of the industry, shipper pressures to reduce costs, and the rising costs of liability. [EPA-HQ-OAR-2014-0827-1262-A1 p.4-5]

'The agencies do not acknowledge TPMSs as a viable menu option since they require user interaction to inflate tires to appropriate pressures. A misguided assumption is that drivers 'may' continue to operate a vehicle with underinflated tires. However, in light of continual pressures on fleets to reduce total costs of operation in order to remain competitive and profitable, the agencies should reconsider their rejection of TPMSs as a viable technology option under the rule. [EPA-HQ-OAR-2014-0827-1262-A1 p.5]

'Given the ability of fleets to monitor fuel consumption remotely, including the ability to identify causes for increased fuel consumption, drivers are routinely held responsible for proper tire pressure levels on TPMS-equipped vehicles. ATA therefore believes that the agencies should provide efficiency credit for TPMS use under the rule. [EPA-HQ-OAR-2014-0827-1262-A1 p.5]

**Therefore, UPS strongly recommends that under the final rule the truck purchaser should have a choice between ATISs and TPMSs, and that the assumed MPR be higher for TPMSs than for ATISs.** [EPA-HQ-OAR-2014-0827-1262-A1 p.5]

#### Errors in EPA's Baseline and Testing Protocols Result in Overly-Stringent Standards

As ATA points out in its comments, the proposed emission standards are actually more stringent than EPA has indicated. An overly stringent regulation can have several unintended consequences. It could force OEMs to offer a truck optimized for the EPA duty cycles rather than a customer's requirements, which could actually increase fuel consumption and GI-IG emissions, or render the truck inadequate for its intended use. If OEMs cannot provide the trucks that a customer needs, the customer has no choice but to continue using its existing trucks. From UPS's vantage point and the fleet we use, the actual stringency in the proposed rule is greater than what EPA has indicated due to the following error in EPA's baselines and testing protocols: [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

The assumed 2017 aero baseline uses the best aero trucks available, not the average. This has the effect of increasing stringency about 2.5%. [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

Aerodynamic and tire power losses for tractor-van trailer combination<sup>8</sup>

UPS endorses ATA's recommendations in their comments: [EPA-HQ-OAR-2014-0827-1262-A1 p.11]

1 Tire Pressure Systems Confidence Report, North American Council for Freight Efficiency (August 2013).

8 National Research Council, Transportation Research Board, Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, (2010).

**Response:**

*Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS.

Please see the agencies' responses to ATA's comments in this Section 4.3 of the response to comments.

**Organization:** Volvo Group

We find a number of the technology assumptions in the NPRM are not justified because the technology is not demonstrated, does not deliver the assumed efficiency, or cannot be forced into the market at the agencies' assumed penetration rates. These include aerodynamic drag reduction, start/stop technology, neutral idle, low rolling resistance tires, 6x2 axles, new transmissions, idle shutdown, vehicle speed limiters, hybridization, "deep integration" of driveline, and vehicle weight reductions. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

**Baseline Errors Increase Effective Stringency**

While the agencies have stated their target efficiency improvement ranges up to 24% over the 2017 baseline for high-rise sleepers, there are significant errors in the baseline from which these targets are established. Two key issues are the assumption that 30% of 2017 sleeper tractors will utilize the regulatory automatic engine shutdown (AES) and the baseline aerodynamic assumptions. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

As of now, nearly two years into mandatory application of the Phase 1 rule, virtually no truck purchaser has been willing to take the AES, nor is there any reason they would ever opt to do so. All tractors come with customer programmable idle shutdown timers. Truck owners program the idle shutdown to suit the needs of their operation while minimizing idle fuel consumption where possible. The regulatory requirement requires locking the timer to shut down after 5 minutes of idling, eliminating the flexibility to set the function to match operational needs or to change it for a second owner. Many fleets use fuel fired heaters to avoid idling in colder weather but choose to idle when cooling is required. Even if a truck is equipped with an APU for hotel operation, an owner may want to enable idling if the APU is not functioning properly, until it can be repaired, thus avoiding a mission disabling failure. Given this situation, it is unreasonable to predict that somehow 30% of purchasers would suddenly opt for the regulatory AES. Since AES is given a 5% GHG/efficiency credit, this faulty assumption amounts to a 1.5% lower baseline. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

Similarly, there is a fundamental error in the way the aerodynamic drag baseline for 2017 tractors was established. As noted in the EMA comments, the agencies evaluated some of the best aerodynamic tractors available and declared these to be the baseline. In fact, the average tractor, the true baseline, is a full bin worse than these best tractors. This error result in baseline fuel consumption and GHG emissions approximately 4.5% better (lower) than the actual baseline. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

Together, these two errors add an additional 6% in efficiency that that does not exist, and accordingly would have to be obtained through other measures beyond the agencies' projected technologies (if even possible) to achieve the Phase 2 targets. This huge, erroneously calculated and infeasible increase in stringency has not been accounted for in any of the agencies' technology assumptions. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

#### Aerodynamic Drag Targets

As noted in comments by the EMA, it is impossible to achieve the targeted aerodynamic drag reductions that ultimately are predicated on 60% of tractors achieving aero bins V, VI, and VII. Our analysis indicates it is physically impossible to achieve these low drag levels with any tractor design coupled to the non-aerodynamic test trailer prescribed in this proposal. In fact, all examples provided in the RIA of combination vehicles that can achieve the targets include a highly aerodynamic trailer. [EPA-HQ-OAR-2014-0827-1290-A1 p.20]

Either the agencies must reduce the aerodynamic targets for tractors or provide for a test trailer with advanced aerodynamics, including, at a minimum, an efficient boat-tail and side skirts. [EPA-HQ-OAR-2014-0827-1290-A1 p.20]

#### SuperTruck Efficiency is not an Appropriate Target

Although the U.S. Department of Energy's SuperTruck program is an outstanding freight efficiency research program, some now argue that the results demonstrate capability to regulate to that level of increased freight efficiency. There are several issues with this supposition. The SuperTruck demonstration vehicles are after all "demonstration vehicles" - the technology is demonstrated but far from proven in terms of cost, reliability, durability, and broad applicability. Each project was funded at \$40 to \$80 million, so technology cost-effectiveness was not a requirement. These trucks were designed for, and demonstrated on, carefully selected routes that enhance their performance. Much of the demonstrated SuperTruck improvement was achieved by careful matching of tractor and trailer aerodynamics. No manufacturer has control of this because tractors and trailers are manufactured by different companies and purchased separately by truck fleets and shippers. In fact, the proposed Phase 2 regulatory test trailer has very limited aerodynamic features, with only side skirts but no other aerodynamic features. This severely limits the potential efficiency of the tractor-trailer combination. In fact, Volvo Group analysis determined that even though our complete SuperTruck combination could achieve aero bin VII, our SuperTruck tractor, coupled with the Phase 2 test trailer, could only achieve bin IV out of the seven Phase 2 aero bins, even though regulators ultimately expect 60% of tractors to achieve bins V, VI, or VII. Even an extremely sleek tractor coupled with a rectangular shaped box trailer cannot achieve the performance required to reach the proposed aerodynamic targets. The test trailer should represent an advanced aerodynamic design that meets the 2027 trailer targets so that future tractors are designed to operate efficiently with future trailers and the combinations can achieve the desired aerodynamic performance. Consequently, with tractors in the fleets that have been optimized for peak performance on the most aerodynamic trailers, the market pull (combined with trailer efficiency regulations) for those most aerodynamic trailers will follow, accelerating efficiency gains. [EPA-HQ-OAR-2014-0827-1290-A1 p.26-27]

[Table, 'Bin determination for Phase 2 High-Roof Tractors Based on Aerodynamic Test Results', can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-A1]

**Aerodynamic improvements expected to achieve tractor standards are infeasible in the context of the proposed rule and must not be factored into stringency expectations unless the issues are corrected.**

As previously noted, even SuperTruck cannot achieve the expected aerodynamic targets. In fact, it is infeasible or impossible to design a tractor with drag results that will achieve bins V, VI, or VII when tested according to the proposal. Section 2.4.2.2.3 of the RIA supposedly provides examples of feasible tractor aerodynamic improvements that are, in fact, completely infeasible due to operational and regulatory constraints (e.g. exceeding length laws) and that are tested and analyzed with a highly aerodynamic trailer rather than the standard regulatory trailer. Inability to achieve the targets is caused by a number of issues with the proposal: [EPA-HQ-OAR-2014-0827-1290-A1 P.27]

- The baseline aero tractors are the best available, not the average expected during 2017.
- The proposed audit process for tractor aero performance eliminates the “one bin” compliance margin granted in the Phase 1 rule, ignoring the tremendous variability of aerodynamic measurements and the differences between possible audit methods. This requires conservative binning to ensure passing an audit.
- The aerodynamic coast-down test procedure fails to account for yaw during the test, increasing the measured drag test result. This means the aerodynamic performance is under-reported as an input to GEM.
- The aerodynamic coast-down test procedure assumes rolling resistance is a constant independent of vehicle speed. In fact, rolling resistance increases substantially with speed. This results in overestimating the vehicle drag force during the testing.
- The test trailer required by the proposal has minimal aerodynamic features. This greatly limits what can be physically achieved by tractor treatments. In fact, the expectation of advanced aerodynamic performance is predicated in the RIA on examples deploying highly aerodynamic trailers. [EPA-HQ-OAR-2014-0827-1290-A1 P.28]

All of these issues are explained more fully in comments submitted by the Truck and Engine Manufacturers. In addition, the four major US tractor manufacturers have provided a detailed proposal to EPA to resolve these issues. [EPA-HQ-OAR-2014-0827-1290-A1 P.28]

#### Tires

In the technology packages anticipated to set Phase 2 stringency levels, the agencies have further relied on unreasonable expectations for lower rolling resistance tires in all regulatory subcategories. Tire manufacturers have continued to claim that they are able to balance tire life, safety, and traction concerns; however, as the agencies have noted in the Regulatory Impact Analysis section 2.4.3.1, tires with higher rolling resistance are likely designed to address only some of these concerns. We continue to hear customer feedback that low rolling resistance tires often lack adequate traction. The reality is that many of the features that provide for traction, especially deep lugs and pliable sidewalls, also create high rolling resistance, but without these features many customers are finding that attaining adequate traction is nearly impossible under many of the demanding conditions that trucks and tractors experience, such as snow and off-road. Customers have stated that, in some cases, they are being pushed into low rolling resistance tires at the point of sale only to be left with no choice but to replace the tires with higher rolling resistance, traction tires immediately after taking delivery of the new vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

In addition, heavy-duty fleets expect to retread tires as many as five times and have concerns that tire casing durability may be compromised with low rolling resistance (LRR) tires. Retreading saves cost and about two thirds of the oil required to produce a new tire (reported to be between 22 and 44 gallons depending on tire size). [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

With respect to highway tractor and heavy-haul tractor penetration and stringency setting the agencies show penetration of Level 3 tires starting in MY 2021. It is unclear how this can be possible given the agencies own determination that this technology “could” be achieved only in the 2025 timeframe. [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

#### Tire Inflation

In setting vehicle stringencies, the agencies have predicated the standards for tractors on adoption of Automatic Tire Inflation Systems (ATIS), while giving no consideration to Tire Pressure Monitoring Systems (TPMS). [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

All commercial vehicle operators are well aware of the increased fuel consumption, maintenance costs, downtime, and safety concerns associated with operating a heavy vehicle with under-inflated tires. These concerns have been much more significant given the volatile diesel prices, the pricing pressure on fleets due to an unstable economy and consolidation within the industry, the continued ratcheting of safety regulations, and the rising costs of liability, all within the last decade. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

In Section 2.4.3.3 of the RIA the agencies noted that “although most fleets understand the importance of keeping tires inflated, it is likely that a substantial proportion of trucks on the road have one or more underinflated tires.” Their evidence of this assertion are two studies, one industry survey conducted by checking pressures at a truck stop in 2002, and another study conducted by the Federal Motor Carrier Safety Administration (FMCSA) in 2003. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]]

The agencies have based their lack of credit provisions for TPMS on this outdated data, as well as their assertion that TPMS requires user interaction to re-inflate a tire to the appropriate pressure and therefore a driver “may” continue to operate a vehicle with underinflated tires, even to their final destination. However, in light of continually increasing pressures on fleets to reduce total costs of operation in order to be profitable, Volvo Group disagrees that two studies dating from 12 to 13 years in the past are truly relevant in the decision making process of today’s fleets. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

In addition, given the poor reliability of past ATIS systems, we are skeptical of supplier’s claims of current or future reliability improvements to these systems. Fleets are even more skeptical than truck OEMs, as an ATIS air leak results in increased fuel consumption due to a compressor cycling more frequently and also in potentially significant downtime of the vehicle, even more so than a tire blowout. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

To incentivize truck operators to maintain tire pressure on vehicles equipped with a TPMS system, fleets have the ability to monitor fuel consumption remotely, including the ability to identify causes for increased fuel consumption. This capability is expected to motivate drivers to properly maintain tire pressure on TPMS equipped vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

For these reasons Volvo Group believes that the agencies should provide the same 1% efficiency credit for TPMS as given to ATIS. Volvo Group does not believe this inclusion should be included in the baseline efficiency assumptions or result in a stringency increase, as these systems are an alternative to

ATIS, are not credited today, and the evolution of the remote tracking systems has only recently made them more likely to result in a positive corrective action. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

#### Automatic Engine Shutdown (AES) and Extended Idle Reduction

In the Phase 2 Greenhouse Gas proposed regulation the agencies have premised a significant amount of the sleeper tractor stringencies on extended idle reduction and have stated that this will generally require the use of an auxiliary power unit (APU) for hotel loads while parked. The agencies project 80% penetration of APUs in 2021 and 90% in 2024 and 2027; however, there is no provision in 40 CFR Part 1037 for Extended Idle Reduction credit beyond the requirements of § 1037.660 allowing credit for a tamper-resistant five minute idle shutdown timer (AES). [EPA-HQ-OAR-2014-0827-1290-A1 p.23-24]

For AES to be at all feasible and acceptable to fleets and owner-operators requires additional technology for hotel loads. Typically, this means an APU, since most trucks are not on dedicated routes and cannot be assured that their operation will always allow them to overnight in a location with shore power or IdleAir type systems that can provide hotel loads absent idling or an APU. Many fleets have tried APUs and have found them to be unreliable and problematic to secure warranty repairs. As of this writing there is only one OEM with a factory installed APU solution, though all OEMs provide a prep-kit to interface the APU with the vehicle systems. [EPA-HQ-OAR-2014-0827-1290-A1 p.24]

There are many types of APUs available: those powered by small diesel engines driving generators and A/C compressors; battery powered units driving heating and cooling systems whose batteries must be periodically recharged by starting and running the engine; and fuel cell APUs that are still in the early stages of development and, if ever technically feasible, will not likely be on the market in the next decade. Acceptance of any of these solutions to date has been low due to several factors. [EPA-HQ-OAR-2014-0827-1290-A1 p.24]

First and foremost, the number one customer complaint regarding APUs has been reliability issues that have driven customers away from large scale deployment of these systems. Moreover, since most APUs are installed in the aftermarket, the warranty support has been lacking. The reliability issues generate operator safety concerns in both cold and hot ambient conditions. The most reliable hotel support system has proven to be fuel fired heaters, but these do not provide for cooling or electrical and accessory loads, and therefore are not sufficient for the majority of the sleeper tractors in operation. However, use of a fuel fired heater greatly diminishes the need for, and payback of, a full APU system but still requires idling to maintain cab cooling when required. [EPA-HQ-OAR-2014-0827-1290-A1 p.24]

Second, all APUs increase total vehicle weight due to the weight of the units themselves, as well as the additional components required to integrate them into vehicle systems. A battery powered APU can add 400-500 lbs. in batteries alone and have a total system weight of 700 lbs. APUs also require additional open frame rail space for installation, which can lead to weight increases due to increased wheelbase requirements if the customer is unwilling to sacrifice fuel capacity to make room for the APU. To further exacerbate the issue aerodynamic performance can be compromised by the added wheelbase driving increased trailer gaps and an APU that does not fit behind the OEM's chassis fairings. [EPA-HQ-OAR-2014-0827-1290-A1 p.24]

Due to the limited acceptance of APUs in the marketplace we propose that the agencies provide a compliance option allowing credit for APUs and a partial credit for a fuel fired heater, which does not require a tamper-resistant AES. It is our belief that this would help drive future penetration of APUs, while still allowing for operator comfort and safety without concerns of system reliability. [EPA-HQ-OAR-2014-0827-1290-A1 p.24]

### Current Technology Example: Auxiliary Power Units (APUs)

The agencies have assumed an 80% penetration rate of APUs in MY 2021 Class 8 Sleeper Tractors for purposes of determining the proposed MY 2021 standards (Preamble Table III-8). They have also put forth in Table III-15 a proposed incremental cost for MY 2021 of \$2,449 for idle reduction with an APU that includes the above adoption rate (which provides for a price of  $\$2,449/80\% = \$3,061$  in 2012\$). Yet, section 2.4.8.1.1 of the RIA states that APUs can retail for over \$7,000. [EPA-HQ-OAR-2014-0827-1290-A1 p.35-36]

Irrespective of the conflicting information, if we consider that an APU requires auxiliary components to interface with the vehicle systems, the current street price for an installed APU can vary from \$9,500 to over \$11,000 depending on the type. Even providing for a conversion to 2012\$ the agencies are off significantly in their cost assessment. [EPA-HQ-OAR-2014-0827-1290-A1 p.36]

### Vehicle Speed Limiters (VSL)

As with Phase 1, the agencies have proposed Phase 2 credit for tamper-resistant vehicle speed limiters set below 65 MPH. However, as has been the experience in Phase 1, truck owners are unwilling to accept this feature since it means they have to give up flexibility in their operations and face reductions in residual value of their used trucks. [EPA-HQ-OAR-2014-0827-1290-A1 p.24-25]

From January 1<sup>st</sup> of 2013 through January 1<sup>st</sup> of 2015 Volvo Group built in excess of 50,000 highway tractors for the North American market. Of these, ~15% were shipped with their programmable road speed limiters set at less than 65 mph from the factory. When comparing road speed limiter (RSL) settings data available from in-use vehicles it was determined that there was actually a slight increase of +0.7% in the percentage of the fleet that had in-use settings set below 65 mph compared to the percentage programmed below 65 mph at the factory. This is indicative that the overall fleet RSL settings remain fairly stable. On top of this, 45% of Volvo vehicles leave the factory with an RSL setting of 65 mph and below, and 47% were reported in use with the same setting, even during a period of very low fuel prices. Due to the apparent stability of the RSL settings across the highway tractor populations and, in fact, the slight increase in the in-use population with RSL settings at or below 65 mph Volvo Group requests that the agencies consider crediting manufacturers for reprogrammable speed limiters set at the factory at, or below 65 mph. [EPA-HQ-OAR-2014-0827-1290-A1 p.25]

The regulatory vehicle duty cycles are standardized with maximum speed of 65 mph, so there is no benefit to a speed limiter set at 65 mph, or above, in the regulated cycles. The reality is that more than half of the in-use fleet is running faster, with nearly 48% having speed limiters set at 68 mph or above. Clearly the programmable RSL is yielding benefits, even if set at 65 mph or above, and should be given appropriate credit in the Phase 2 regulation. Volvo Group is willing to continue to work with the agencies to validate the benefits of programmable RSLs, and to develop a means to ensure benefits are verifiable in use. [EPA-HQ-OAR-2014-0827-1290-A1 p.25]

### 6x2 Penetration

The expected penetration rates of 6x2 axle configurations are infeasible due to operational requirements and confusing or conflicting state and provincial regulations. The maximum penetration rate for highway tractors should be lowered from 60% to 5% in 2027 and 0% for vocational vehicles, including vocational tractors. [EPA-HQ-OAR-2014-0827-1290-A1 P.28]

6x2 axle configurations are only feasible when combined with the capability to transfer load to the driven axle when needed for traction. This may occur on a slippery road, in many off-road situations, and at take-off (either on a grade or at high gross combination weights). Volvo Group has been a leader in developing 6x2 tractor drive systems including both a conventional system where the front tandem is driven and a “pusher” where the rear axle is driven. Both systems are confronted with a hodge-podge of state and provincial regulations that may not allow control of axle load from inside the cab or may require load balance between the tandem axles. A compendium of these regulations is attached to the EMA comments; however, to summarize the major issues, there are nine states and five Canadian provinces which do not allow, or severely limit the amount of load shifting control on variable suspension axles. In some cases the load shifting between axles in a tandem system is limited to either a 60/40 load split (driven/dead axle), or a maximum weight delta of 1,000 kg. In other cases states and provinces have regulations that require that any controls for load distribution be located outside the cab of the vehicle such that the driver is unable to make any load corrections during operation. These regulations appear to be aimed at limiting any ability for load shifting to occur during vehicle operation, but require further rulings from the state and provincial regulatory agencies on a case by case basis. [EPA-HQ-OAR-2014-0827-1290-A1 P.28]

It is unclear, in many cases, how these rules apply or how they would restrict 6x2 application. What is clear is that these rules limit acceptance of 6x2 axles because owners are unsure if they will pass inspections. Unless and until there are federal regulations that clarify what is allowable, we cannot expect high penetration of 6x2 drives. [EPA-HQ-OAR-2014-0827-1290-A1 P.28-29]

With respect to stringency settings (at the above noted penetrations) the agencies project a 2% benefit of the part-time 6x2 on the highway cruise cycles, but have proposed to assign a fixed value in GEM of 2.5 percent over these same cycles (see Preamble Section V.C.1.a.ii). Given the issues noted with the current architecture of the part-time 6x2 systems, the inadequacy for use of 6x2 in HHD vocational applications, and the fixed GEM value at a greater benefit than the agencies expect, it is not feasible to set stringencies at the levels projected based on application of 6x2 systems. [EPA-HQ-OAR-2014-0827-1290-A1 P.29]

#### Compromising Vehicle Utility

Given the previously stated concerns regarding inability to meet the standards with the agencies assumed technology packages and penetration rates, the far reaching timeframe for the Phase 2 regulation, the uncertainty in the feasibility of the proposed technologies and their penetrations, and the expected increases in fuel economy and GHG performance measured on non-representative duty cycles that are still under revision, Volvo Group is concerned that the proposed regulation will force technologies that are not suited for the specific intended applications and duty cycles. One such example is expected penetration of Waste Heat Recovery on a highway tractor which could serve to limit aerodynamic performance due to increased cooling package size, as well as suitability for weight sensitive applications. If, forced to introduce this technology, OEMs could likely face pre-buy, no-buy, or delayed-buy effects, all of which would result in continued operation of old trucks and large scale rebuilding of older vehicles and engines. This again renders the proposal uncertain to accomplish its intended purpose. [EPA-HQ-OAR-2014-0827-1290-A1 p.31-32]

#### **Response:**

##### *Baseline*

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent



used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>126</sup> Therefore, the agencies are projecting for the baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will include tamper proof AESS.

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The baseline was not determined by or declared to be the average results of the vehicles tested, as some commenters maintained. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2 NPRM. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. See RIA Chapter 3.2.1.2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

### *Aerodynamics*

The agencies' assessment is that the best aerodynamic tractor tested by EPA in 2015 achieved Bin IV performance. This vehicle did not include all of the possible aerodynamic technologies, such as wheel covers or active aerodynamics like a grill shutter or front air dam. Thus, the agencies' assessment is that Bin V is achievable with known aerodynamic technologies, as discussed in RIA Chapter 2.4, but agree with the manufacturers that Bins VI and VII have less known technology paths. However, we are including Bins VI and VII in the Phase 2 regulations as a potential Phase 2 technology to recognize the possibility that over the next ten years (until the full implementation of the Phase 2 program) tractor manufacturers may advance their aerodynamic technologies beyond the Bin V levels projected for the Phase 2 standards, and to provide a value to be input to GEM should they do so. In consideration of the comments, the agencies have adjusted the aerodynamic adoption rate for Class 8 high roof sleeper cabs used to set the final standards in 2021, 2024, and 2027 MYs (*i.e.*, the degree of technology adoption on which the stringency of the standard is premised). Upon further analysis of simulation modeling of a SuperTruck tractor with a Phase 2 reference trailer with skirts, we agree with the manufacturers that a SuperTruck tractor technology package would only achieve the Bin V level of  $C_dA$ . The changes required for Bin V and better performance reflect the kinds of improvements projected in the Department of Energy's SuperTruck program. That program assumes that such systems can be demonstrated on vehicles by 2017. In this case, the agencies are projecting that truck manufacturers will be able to begin implementing these demonstrated aerodynamic technologies as early as 2021 MY on a limited scale. Accordingly, we adjusted the adoption rates for MY 2027 in the technology package developed for the final rule to consist of 20 percent of Bin III, 30 percent Bin IV, and 50 percent Bin V reflecting our assessment of the fraction of high roof sleeper cab tractors in this segment that we project could successfully apply these aerodynamic packages with this amount of lead time. Overall, while the agencies are now projecting slightly less benefit from aerodynamic improvements than we did in the

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<sup>126</sup> North American Council for Freight Efficiency. Confidence Report:Idl- Reduction Solutions. 2014. Page 13.

NPRM (i.e. because the agencies have reevaluated the efficiencies of these technologies, consistent with this and other comments), the actual aerodynamic technology being projected is very similar to what was projected at the time of NPRM.

With respect to the comments related to the aerodynamic test procedures, please see the agencies' response to the EMA comments in Section 4.5 of this response to comments document.

#### *Low Rolling Resistance Tires*

For the final rulemaking, the agencies evaluated the tire rolling resistance levels in the Phase 1 certification data.<sup>127</sup> We found that high roof sleeper cabs are certified today with steer tire rolling resistance levels that ranged between 4.9 and 7.6 kg/ton and with drive tires ranging between 5.1 and 9.8 kg/ton. In the same analysis, we found that high roof day cabs are certified with rolling resistance levels ranging between 4.9 and 9.0 kg/ton for steer tires and between 5.1 and 9.8 kg/ton for drive tires. This range spans the baseline through Level 3 rolling resistance performance levels. Therefore, for the final rule we took an approach similar to the one taken in Phase 1 and proposed in Phase 2 that considers adoption rates across a wide range of tire rolling resistance levels to recognize that operators may have different needs. 76 FR 57211 and 80 FR 40227.

Also in our analysis of the Phase 1 certification data, we found that the drive tires on low and mid roof sleeper cab tractors on average had 10 to 17 percent higher rolling resistance than the high roof sleeper cabs. But we found only a minor difference in rolling resistance of the steer tires between the tractor subcategories. Based on comments received and further consideration of our own analysis of the difference in tire rolling resistance levels that exist today in the certification data, the agencies are adopting Phase 2 standards using a technology pathway that utilizes higher rolling resistance levels for low and mid roof tractors than the levels used to set the high roof tractor standards. This is also consistent with the approach that we took in setting the Phase 1 tractor standards. 76 FR 57211. In addition, the final rule reflects a reduction in Level 3 adoption rates for low and mid roof tractors from 25 percent in MY 2027 used at proposal (80 FR 40227) to zero percent adoption rate. The technology packages developed for the low and mid roof tractors used to determine the stringency of the MY 2027 standards in the final rule do not include any adoption rate of Level 3 drive tires to recognize the special needs of these applications, consistent with the comments noted above raising concerns about applications that limit the use of low rolling resistance tires.

With respect to the comments about the ability to retread low rolling resistance tires, we have asked fleets and others for data regarding this topic, but we have not received any. In discussions with EPA's SmartWay, tire manufacturers have claimed that their low rolling resistance tires are as retreadable as those with higher rolling resistance. While there may be individual tire models that do not perform as well in terms of retreadability, we do not believe this is a systematic issue related to low rolling resistance tires.

DOT's Federal Motor Carrier Safety Administration and NHTSA sponsored a test program conducted by Oak Ridge National Laboratory to explore the effects of tire rolling resistance levels on Class 8 tractor-trailer stopping distance performance over a range of loading and surface conditions. The objective was to determine whether a relationship exists between tire rolling resistance and stopping distance for vehicles of this type. The overall results of this research suggest that tire rolling resistance is not a

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<sup>127</sup> Memo to Docket. Coefficient of Rolling Resistance and Coefficient of Drag Certification Data for Tractors. Docket EPA-HQ-OAR-2014-0827.

reliable indicator of Class 8 tractor-trailer stopping distance. The correlation coefficients (R<sup>2</sup> values) for linear regressions of wet and dry stopping distance versus overall vehicle rolling resistance values did not meet the minimum threshold for statistical significance for any of the test conditions. Correlation between CRR and stopping distance was found to be negligible for the dry tests for both loading conditions. While correlation was higher for the wet testing (showing a slight trend in which lower CRRs correspond to longer stopping distances), it still did not meet the minimum threshold for statistical significance. In terms of compliance with Federal safety standards, it was found that the stopping distance performance of the vehicle with the four tire sets studied in this research (with estimated tractor CRRs which varied by 33 percent), were well under the FMVSS No. 121 stopping distance requirements. The agencies agree, though, that continuing research will be important as new tire technologies enter the marketplace, and like the extensive rolling resistance testing conducting to support the Phase 1 regulation and, in part, this final rule, the agencies will continue to monitor developments in the tire supply marketplace through the EPA Smartway program and other, potential, research. NHTSA notes that FMVSS No. 121 will continue to play a role in ensuring the safety of both current and future tire technologies.

#### *Tire Pressure Systems*

After consideration of the comments, the agencies are adopting provisions in Phase 2 GEM that allow manufacturers to show compliance with the CO<sub>2</sub> and fuel consumption standards using various technologies, including either ATIS or TPMS (see 40 CFR 1037.520). See Preamble Section III.D.1.b.iv. This reflects a change from the Phase 2 NPRM, where only ATIS (not TPMS) was a GEM input. The agencies believe that sufficient incentive exists for truck operators to address low tire pressure conditions if they are notified that they exist through a TPMS, however, we set the effectiveness value of TPMS lower than ATIS to reflect the need for operator intervention.

#### *Idle Reduction Technologies*

The agencies received numerous comments on our proposed adoption rates of tamper-proof AESS. We generally agree with this commenter (and others) that the agencies should consider other types of idle reduction technologies because an automatic engine shutdown system (or an APU) may not be the optimum choice for every tractor. For the final rule, we now differentiate effectiveness based on the specific idle reduction technology installed by the tractor manufacturer. This change is consistent with the commenter's concern that APUs would not benefit all operators or may lead to a concern regarding weight. For the final rule, we recognize a variety of idle reduction technologies –including automatic engine shutdown systems, fuel operated heaters, automatic stop/start systems, and diesel powered APUs. Phase 2 will allow a variety of both tamper-proof and adjustable (programmable) systems to qualify for some reduction. After consideration of the comments, the agencies have refined the adoption rates of a new menu of idle reduction technologies and only projected adoption of idle reduction technologies with adjustable AESS.

EPA considered the comments and more closely evaluated NHTSA's contracted TetraTech cost report found the retail price of a diesel-powered APU with a DPF to be \$10,000. The agencies used a retail price of a diesel-powered APU to be \$8,000 without a DPF and \$10,000 with a DPF in the cost analysis for this final rulemaking.

#### *Vehicle Speed Limiters*

The agencies considered DOT's upcoming actions with respect to mandatory vehicle speed limiters for heavy-duty trucks, but could not take it into account in this Phase 2 rulemaking because that rule is not

final yet. The existing Phase 1 VSL flexibilities provide opportunities for manufacturers to account for the impact of VSLs on reducing GHG emissions and fuel consumption, while still allowing the settings to change after an “expiration” time determined by the manufacturer or to include a soft top. At this time, we believe that the Phase 1 flexibilities sufficiently balance the desire to encourage technologies that reduce GHG emissions and fuel consumption while minimizing the compliance burden of trying to accommodate changes throughout the useful life of the vehicle. Therefore, the agencies are not adopting any new VSL provisions for Phase 2. With respect to the commenter’s request that the agencies recognize the effectiveness of VSLs set at greater than 65 mph, the agencies’ assessment is that based on truck speed limits in each of the states, weighted by truck miles in each state, that 65 mph is an appropriate speed for one of the cruise cycles. If a manufacturer has sufficient data to support the real world reduction of VSLs set at greater than 65 mph, then they may pursue off-cycle credit approval.

### *6x2 Axles*

Upon further consideration, the agencies have lowered the adoption rates of 6x2 axles in the final rule from those used in the proposal. We projected a 15 percent adoption rate in the technology package used to determine the final 2021 MY standards and a 30 percent adoption rate in the technology package used to determine the 2027 MY standards. This adoption rate represents a combination of 6x2 axles (which as noted by a commenter that liftable axles are expected to be allowed in all states by the time of implementation of Phase 2), enhanced 6x2 axles, disconnectable 6x4 axles, and 4x2 axles. Some axle manufacturers offer enhanced 6x2 products that perform similar to the 6x4 configurations and address concerns regarding traction. SMARTandem offered by Meritor is just one of the examples.<sup>128</sup> In this system, the axle runs 6x2 for most time. Once the conditions that require more traction are experienced, the vehicle activates the system to add more loads into one the powered axle, thus instantly increasing traction. In addition to enhanced 6x2 axles, based on confidential stakeholder discussions, the agencies anticipate that the axle market may offer a Class 8 version of axle disconnect to automatically disconnect or reconnect the one of the tandem axles depending on needs for traction in varying driving conditions. Recently, Dana Holding Corporation has developed an axle system that switches between the two modes based on driving conditions to maximize driveline efficiency.<sup>129</sup> When high traction is required, the system operates in 6x4 mode. When 6x4 tractive effort is not required, the system operates in 6x2 mode. Though the adoption rate of 6x2 axles have been low in the U.S. market, NACFE found in their confidence report that more fleets are adopting 6x2 axles. NACFE found that one large national fleet, Conway Truckload, has purchased around 95% of their new tractors in the past few years with 6x2s.”<sup>130</sup> In addition, it is worth noting that the standards are performance standards, therefore, the agencies are not mandating any specific fuel consumption or GHG emission reducing technology. For each standard, we developed *one* potential technology pathway to demonstrate the feasibility of the standards, but manufacturers will be free to choose other paths.

The agencies have modified how 6x2 axles are recognized in the final rule. In lieu of a fixed improvement, GEM will simulate a 6x2 axle by removing the axle losses of one of the drive axles. The agencies believe this is a more representative approach. See RIA Chapter 4.4.1.2.

### *Vehicle Utility*

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<sup>128</sup> Fleet Owner, “Meritor Expects to offer new tandem axle in 2013,” <http://fleetowner.com/equipment/meritor-expects-offer-new-tandem-axle-2013>, December 2012.

<sup>129</sup> Dana Holding Corporation Patents (8,523,738, 8,795,125, and 8,911,321).

<sup>130</sup> North American Council for Freight Efficiency. “Confidence Findings on the Potential of 6x2 Axles.” January 2014. Page 19.

The agencies understand the potential impact that certain designs of WHR could have on aerodynamics; however, WHR systems have evolved from earlier versions demonstrated in SuperTruck and will continue to evolve over the next 5-10 years (as noted in Cummins' comments to the rule). The WHR systems continue to reduce weight, improve packaging, and reduce the impact on the aerodynamics. As demonstrated on the Cummins-Peterbilt, the Volvo, and the Daimler SuperTrucks, manufacturers were able to demonstrate tractors that incorporated WHR and simultaneously improved the aerodynamics of the tractor-trailer. We understand the limitations of the DOE SuperTruck program in terms of applying the reductions broadly across vehicle applications and duty cycles, and in terms of durability and cost. However, this program demonstrates that it is possible to design systems that utilize WHR without significant compromise to aerodynamics. In addition, the agencies premised the final Phase 2 standards on engine technology packages that include WHR only on sleeper cab tractors and only on 50 percent of those vehicles in 2027. It is important to also note that manufacturers that do not invest to achieve a level of engine reduction through WHR could potentially be able to make up the difference by applying one of the many other available and cost-effective tractor technologies to a greater extent or more effectively, so that there are multiple technology paths for meeting the final standards. See Section 3 of this RTC for additional discussion of WHR technology.

**Organization:** Werner Enterprises

There are several key areas the agencies need to address: [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

-Due to errors in EPA's baseline vehicle assumptions (used to determine future achievable stringency) and testing protocols, the actual stringency of the proposed standards is much greater than what EPA had indicated. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

**Response:**

*Baseline*

In the proposal, the agencies noted that the manufacturers were not using tamper-proof AESS to comply with the Phase 1 standards so the agencies reverted back to the baseline APU adoption rate of 30 percent used in the Phase 1 baseline. The agencies received a number of comments regarding this. In response to these comments, the agencies reassessed the baseline idle reduction adoption rates. The latest NACFE confidence report found that 9 percent of tractors had auxiliary power units and 96 percent of vehicles are equipped with adjustable automatic engine shutdown systems.<sup>131</sup> Therefore, the agencies are projecting for the baseline that 9 percent of sleeper cabs will contain an adjustable AESS and APU, while the other 87 percent will only have an adjustable AESS, and none will include tamper proof AESS.

While the agencies agree with the commenters that it is important to develop an accurate baseline so that the appropriate aerodynamic technology package effectiveness and costs can be evaluated in determining the final Phase 2 standards, there appears to be some confusion regarding the NPRM baseline aerodynamic assessment. The Phase 2 baseline in the NPRM was determined based on the aerodynamic bin adoption rates used to determine the Phase 1 MY 2017 tractor standards. The baseline was not determined by or declared to be the average results of the vehicles tested, as some commenters maintained. The vehicles that were tested prior to the NPRM were used to develop the aerodynamic bin structure for Phase 2. In both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into

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<sup>131</sup> North American Council for Freight Efficiency. Confidence Report:Idl- Reduction Solutions. 2014. Page 13.

consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that tractors that performed as a Bin III in Phase 1 would also perform as Bin III tractors in Phase 2. The baseline aerodynamic value for the Phase 2 final rulemaking was determined in the same manner as the NPRM, using the adoption rates of the bins used to determine the Phase 1 standards, but reflect the final Phase 2 bin  $C_dA$  values.

## 4.4 Proposed Exclusions from the Phase 2 Tractor Standards

**Organization:** Allison Transmission, Inc.

EPA and NHTSA should amend the definition of heavy-haul tractors to account for lower overall gear reductions with fully automatic transmissions and to provide credits for same. [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

### **EPA and NHTSA Should Amend Proposed Definition of Heavy-Haul Tractors To Account for Lower Gear Ratios Used by ATs And Allow For Crediting of AT Architecture and Neutral-Idle**

EPA and NHTSA are proposing to add a tenth subcategory to the tractor category in order to address heavy-haul tractors. This category would be defined with reference to weight (GCWR over 120,000 lb) and with respect to total gear ratio (greater than 57:1) and a frame Resisting Bending Motion of 2,000,000 in-lb. While Allison supports creation of this category, we would recommend that in heavy-haul tractors equipped with an AT, the gear reduction ratio requirements be changed to greater than or equal to 24.9:1. A 57:1 gear reduction requirement is required for a manual/AMT transmission to launch due to heavy haul weights and engine torque being limited to protect a slipping clutch. But this ratio is excessive for a torque converter AT which can launch a vehicle at full power. If the 57:1 requirement was applied to ATs, it would unnecessarily result in poor fuel economy in actual service. [EPA-HQ-OAR-2014-0827-1284-A1 p.37]

Specifically, due to an AT's torque converter allowing full power at stall, its torque multiplying characteristics and the ability to do full power shifting, deep gear reduction is not required for ATs. The total gear reduction (including torque converter ratio) for an AT in the heavy haul application ranges from 24.9:1 to 144.4:1. Typical (i.e., standard) configurations utilize a range from 24.9 to 48:1 gear reduction ratio. [EPA-HQ-OAR-2014-0827-1284-A1 p.37]

We include with our comments the following data from current heavy haul applications: [EPA-HQ-OAR-2014-0827-1284-A1 p.37]

[Chart, 'Data from current Allison transmission heavy haul applications', can be found on p.37 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

This data supports our view that the total gear reduction ratio for ATs needs to be different from other transmission architectures and request that EPA change the proposed regulatory definition at 40 C.F.R. 1037.801 (which is cross-referenced within NHTSA regulations). Specifically, EPA and NHTSA should adopt the following definition: [EPA-HQ-OAR-2014-0827-1284-A1 p.37]

Heavy-haul tractor means a tractor with GCWR above 120,000 pounds, a total gear reduction at or above 24.9:1 for tractors containing fully automatic transmissions, a total gear reduction at or above 57 for all other tractors, and a frame Resisting Bending Moment at or above 2,000,000 in-lb per rail, or per rail and liner combination. Total gear reduction is the transmission gear ratio in the lowest gear multiplied by the drive axle ratios. A heavy-haul tractor is not a vocational tractor.<sup>60</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.38]

### **Separate Certification Approach for Vocational Tractors**

EPA and NHTSA have proposed to allow vocational tractors to follow the same subcategory assignment process as other vehicles. Allison lacks data upon which to address the agencies' request for comment on whether vocational tractors, when measured against vocational vehicle baseline configurations, would be deficit-generating vehicles. But as a matter of policy, we believe it would be reasonable to not limit the number of tractors that can be certified as vocational vehicles as was done in Phase 1. This limitation may have been reasonable in the initial years of the program as a precaution against unreasonably assigning too many tractors to the vocational vehicle category. Vehicle configurations, however, change over time. For example, beverage delivery was formerly performed by straight trucks but now primarily occurs using tractors. [EPA-HQ-OAR-2014-0827-1284-A1 p.42]

In Phase 2, EPA and NHTSA have both diversified the vocational vehicle category and include additional elements within GEM for vehicle certification. This regulatory framework seeks to better represent the diversity of vocational vehicles and their differentiated uses that may change over time. Given the scope of the Phase 2 regulations, extending into major vehicle components such as transmissions, axles and tires, it would be correspondingly reasonable to allow manufacturers to certify all HD vehicles, both vocational and tractor, with regard to intended use. This would allow for better alignment of vehicles with duty cycles that are more representative of their real-world operation. [EPA-HQ-OAR-2014-0827-1284-A1 p.42]

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60 Italicized words are not in the proposed regulatory definition for heavy-haul tractor.

**Response:**

For the FRM, EPA and NHTSA are revising the Phase 1 heavy-haul tractor provisions (and the Phase 2 proposal) to better assure that vehicles are regulated in an appropriate subcategory. Based on our assessment, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S. Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios.

The final version of Phase 2 GEM treats ATs and AMTs the same for heavy-haul tractors as for the other tractors.

The agencies evaluated the sales cap limit proposed for special purpose tractors and the comments addressing the issue of a sales cap. EPA calculated the number of vocational tractors certified in MY 2014 and MY 2015. The number of tractors ranged between approximately 2,600 and 6,200 per year per manufacturer that certified special purpose tractors, but one manufacturer did not use this provision at all.<sup>132</sup> It is apparent that none of the manufacturers are utilizing this provision near the maximum allowable level in Phase 1 (a rolling three year sales limit of 21,000). We also believe that there is more incentive for manufacturers to use the special purpose tractor provisions in Phase 1 because the relative difference in stringency between the tractor and vocational programs is much greater in Phase 1 than in Phase 2. Upon further consideration, we concluded that there is significantly less incentive for the manufacturers to reclassify tractors that are not truly special purpose tractors as vocational vehicles as a pathway to a less stringent standard in Phase 2 primarily due to the fact that the Phase 2 vocational vehicle program stringency is more in line with the tractor program stringency. In addition, the Phase 2 vocational vehicle compliance program and standards better represent the duty cycles expected of these

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<sup>132</sup> U.S. EPA. Memo to Docket: Special Purpose Tractor Production Volumes. Docket EPA-HQ-OAR-2014-0827.



vehicles and are predicated on performance of similar sets of vehicle technologies as the primary tractor program (although some of the vocational vehicle standards are predicated on stop start and hybrid technologies, which are not part of the technology path predicated for tractors and vocational vehicle standards are not predicated on aerodynamic technologies). Therefore, we are adopting Phase 2 special purpose tractor provisions without a sales cap.

**Organization:** American Reliance Industries, Co. (ARI)

ARI serves as a second stage manufacturer that improves completed vocational vehicles and heavy duty tractors. ARI does not receive or work on incomplete vehicles and thus 40 C.F.R. § 1037.620 does not apply to ARI's circumstances. Instead, ARI's primary focus is to make cab sleeper modifications to vocational vehicles and heavy duty tractors that are considered complete prior to arrival. The vehicles received by ARI for improvement must meet the requirements of the EPA and DOT/NHTSA regulations relevant to the specific vehicle in its completed form. This includes the labeling requirements that an OEM must comply with under Phase 1 and soon to be Phase 2. [EPA-HQ-OAR-2014-0827-1300-A1 p.2]

### **EPA and NHTSA's Intent Related to Second Stage Manufacturers Performing Cab Sleeper Modifications**

Upon review of the proposed regulations and after discussions with representatives of the agencies, ARI believes that it is EPA and NHTSA's intent to continue to exclude or exempt second stage manufacturers performing cab sleeper modifications from the Phase 2 proposed regulations. ARI appreciates EPA and NHTSA's recognition of the unique nature of this niche market and the significant adverse effect the proposed regulations could have on small businesses in this market, like ARI. ARI appreciates EPA and NHTSA's focus on their top priority of obtaining real world emission reductions and recognition that regulating this niche market in addition to the regulations placed upon the OEM would not provide such results. ARI values EPA and NHTSA's recognition that such regulation would have the unintended consequence of being a barrier to entry and a disruption to the current marketplace. [EPA-HQ-OAR-2014-0827-1300-A1 p.3]

EPA and NHTSA have drafted specific provisions in the proposed regulation to implement the above intent. EPA and NHTSA have also sought comment on several of the drafted sections. Included herein are sections of the proposed regulation that ARI believes are important to consider when implementing the agencies' intent. ARI will include the specific section(s) with citation below along with ARI's comments on the section(s). [EPA-HQ-OAR-2014-0827-1300-A1 p.3]

### **ARI's Analysis of Sections of the Proposed Regulation**

#### **80 Fed. Reg. 40214–15 (July 13, 2015).**

Also in Phase 1, EPA determined that manufacturers that met the small business criteria specified in 13 CFR 121.201 for "Heavy Duty Truck Manufacturing" were not subject to the greenhouse gas emissions standards of 40 CFR 1037.106.130 The regulations required that qualifying manufacturers must notify the Designated Compliance Officer each model year before introducing the vehicles into commerce. The manufacturers are also required to label the vehicles to identify them as excluded vehicles. EPA and NHTSA are seeking comments on eliminating this provision for tractor manufacturers in the Phase 2 program. The agencies are aware of two second stage manufacturers building custom sleeper cab tractors. We could treat these vehicles in one of two ways. First, the vehicles may be considered as dromedary vehicles and therefore treated as vocational vehicles. Or the agencies could provide provisions that stated if a manufacturer changed the cab, but not the frontal area of the vehicle, then it could retain the

aerodynamic bin of the original tractor. We welcome comments on these considerations. [EPA-HQ-OAR-2014-0827-1300-A1 p.3]

**ARI Comment:** ARI recognizes EPA and NHTSA's desire to limit the small business exemption previously set forth in 40 C.F.R. § 1037.150(c). ARI appreciates EPA and NHTSA's efforts to propose alternative methods for excluding or exempting those second stage manufacturers performing cab sleeper modifications that previously qualified for the small business exemption under 40 C.F.R. § 1037.150(c). ARI has some concerns related to the methods set forth by the agencies. [EPA-HQ-OAR-2014-0827-1300-A1 p.3-4]

#### *Dromedary Vehicles*

ARI understands that the idea behind considering the vehicles as dromedary vehicles and thus vocational vehicles would be that the aerodynamic requirements of the proposed regulation are not applicable to the vocational vehicles. ARI is concerned that treating these vehicles as vocational vehicles will result in three possible issues: (1) other regulations related to vocational vehicles will become applicable and have unanticipated adverse results; (2) the vehicles will be treated as heavy duty vehicles and not vocational vehicles when originally certified by an OEM; and (3) vocational vehicles are often considered the highest polluters of greenhouse gas emissions with the lowest fuel efficiencies, and heavy duty trucks with cab sleeper modifications do not fit this general category. ARI is open to discussing this option further, but does not believe it is the best solution for adopting EPA and NHTSA's intent under these circumstances. [EPA-HQ-OAR-2014-0827-1300-A1 p.4]

#### **80 Fed. Reg. 40653 (July 13, 2015).**

**§ 1037.622 Shipment of incomplete vehicles to secondary vehicle manufacturers.** This section specifies how manufacturers may introduce partially complete vehicles into U.S. commerce. The provisions of this section do not apply for trailers, except in unusual circumstances. You may not use the provisions of this section to circumvent the intent of this part. [EPA-HQ-OAR-2014-0827-1300-A1 p.5-6]

(a) The provisions of this section allow manufacturers to ship partially complete vehicles to secondary vehicle manufacturers or otherwise introduce them into U.S. commerce in the following circumstances: [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

(2) Small businesses modifying certified tractors. Small businesses that build custom sleeper cabs may modify complete or incomplete vehicles certified as tractors, as long as they do not increase the effective frontal area of the certified configuration. [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

**ARI Comment:** ARI is first concerned that this section appears in part to only address the shipment of incomplete vehicles, but later permits small businesses modifying certified tractors to modify complete or incomplete vehicles. ARI believes that EPA and NHTSA's goal is to use this section to adopt the frontal area approach previously discussed. If EPA and NHTSA adopt a frontal area approach for second stage manufacturers making cab sleeper modifications, ARI requests that the section be revised to ensure greater clarity as to the intention and effect of this section. ARI believes that it is important for any final section providing an exemption or an exclusion to directly state that it is an exemption or exclusion from the Phase 2 regulation in order to avoid possible ambiguities arising at a later date. EPA and NHTSA took a direct approach in the small business exemption under the Phase 1 regulation. ARI encourages the agencies to take a similar approach in the Phase 2 regulation. [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

Thank you for recognizing the need for an exemption or exclusion for small businesses engaged in the unique niche market of second stage manufacturers performing cab sleeper modifications. [EPA-HQ-OAR-2014-0827-1300-A1 p.7]

Otherwise, ARI requests that the agencies engage in additional discussions to evaluate what significant changes would need to be made to provide an exemption or exclusion that allows day cabs to be changed to sleeper cabs and permits the addition of aerodynamic technologies. [EPA-HQ-OAR-2014-0827-1300-A1 p.7]

#### *Frontal Area*

ARI recognizes that the idea behind permitting a second stage manufacturer to change the cab, but not the frontal area of the vehicle, would permit the second stage manufacturer to keep the original OEM's certification within a specific aerodynamic bin category. Our primary concerns for this approach is that it does not permit a second stage manufacturer performing cab sleeper modifications to convert a day cab into a sleeper cab or improve the frontal area as a part of the modifications. As the EPA and NHTSA recognize, aerodynamic technologies provide an "opportunity to reduce aerodynamic drag from the tractor." 80 Fed. Reg. 40216 (July 13, 2015). [EPA-HQ-OAR-2014-0827-1300-A1 p.4]

Depending on the custom cab sleeper modification, ARI may use wind fairings on the sleeper, fuel tank fairings, roof fairings, and side extenders or gap reducing tractor fairings that can modify the frontal area of the vehicle in height and width as compared to the frontal area of the vehicle used to obtain the original certification. These additions will, in some circumstances, result in the vehicle being taken out of its prior certification configuration because roof height is defined to "include[e] any wide accessories such as roof fairings." 80 Fed. Reg. 40664, 40739 (July 13, 2015). Requiring the small businesses to test the vehicle for recertification or certify the vehicle at the worst case aerodynamic bin for the type of vehicle under these circumstances would not further the intent of EPA and NHTSA and would have a significant adverse impact on small businesses in this niche marketplace. [EPA-HQ-OAR-2014-0827-1300-A1 p.4]

ARI wishes to continue improving the client's lifestyles, health, and happiness by modifying day cabs into sleeper cabs. ARI also wishes to continue using aerodynamic technologies in connection with the cab sleeper modifications to benefit the clients and further, although modestly, the goals of the EPA and NHTSA. As recognized by the EPA and NHTSA, "fuel tank fairings can reduce the surface area perpendicular to the wind and provide a smooth surface to minimize disruptions of the air flow[;] [r]oof fairings provide a transition to move the air smoothly over the tractor and trailer[; and] [s]ide extenders can minimize the air entrapped in the gap[s] . . ." 80 Fed. Reg. 40216 (July 13, 2015). ARI is open to discussing this option further, but does not believe it is the best solution for adopting EPA and NHTSA's intent under these circumstances. [EPA-HQ-OAR-2014-0827-1300-A1 p.4-5]

#### **80 Fed. Reg. 40603 (July 13, 2015).**

*Basic vehicle frontal area* has the meaning given in 40 CFR 86.1803. [EPA-HQ-OAR-2014-0827-1300-A1 p.5]

#### **40 C.F.R. § 86.1803.**

*Basic vehicle frontal area* means the area enclosed by the geometric projection of the basic vehicle along the longitudinal axis, which includes tires but excludes mirrors and air deflectors, onto a plane perpendicular to the longitudinal axis of the vehicle. [EPA-HQ-OAR-2014-0827-1300-A1 p.5]

**ARI Comment:** ARI is concerned that if EPA and NHTSA adopt a frontal area approach for second stage manufacturers making cab sleeper modifications, that the above definitions are too restrictive and would not permit the addition of beneficial aerodynamic technologies. [EPA-HQ-OAR-2014-0827-1300-A1 p.5]

**80 Fed. Reg. 40657 (July 13, 2015).**

(d) Examples of prohibited modifications. The following are examples of modifications that are not allowable: [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

(2) No person may remove aerodynamic fairings from tractors that are used primarily to pull box trailers on highways. [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

**ARI Comment:** Depending on the custom cab sleeper modification, ARI may replace an aerodynamic fairing from the tractor in order to provide better aerodynamic results in light of the cab sleeper modification. ARI does not want to be precluded from continuing to provide these benefits to clients. ARI believes an exception to this section would resolve these concerns. [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

**80 Fed. Reg. 40664 (July 13, 2015).**

Secondary vehicle manufacturer [means] (sic) anyone that produces a vehicle by modifying a complete or partially complete vehicle. For the purpose of this definition, “modifying” does not include making changes that do not remove a vehicle from its original certified configuration. [EPA-HQ-OAR-2014-0827-1300-A1 p.6]

**ARI Comment:** ARI recognizes that the purpose of this definition was to further support the frontal area approach. ARI remains concerned that making a day cab a sleeper cab or adding the aerodynamic technology described above will result, in some circumstances, in the vehicle being removed from its original certified configuration. [EPA-HQ-OAR-2014-0827-1300-A1 p.7]

**Response:**

In response to these comments, EPA is clarifying in 40 CFR 1037.622 that small businesses may modify tractors as long as they do not modify the front of the vehicle and so long as the sleeper compartment is no more than 102 inches wide or 162 inches in height. As an interim provision, to allow for a better transition to Phase 2, EPA is finalizing a more flexible compliance path in 40 CFR 1037.150(r). This option allows small manufacturers to convert a low or mid roof tractor to a mid or high roof configuration without recertification, provided it is for the purpose of building a custom sleeper tractor or for conversion to a natural gas tractor.

Although this more flexible allowance to convert low and mid roof tractors to mid or high roof tractors is being adopted as an interim provision, we have not established an end date at this time. We expect to reevaluate this provision as manufacturers begin to make use of and may decide to revise it in the future, potentially to make it a permanent allowance. To be eligible for this option, the secondary manufacturer must be a small manufacturer and the original low or mid roof tractor must be covered by a valid certificate of conformity. The modifications may not increase the frontal area of the tractor beyond the frontal area of the equivalent high roof tractor paired with a standard box van.

See also Section III.C.5 of the Preamble to the final regulation.

**Organization:** Daimler Trucks North America LLC

**Elimination of the vocational engine limitation that is no longer necessary in Phase 2** - The agencies propose to remove the prohibition against the use of vocational engines in tractors, given that the performance of the engine would be appropriately reflected in GEM regardless which engine certification procedure was used to certify the engine. We agree that, with the engine properly represented in GEM, there is less need for the prohibition on vocational-only certified engines in tractors. In fact, the agencies' reasoning shows why the engine-based standards on the FTP or RMC tests are so outdated: the true in-vehicle emissions are represented by the full-vehicle standard. 80 FR 40251. [EPA-HQ-OAR-2014-0827-1164-A1 p.30]

**Proposed Heavy-Haul Tractor Definition** - The agencies request comment on the proposed heavy-haul tractor definition, including whether Gross Vehicle Weight Rating (GVWR) OR Gross Axle Weight Rating (GAWR) would be a more appropriate metric to differentiate between a heavy-haul tractor and typical tractor. 80 FR 40233. In discussions with the EPA, we originally had suggested using GVWR as a surrogate for Gross Combination Weight Rating (GCWR), given that the vehicle purchaser inputs GCWR while GVWR is calculated from items that are on the vehicle—making GVWR harder a metric to game than GCWR. However, as we dug deeper into the question of whether GVWR or GCWR is better for the regulations, for example analyzing our sales numbers by the agencies' proposed heavy-haul definitions and by a definition offered by Paccar, we learned that 1) there was not a one-to-one relation between GVWR and GCWR, with some vehicles designed for high GCWR having relatively low GVWR and vice versa, and more importantly 2) our computer system does use GCWR in such a way that a vehicle purchaser would penalize himself if he chose an inaccurately high GCWR in order to avoid having a vehicle regulated as a standard tractor. In conclusion, we think that the agencies' general proposal for a GCWR-based definition of heavy haul will work, as will Paccar's, although each one will catch a slightly different set of vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.33]

So although either the GCWR- or GVWR-based proposals will work, the question is whether the actual definitions properly catch all of the intended vehicles. As we analyze our vehicles, trying to match vehicles that we expect to be categorized as heavy-haul with those that are, we find several ways to improve the definition. First, the total gear reduction of 57:1 is too high. It will exclude many vehicles that, by our standards, would be heavy-haul. Second, the weight of 120,000 lb. or more (note that, as we discussed with the agencies, many heavy-haul vehicles are specified at 120,000 lb. exactly, so the correct definition is not “over 120,000 lb.” as the agencies propose but “120,000 lb. or more”) is so high that it misses many heavy-haul vehicles. We think that 105,000 lb., which catches 105,500 lb. to 120,000 lb. vehicles and those originally in the agencies' proposal, is better. This broader weight definition catches a very small number of US vehicles (0.1 to 0.9% of the vehicles, depending on other factors) but catches the large number of Canadian vehicles that are heavy-haul, as shown below. Third, when we look at the vehicles excluded from the heavy-haul category by the use of the agencies' proposed requirements for a 2 million in-lb. RBM or rail/liner combination plus 57:1 total gear reduction, we see that the RBM and gear reduction criteria exclude a lot of vehicles that are rated to haul either 105,000 lb. or 120,000 lb. and thus are heavy-haul vehicles. [EPA-HQ-OAR-2014-0827- 1164-A1 P.33-34]

In conclusion, we propose to go with just a 105,000 lb. GCWR-based definition without a requirement for an RBM or gear reduction; the manufacturers, in building vehicles capable of hauling such a GCWR will do what it takes to meet the hauling requirements, whether through a particular RBM and gear reduction or otherwise. [EPA-HQ-OAR-2014-0827-1164-A1 P.34]

[The tables, showing the percentage of vehicles matching heavy haul criteria at 120,000 lbs or more versus 105,000 lbs or more, in the US and Canada, can be found on p.34 of EPA-HQ-OAR-2014-0827-1164-A1]

We have invited the agencies to participate in a meeting to go through our vehicle categorization data, and we reiterate our invitation. [EPA-HQ-OAR-2014-0827-1164-A1 P.34]

**Proposed Exclusions from the Phase 2 Tractor Standards** - The agencies seek comment on whether the proposed rolling 21,000 sales volume limit for special purpose tractors is set at an appropriate level looking into the future. 80 FR 40214. First, we wish to note that we think the agencies are correct in choosing not to apply a sales volume limit to heavy haul vehicles. The agencies are working toward a good definition of these vehicles, as well as reasonable standards for the vehicles, and therefore have no reason to limit the use of the heavy haul provisions to a fixed number of vehicles. Regarding special purpose tractors, we think that with the addition of heavy haul vehicles, there will be less need for a sales volume limit on special purpose tractors. But in the absence of a finalized definition for the heavy haul vehicle, we cannot say how many special purpose tractors there will be. In Phase 1, we sold nearly the sales volume limit of special purpose tractors, indicating that it would be inappropriate for the agencies to lower the limits unless the definition of a heavy haul vehicle were very broad. We wish to work with the agencies further to understand 1) the final heavy haul definition and 2) how this affects the size of special purpose tractor sales volume limit that would be needed to satisfy the industry's need for such vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.131-132]

**Proposed Exclusions from the Phase 2 Tractor Standards** - The agencies discuss two possible approaches for second stage manufacturers that build custom sleepers, that the vehicles be considered 1) as dromedary vehicles or 2) if the manufacturer changed the cab, but not the frontal area of the vehicle, then it could retain the aerodynamic bin of the original tractor. 80 FR 40214. Our main concern is to clarify that where the primary manufacturer has certified a vehicle as a day cab, the second stage manufacturer's actions do not draw the primary manufacturer into noncompliance. In many cases, we do not know a priori that a vehicle will be altered by a second stage manufacturer; we have simply sold (for example) a long wheel base tractor like any other long wheel base tractor. Given the extremely large number of companies that buy our vehicles and alter them or add components to perform the vehicles' intended tasks, we cannot monitor each company to see if it is (for example) adding a sleeper that will enlarge the frontal area. Rather, we sell vehicles as compliant and essentially our obligation ends there (albeit with warranty requirements, etc.). Either way that the agencies propose to regulate these secondary vehicle manufacturers is fine, as long as we the primary vehicle manufacturers can continue to sell vehicles with the expectation that anyone changing them from the compliant state in which we built them will certify those changes. [EPA-HQ-OAR-2014-0827-1164-A1 p.132]

**Response:**

EPA is adopting the proposed regulatory language in 40 CFR 1037.601(a)(1) that states it is a violation to introduce into U.S. commerce a *Phase 1* tractor containing an engine not certified for use in tractors; or to introduce into U.S. commerce a vocational vehicle containing a light heavy-duty or medium heavy-duty engine not certified for use in vocational vehicles.

For the FRM, EPA and NHTSA are revising the heavy-haul tractor provisions to better assure that vehicles are regulated in an appropriate subcategory. Based on our assessment of CBI data provided by a manufacturer, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S. Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios.

The agencies evaluated the sales cap limit proposed for special purpose tractors and the comments addressing the issue of a sales cap. EPA calculated the number of vocational tractors certified in MY 2014 and MY 2015. The number of tractors ranged between approximately 2,600 and 6,200 per year per manufacturer that certified special purpose tractors, but not all manufacturers utilized this provision.<sup>133</sup> From this, we can conclude that none of the manufacturers are utilizing this provision near the maximum allowable level in Phase 1. We also believe that there is more incentive for manufacturers to use the special purpose tractor provisions in Phase 1 because of the relative difference in stringency between the tractor and vocational programs is much greater in Phase 1 than in Phase 2. We therefore concluded that there is significantly less incentive for the manufacturers to reclassify tractors that are not truly special purpose tractors as vocational vehicles. In addition, the Phase 2 vocational vehicle compliance program and standards better represent the duty cycles expected of these vehicles and are predicated on performance of similar sets of vehicle technologies, except for aerodynamic technologies, as the primary tractor program. Therefore, we are adopting Phase 2 special purpose tractor provisions without a sales cap.

In response to these comments, EPA is clarifying in 40 CFR 1037.622 that small businesses may modify tractors as long as they do not modify the front of the vehicle and so long as the sleeper compartment is no more than 102 inches wide or 162 inches in height. As an interim provision, to allow for a better transition to Phase 2, EPA is finalizing a more flexible compliance path in 40 CFR 1037.150(r). This option allows small manufacturers to convert a low or mid roof tractor to a high roof configuration without recertification, provided it is for the purpose of building a custom sleeper tractor or for conversion to a natural gas tractor. Although this more flexible allowance to convert low and mid roof tractors to high roof tractors is being adopted as an interim provision, we have not established an end date at this time. We expect to reevaluate this provision as manufacturers begin to make use of and may decide to revise it in the future, potentially to make it a permanent allowance. To be eligible for this option, the secondary manufacturer must be a small manufacturer and the original low or mid roof tractor must be covered by a valid certificate of conformity. The modifications may not increase the frontal area of the tractor beyond the frontal area of the equivalent high roof tractor paired with a standard box van. See generally Section III.C.5 in the Preamble to the final rule.

**Organization:** Navistar, Inc.

Navistar supports creating a new Heavy Haul sub-category as this type of vehicle is specified uniquely and is not designed for standard trailers. To appropriately identify the vehicles for this category, the proposed total gear reduction ratio of 57:1 should be revised to 53:1. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

4x2 tractors with heavy duty powertrains are typically purchased to pull multiple trailers. These tractors should be classified as Class 8 vehicles regardless of their GVWR. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

**Response:**

For the FRM, EPA and NHTSA are revising the heavy-haul tractor provisions to balance the certainty that vehicles are regulated in an appropriate subcategory. Based on our assessment, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S.

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<sup>133</sup> U.S. EPA. Memo to Docket: Special Purpose Tractor Production Volumes.

Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios.

Also for the FRM, EPA adopted regulations (40 CFR 1037.106(f)) that allow manufacturers to optionally certify 4×2 tractors with heavy heavy-duty engines to the standards and useful life for Class 8 tractors, with no restriction on generating or using emission credits within the Class 8 averaging set.

**Organization:** PACCAR, Inc.

PACCAR requests that the definition of special purpose tractors in §1037.630 be maintained as it is for Phase 1. The provision for gross combination weight rating of over 120,000 lb. should be retained since not all heavy hauling vehicles will meet all the requirements of a heavy-haul tractor but will meet the requirements for the Special Purpose Tractor and therefore OEMs should have the option to include them in this vehicle family. A modification to the definition to include “equal to 120,000 GCWR” is also requested. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

PACCAR supports the current sales limit for vocational tractors at 21,000 per OEM over a 3-year period. [EPA-HQ-OAR-2014-0827-1204-A1 p.30] PACCAR also supports removing the prohibition on the installation of vocational engines into tractors where these engines are appropriate for the customer’s application. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Definitions**

In the definition of “heavy haul tractors,” PACCAR has several suggestions. First, Total Reduction ratio should be 53:1 not 57:1 based on transmission and rear axle ratio combinations that are typically used in heavy-haul tractors meeting the agencies’ definition. Specifically, the ratio change will allow vehicles using 9-speed low-low and 18-speed transmissions with appropriate rear axle ratios, plus Allison heavy-duty 4500 and 4700 series automatic transmissions, to be properly included in the Heavy-Haul Tractor regulatory subcategory. The 14.4 first gear of the 18-speed transmission coupled with the 3.73 rear axle ratio is an example of a significant sales volume combination that meets the recommended 53:1 Total Reduction ratio. Second, the Drive Axle Ratio in Table III-19 of the Preamble needs to be increased numerically so that the Total Reduction ratio (lowest transmission gear multiplied by rear axle ratio) matches the heavy haul tractor definition. In the table, the 12.29 first gear ratio for the 13-speed transmission and the 3.55 drive axle ratio yield a 43.6:1 Total Reduction ratio. Changing the rear axle ratio to 4.31 would reach the 53:1 definition that PACCAR is recommending. Third, an automatic transmission torque converter ratio should be included in the Total Reduction ratio calculation to properly incorporate the slip and first gear ratio combination that is inherent in an automatic transmission. A ratio of 1.5:1 should be the minimum recommended ratio for consideration as the bottom of the range for torque converter ratios, with 2.0:1 being a more fitting ratio at the middle of the range for heavy-haul automatic transmissions. Fourth, the definition of heavy-haul should be revised to be “equal to or greater than 120,000 lb. GCWR” rather than “over 120,000 GCWR.” PACCAR agrees with the agencies’ approach that all heavy-haul tractors should be combined into a single subcategory regardless of roof height/configuration. [EPA-HQ-OAR-2014-0827-1204-A1 p.31]

**Response:**

EPA is maintaining the definition of special purpose tractors in 40 CFR 1037.630 for Phase 1, with the exception of including tractors with a GCWR equal to 120,000 pounds.

EPA is retaining the 21,000 special purpose tractor three-year sales cap for Phase 1.



EPA is adopting the proposed regulatory language in 40 CFR 1037.601(a)(1) that states it is a violation to introduce into U.S. commerce a *Phase 1* tractor containing an engine not certified for use in tractors; or to introduce into U.S. commerce a vocational vehicle containing a light heavy-duty or medium heavy-duty engine not certified for use in vocational vehicles.

EPA and NHTSA are revising the heavy-haul tractor provisions to balance the certainty that vehicles are regulated in an appropriate subcategory. Based on our assessment, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S. Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios. See generally Section III.C.4.a to the Preamble to the final rule.

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Heavy-Haul Tractor Definition

EPA's proposed specifications for heavy-haul tractors are unworkable. More specifically, the relevant vehicles do not actually meet the Agency's proposed total gear reduction ratio of 57:1 or greater. Even EPA's baseline heavy-haul vehicle only generates a 43.6:1 total reduction, which is well short of the proposed regulatory mark. Consequently, the Agency needs to lower the benchmark total reduction to 53:1. For example, the Allison 7-speed 4700 transmission and the Eaton 9LL products both are specifically designed for heavy-haul operations, but cannot meet the proposed 57:1 ratio. They could, however, meet a 53:1 specification, which is where the heavy-haul requirement should be set. To that end, the agencies should change the rear axle ratio for the baseline vehicle to attain the 53:1 total reduction ratio.<sup>1</sup> [EPA-HQ-OAR-2014-0827-1269-A1 p.43-44]

That said, EMA supports the agencies' proposed approach of not requiring the use of aerodynamic technologies as a component of the proposed Phase 2 heavy-haul tractor standards. Those vehicles are already quite heavy (by virtue of need), are designed to meet high-cooling needs (thus having, for example, large grilles), and generally are not designed for hauling standard trailers on highways. In addition, those vehicles are often designed to be capable of operation off-road or on difficult terrain. Consequently, mandating aerodynamic values (which could push manufacturers toward smaller grilles) or aerodynamic components (which are often unsuitable for difficult terrain) could compromise the vehicles' work. [EPA-HQ-OAR-2014-0827-1269-A1 p.44]

In addition, the agencies should revise the definition of "heavy-haul tractor" to be "equal to or greater than 120,000 pounds GCWR" rather than "greater than 120,000 pounds GCWR." The specifications for the heavy-haul market start with and include 120,000 pounds GCWR. [EPA-HQ-OAR-2014-0827-1269-A1 p.44]

#### Special Purpose Tractors

There is a group of special purpose tractors with a gross combination weight rating ("GCWR") over 120,000 pounds that needs to be accounted for in a separate and distinct manner. Those special-purpose vehicles, in essence, fall in between the regulatory categories for heavy-haul tractors and Class 8 tractors. Such vehicles are still appropriately categorized as "Specialty Tractors" and should be included at the manufacturer's option in the Vocational Tractor family, even though they may not meet the total gear reduction requirement (which, as noted above, should be 53:1, not 57:1), or the frame rail RBM requirements. Accordingly, the 120,000 GCWR metric should remain as a sufficient defining criteria for Vocational/Specialty Tractors. [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

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1 In addition, an automatic transmission torque converter ratio should be included in the total reduction ratio calculation to properly incorporate the slip and first gear ratio combination that is inherent in automatic transmissions. A ratio of 1.5:1 should be considered as the bottom of the range for torque converter ratios, with 2.0:1 being a more suitable ratio at the middle of the range for heavy-haul automatic transmissions.

**Response:**

EPA and NHTSA are revising the heavy-haul tractor provisions to better assure that vehicles are regulated in an appropriate subcategory. Based on our assessment, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S. Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios. With these Phase 2 changes to the proposed heavy-haul tractor definition, all tractors that would have been considered as Special Purpose Tractors in Phase 1 due to the GCWR criteria listed in EPA's 40 CFR 1037.630 and NHTSA's regulation at 49 CFR 523.2 will now qualify as heavy-haul tractors in Phase 2. Therefore, we no longer believe that it is necessary for heavy-haul tractors to be treated as Special Purpose Tractors. See generally Section III.C.5 of the Preamble for additional discussion.

EMA's comments about aerodynamic limitations for heavy-haul tractors largely echo the agencies' own concerns voiced at proposal. After considering these comments, the agencies are using a technology package that does not use aerodynamic improvements in setting the Phase 2 heavy-haul tractor standards, as we proposed.

**Organization:** Volvo Group

The agencies have proposed to add a heavy haul category to Class 8 tractors. We support this addition since heavy haul tractors require large engines and increased cooling capacity. In addition, most heavy haul rigs have some requirement for off-road access to pick up machinery, bulk goods, and unusual loads. For all these reasons, it is infeasible or ineffective to add many aerodynamic features to heavy haul vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.45]

**Heavy Haul Tractor Subcategory**

Volvo Group supports the agencies' proposal to provide for a heavy haul tractor regulatory subcategory; however, and in support of the EMA comments, Volvo Group proposes a gross combination weight rating of greater than or equal to 120,000 lbs. and a total gear reduction at or above 53:1. In addition, Volvo Group has concerns regarding the drive cycle weighting for the heavy haul subcategory (19% transient, 17% 55 mph, and 64% 65 mph cycles). [EPA-HQ-OAR-2014-0827-1290-A1 p.45]

In reality, there are multiple types of heavy-haul tractors, each with their own specific characteristics based on operational considerations: high-roof highway sleeper tractors pulling box vans at or above 120k GCWR (e.g. long combination vehicles) that run regional and long-haul operations and can benefit from the same technologies as high-roof sleepers with 80k GCWR and should be credited for the higher payload, low- and mid-roof sleepers that primarily run long-haul routes (e.g. pulling low-boy trailers and heavy equipment), low-roof day cab tractors running regional and shorter routes (e.g. bulk haul), and then what the industry typically refers to as heavy-haul that are extremely high GCWR and can haul above 300 metric tons and sometimes run in multiple tractor configurations that provide for one or more tractor(s) pulling and one or more tractor(s) pushing. [EPA-HQ-OAR-2014-0827-1290-A1 p.45-46]

Volvo Group does not agree that certain segments of the heavy-haul population are appropriately represented by the baseline and technology packages for each stringency step. These types of vehicles typically utilize an 18-speed transmission, since they require the very close gear ratios (as the agencies noted in their technology assessment), would not likely be able to utilize even current SmartWay tires, let alone Level 2 and 3 tires as proposed in the penetration rates, would see no benefit from predictive cruise, sometimes utilize an auxiliary transmission for further reduction or closer ratios, and nearly all heavy-haul tractors have deeper drive axle ratios than the agencies have assumed (3.55). [EPA-HQ-OAR-2014-0827-1290-A1 p.46]

Lastly, Volvo Group does not agree with the proposal in Section III.D.3.d.i “Proposed Heavy-Haul Tractor Standard” that the engine installed in a heavy-haul tractor must meet the tractor engine standard defined in 40 CFR 1036.108. [EPA-HQ-OAR-2014-0827-1290-A1 p.46]

Since the agencies have given the ability for a broad definition of a heavy-haul tractor, but limited that tractor to a day cab tractor duty cycle and tractor engine standard, there is still a significant segment of the heavy-haul market which is unaccounted for. We request that the agencies add a Vocational Heavy-Haul Tractor subcategory that allows for a heavy-haul tractor which benefits from the utilization of a powertrain optimized to meet the vocational operational requirements of this segment, a technology package corresponding to those operational characteristics, and with a corresponding duty cycle and, most importantly, a payload representative of heavy-haul operation. We also request the agencies be clearer on what they perceive to be a “heavy-haul” tractor. Volvo would like to continue to work with the agencies to further define the heavy-haul tractor sub-category and any definition of an additional “Vocational” heavy-haul tractor sub-category. [EPA-HQ-OAR-2014-0827-1290-A1 p.46]

#### Vocational Tractor Production Limit

During the development of the Phase 1 regulation Volvo Group proposed and led the way for the creation of the Vocational Tractor subcategory. In addition, Volvo Group offered many suggestions on how to identify and categorize these vehicles in order to avoid gaming. The final proposal was based on vocational tractor characteristics and can be outlined as follows: [EPA-HQ-OAR-2014-0827-1290-A1 p.49]

1. Vocational specific model – Volvo VHD, Mack Granite, Titan, and TerraPro Or,
2. GCWR > 120,000k Or,
3. Any three of the following
  1. Configuration other than 4\*2, 6\*2, 6\*4
  2. >14.6k FAL
  3. >46k RAL
  4. >3.00:1 OAR in trans high range
  5. >57.00:1 OAR in trans low range
  6. RBM >=2e6 in\*lbs.
  7. >=20° approach angle
  8. >=14” ground clearance as measured from the lowest point of any chassis mounted component [EPA-HQ-OAR-2014-0827-1290-A1 p.49]

The first item denotes any vehicle designed specifically as a vocational vehicle and for any off-road operation. These vehicles typically meet many of the criteria from item 3. [EPA-HQ-OAR-2014-0827-1290-A1 p.49]

The second item was based on the EPA provision to allow for heavy-haul tractors to be categorized as vocational due to their operational considerations. This option will no longer be available in Phase 2 with the creation of the Heavy-Haul Tractor subcategory. [EPA-HQ-OAR-2014-0827-1290-A1 p.49]

The last item was a list of vocational tractor and vehicle characteristics that make a vehicle suitable for off-road operation and the specific tractor in question had to meet at least three of these criteria. Due to the unsuitability of the majority of these characteristics for line haul operation, especially in terms of fuel economy and ride comfort, as well as the significant added costs for these features, the agencies understood that they would provide little opportunity for gaming due to negative incentives to specify a vehicle with these features for purely highway operation, and even noted some of the Volvo proposed characteristics in the Phase I rule. [EPA-HQ-OAR-2014-0827-1290-A1 p.49-50]

Unfortunately, EPA and NHTSA could not gain consensus on these features from other OEMs since, at the time, they were utilizing several models as highway and vocational and could not commit to this approach. Thus, the EPA instituted a volume limit on the number of tractors that could be certified as vocational tractors. [EPA-HQ-OAR-2014-0827-1290-A1 p.50]

In Volvo Group's opinion, this volume limit is overly constraining and burdensome and should be removed. Given the recent product lineup overhauls across the industry we do not believe that there are many models still on the market that are sold in large numbers into both highway tractor and vocational tractor segments, nor is there sufficient reason that any OEM cannot identify specific vehicle attributes in order to classify a tractor as suitable solely for highway use, or on/off-road use. Given the stringencies proposed in Phase 2, it is not likely that many vehicles will be able to meet the demands of both applications. As well, the agencies have made no mention of any OEM incorrectly or intentionally misapplying the Vocational Tractor provision in order to game the system. [EPA-HQ-OAR-2014-0827-1290-A1 p.50]

For these reasons Volvo Group proposes that the agencies remove the vocational tractor volume restrictions and employ a guideline based on the aforementioned vehicle characteristics, as they have done with the Heavy-haul Tractor subcategory on a much more limited basis. [EPA-HQ-OAR-2014-0827-1290-A1 p.50]

**Response:**

The agencies are adopting heavy-haul tractor standards for Phase 2. Volvo's comments about aerodynamic limitations for heavy-haul tractors largely echo the agencies' own concerns voiced at proposal. After considering these comments, the agencies are using a technology package that does not use aerodynamic improvements in setting the Phase 2 heavy-haul tractor standards, as we proposed.

EPA and NHTSA are revising the heavy-haul tractor provisions to balance the certainty that vehicles are regulated in an appropriate subcategory. Based on our assessment, the tractors with GCWR greater than or equal to 120,000 pounds truly represent heavy-haul applications in the U.S. Therefore, we are adopting criteria only based on GCWR, not the proposed RBM or total gear reduction ratios or the requirement to include a heavy heavy-duty tractor engine. With these Phase 2 changes to the proposed heavy-haul tractor definition, all tractors that would have been considered as Special Purpose Tractors in Phase 1 due to the GCWR criteria listed in EPA's 40 CFR 1037.630 and NHTSA's regulation at 49 CFR 523.2 will now qualify as heavy-haul tractors in Phase 2. Therefore, we no longer believe that it is necessary for heavy-haul tractors to be treated as Special Purpose Tractors. See Section III.C.5 of the Preamble to the final rule for additional discussion.

The agencies have revised the baseline heavy-haul tractor to use an 18-speed transmission and a numerically higher axle ratio to better reflect the drivelines used in these types of tractors. After considering the other technology comments and the information regarding the tire rolling resistance improvement opportunities, the agencies have adjusted the adoption rate of low rolling resistance tires.

The agencies considered Volvo's request for an additional heavy-haul vocational subcategory and analyzed the expected technology package differences between the vocational and tractor program. As described in Section III.D.1 of the FRM Preamble, the agencies are only adopting technologies in the heavy-haul tractor category that would be applicable to the operation of these vehicles. For example, we are not adopting standards that are premised on any improvements to aerodynamics or extended idle reduction. Therefore, we concluded that there is not a need to develop another vocational subcategory to account for heavy-haul tractors.

The agencies also reviewed Volvo's suggested criteria for Special Purpose Tractors and concluded that the Phase 1 approach and the existing criteria are working well; therefore, we do not foresee the need to adopt more restrictive criteria. The agencies are adopting in Phase 2 provisions (but not revising Phase 1) in EPA's 40 CFR 1037.630 and NHTSA's regulation at 49 CFR 523.2 to only allow the following two types of vocational tractors to be eligible for reclassification to Special Purpose Tractors by the manufacturer:

- (1) Low-roof tractors intended for intra-city pickup and delivery, such as those that deliver bottled beverages to retail stores.
- (2) Tractors intended for off-road operation (including mixed service operation), such as those with reinforced frames and increased ground clearance.

The agencies evaluated the sales cap limit proposed for special purpose tractors and the comments addressing the issue of a sales cap. EPA calculated the number of vocational tractors certified in MY 2014 and MY 2015. The number of tractors ranged between approximately 2,600 and 6,200 per year per manufacturer that certified special purpose tractors, but not all manufacturers utilized this provision.<sup>134</sup> From this, we can conclude that none of the manufacturers are utilizing this provision near the maximum allowable level in Phase 1. We also believe that there is more incentive for manufacturers to use the special purpose tractor provisions in Phase 1 because of the relative difference in stringency between the tractor and vocational programs is much greater in Phase 1 than it will be in Phase 2. Upon further consideration, we concluded that there is significantly less incentive for the manufacturers to reclassify tractors that are not truly special purpose tractors as vocational vehicles as a pathway to a less stringent standard in Phase 2 primarily due to the fact that the Phase 2 vocational vehicle program stringency is more in line with the tractor program stringency. In addition, the Phase 2 vocational vehicle compliance program and standards better represent the duty cycles expected of these vehicles and are predicated on performance of similar sets of vehicle technologies, except for aerodynamic technologies, as the primary tractor program. Therefore, we are adopting Phase 2 special purpose tractor provisions without a sales cap. See generally Section III.C.5 of the Preamble for additional discussion.

## **4.5 Compliance Provisions and Flexibilities for Tractor Standards 863**

**Organization:** A de F Limited

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 169-170.]

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<sup>134</sup> U.S. EPA. Memo to Docket: Special Purpose Tractor Production Volumes.

EPA, it appears, took the approach to carve up the combination tractor-trailer into two regulatory phases. In the first phase, a tractor manufacturer offers a coefficient of drag for their tractor, which in the case of our product is buried within that number and not quantified. Yet, it is known to be a significant contributor in lowering drag.

In the second phase, a collection of various products, largely aerodynamic, are encouraged to be incorporated into a trailer to reach the desired increase in efficiency. The truck and the trailer do not operate independent of one another. Making them more incorporated as a single efficient unit is the ultimate goal. However, EPA collects a coefficient of drag from the manufacturer for their tractor and then relies on its certification methodology for its trailers.

**Response:**

The agencies have developed regulations that regulate the tractor separately from the trailer for several reasons. First, the manufacturers of the tractor are different entities than those that manufacture trailers. Requiring tractor manufacturers to certify to a proper trailer configuration is thus both unnatural and unfair. The applicable principle, which EPA has applied in numerous certification contexts, is that the entity with most control over the particular vehicle segment due to producing it should normally be the entity which certifies. See 73 FR 59115. Second, tractors and trailers are not typically purchased together. Third, a specific tractor is rarely paired with a specific trailer in-use throughout its life. The agencies have adopted aerodynamic protocols that have the ability to quantify the impact of technologies, such as wheel covers, on the aerodynamic drag of the tractor and trailer independently.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Chassis testing of tractor and vocational vehicles

ACEEE supports the agencies' proposal that tractor and vocational vehicle manufacturers annually chassis test some of their production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production (*p. 40190*). ACEEE in its 2011 report recommended physical testing (road, track, or chassis dynamometer) for a basic set of well-defined vehicle configurations.<sup>1</sup> The results of these tests should be public information. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

Such a requirement can benefit the heavy-duty vehicle program greatly by: [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

1. Helping to make further changes to the GEM model that will improve its accuracy in projecting real-world effectiveness of fuel efficiency technology packages, and [EPA-HQ-OAR-2014-0827-1280-A1 p.7]
2. Generating extensive data on vehicle performance that could be used by researchers to evaluate the program. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

*Recommendation: Chassis testing requirements*

- Finalize the requirement that manufacturers provide results from annual chassis testing of a small number of vehicles. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]
- Provide the results of this testing to the public in a usable format. [EPA-HQ-OAR-2014-0827-1280-A1 p.7]

## Tractor trucks

### Road grade in GEM certification

ACEEE supports the agencies' proposal to include road grade in the constant speed cycles used in vehicle certification. Significant road grade is common much of the country. Driving through the grade demands more power from the engine and hence increases fuel consumption. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

The grade profile discussed in the proposal was developed by Southwest Research Institute on a 12.5 mile stretch of restricted-access highway during on-road tests. The agencies have requested comment on related work done by the National Renewable Energy Laboratory (NREL). We agree with NREL's concern that a cycle that requires constant speeds (55-mph and 65-mph) on positive and negative grades misrepresents the real-world operation of MD/HD trucks, because there is a strong correlation between road grade and average speed for these vehicles<sup>11,12</sup>. The agencies should address this issue before adopting the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1280-A1 p.14]

### Measurement issues

We support the agencies' proposal to shift to wind-averaged drag in the calculation of CdA. This step is necessary to capture the benefits of certain aerodynamic improvements whose primary function is to reduce drag with non-zero yaw. Such devices can provide substantial real-world savings, so the standards should promote their adoption. [EPA-HQ-OAR-2014-0827-1280-A1 p.15]

We take this opportunity to comment on an adjustment EPA proposes to the Phase 1 measurement of Cd. Phase 1 does not call for the measurement of wind-averaged drag but offers manufacturers the option of using wind-averaged drag, together with a downward adjustment factor, to estimate Cd for compliance purposes. Due to an error in the agencies' specified adjustment factor, however, manufacturers using this option are currently generating unwarranted fuel efficiency and GHG credits. The discrepancy is significant. In order not to lose benefits of the program through the application of credits that do not correspond to real-world savings, the agencies should as soon as possible correct the factor applied to wind-averaged drag to generate Cd values for Phase 1 compliance. [EPA-HQ-OAR-2014-0827-1280-A1 p.15-16]

### *Recommendations: Tractor aero measurement issues*

- Include wind-averaged drag, as proposed, in the final measurement protocol for tractor CdA measurement. [EPA-HQ-OAR-2014-0827-1280-A1 p.16]
- At the earliest opportunity, correct the factor applied to wind-averaged drag to generate Cd values for Phase 1 compliance. [EPA-HQ-OAR-2014-0827-1280-A1 p.16]

### Standard trailer for tractor certification

The agencies seek comment on the proposed Phase 2 standard trailer configuration (p.40245). While the agencies' decision to use a more aerodynamic trailer as the standard trailer than in Phase 1 is welcome, the proposed improvement is not sufficient. The wind tunnel testing results shown in Table 3-10 of the RIA indicates that the addition of a skirt to a trailer achieves a delta CdA of approximately 0.5 on a high roof sleeper. This suggests that the proposed Phase 2 standard trailer is a Bin IV trailer ("advanced skirt or tail," according to the characterization in RIA Table 2-70).<sup>13</sup> However, by the time the standard trailer is updated in 2021, the agencies' compliance package assumes an average delta CdA = 0.66, considerably

better than that of the new standard trailer. By 2027, the compliance package has average delta CdA = 1.1. To the extent that the tractor manufacturers seek to design tractors to tow the more aerodynamic trailers coming into the market over the course of Phase 2, keeping the standard trailer static could be counterproductive. In fact, it does not seem realistic to expect that all tractors would necessarily admit testing with a standard trailer, as advanced aerodynamic designs call for more dramatic changes in cab shape. [EPA-HQ-OAR-2014-0827-1280-A1 p.16]

We recommend that, at a minimum, tractor OEMs be given the option of testing with a trailer more advanced than the proposed standard trailer. This option would help to promote the integration of tractor and trailer, which represents an enormous opportunity for savings in the longer term. Volvo's SuperTruck project reports that it has already achieved approximately 6% drag reduction from "co-optimization" of tractor and trailer and anticipates additional drag reductions of over 10% from "integrated design."<sup>14</sup> Major gains in tractor-trailer efficiency through improved aerodynamics will eventually allow these trucks to far surpass the 2027 standards. In discussing the Peterbilt SuperTruck project, which is said to have achieved a 25% gain in fuel economy through aerodynamic improvements, the agencies observe: "This effort represents the first step in the evolution of improving the aerodynamic efficiency of tractor-trailer by radically redesigning today's tractor-trailer combination, as a wholly integrated system rather than each component, tractor and trailer, independently." (RIA p.2-23) The RIA (p.2-24) also discusses Lawrence Livermore National Laboratory's advanced aerodynamic research, which developed a prototype tractor-trailer designed to achieve 50 percent reduction in aerodynamic drag. [EPA-HQ-OAR-2014-0827-1280-A1 p.16]

While the standards perhaps should not anticipate that that transition will occur by 2027, Phase 2 should facilitate the transition by promoting full tractor-trailer integration. The current requirement that tractors be tested using a standard box trailer cannot recognize integration and therefore cannot promote it. [EPA-HQ-OAR-2014-0827-1280-A1 p.16-17]

Allowing manufacturers to test their tractors with advanced trailers would yield results reflecting the aerodynamic gains of both tractor and trailer, as well as their integration. To prevent double counting of the drag reductions provided solely by the more advanced trailer under this option, the result of testing would need to be corrected using a "delta CdA" approach, as is discussed in the proposal in connection with trailer aero. Specifically, a manufacturer could assign tractor X to a given bin if CdA of tractor X with aerodynamic trailer + delta CdA of aerodynamic trailer met the bin threshold. Note that the value of second term in this expression would be available from compliance testing for the aerodynamic trailer, so this approach would not increase the test burden on the tractor manufacturer. [EPA-HQ-OAR-2014-0827-1280-A1 p.17]

While tractor X might not always be paired with an aerodynamic trailer in operation and thus might not realize the calculated benefit (just as any tractor might operate with a trailer less aerodynamic than the standard box trailer), manufacturers and purchasers of advanced tractors presumably would seek to ensure that the correct pairings were made as a matter of course. As the agencies note, "tractor-trailer pairings are almost always optimized." (p.40245) Furthermore, the value of a meaningful incentive to accelerate the aerodynamic integration of tractors and trailers likely outweighs potential costs in fuel savings of mismatched tractors and trailers. However, if the possibility of unrealized benefits poses an obstacle to allowing certification with an advanced trailer, the agencies could require that tractors so certified be used only with advanced trailers and that this requirement be indicated on the tractor label. [EPA-HQ-OAR-2014-0827-1280-A1 p.17]

It should be noted that trailer manufacturers are already given the latitude to test with any tractor of Bin III or better: [EPA-HQ-OAR-2014-0827-1280-A1 p.17]



In order to maintain a minimal level of performance, we are proposing that tractors used in trailer aerodynamic tests meet Phase 2 Bin III or better tractor requirements (see Section III.D.). We believe the majority of tractors in the U.S. trucking fleet will be Bin III or better in the timeframe of this rulemaking, and trailer manufacturers have the option to choose higher performing tractors in later years as tractor technology improves. (p. 40280) [EPA-HQ-OAR-2014-0827-1280-A1 p.17]

Tractor manufacturers should be accorded this flexibility as well. While allowing such flexibility on the tractor side, as well as for the trailer, might appear to invite double counting of tractor-trailer integration benefits that is not the case. If the trailer manufacturer has already taken credit for integration through this mechanism, that trailer's delta CdA will have been elevated as a result. Hence the (upward) correction of the tractor's CdA will be greater, and the tractor OEM will gain no integration credits in this situation. [EPA-HQ-OAR-2014-0827-1280-A1 p.17]

*Recommendation: Standard trailer for tractor certification*

- To promote integration of aerodynamically advanced tractors and trailers, provide manufacturers the option to test tractors with advanced trailers; correct the test result appropriately to account for the benefit provided by the trailer alone. [EPA-HQ-OAR-2014-0827-1280-A1 p.17]

Standard tractor for trailer certification

The Phase 2 proposal would permit manufacturers to test their trailers with tractors meeting Phase 2 Bin III or better (p. 40280). This will allow trailer manufacturers to gain credit for integration with tractors as both tractor and trailer aerodynamics evolve. Above we recommend that tractor manufacturers be given a comparable flexibility in their choice of test trailer while noting that a trailer already certified to a higher delta CdA by virtue of such integration would negate any integration benefits on the tractor side. This is appropriate, since double counting of integration benefits cannot be permitted. However, tractor manufacturers may be far more likely than trailer manufacturers to pursue the development of integrated tractor-trailer aerodynamic designs, so the availability of an integration credit on the trailer side does not diminish the need for such a credit on the tractor side. [EPA-HQ-OAR-2014-0827-1280-A1 p.18-19]

*Test trailer*

The comments of Volvo Trucks (p.20) state: "Either the agencies must reduce the aerodynamic targets for tractors or provide for a test trailer with advanced aerodynamics, including, at a minimum, an efficient boat-tail and side skirts." While we do not support the view that the proposed aerodynamic targets are too demanding when the prescribed test trailer is used, making the standard trailer for testing tractors more aerodynamic makes sense. As Volvo says (p.27), "The test trailer should represent an advanced aerodynamic design that meets the 2027 trailer targets so that future tractors are designed to operate efficiently with future trailers and the combinations can achieve the desired aerodynamic performance." Yet, by 2021, the average trailer will have better aerodynamics (delta CdA = 0.66) than the proposed standard trailer (delta CdA = 0.5). By 2027, the average trailer will achieve delta CdA = 1.1. This trailer would reduce the drag of the 2027-compliant tractor (high roof sleeper with standard trailer, CdA = 5.32) by more than 20%. [EPA-HQ-OAR-2014-0827-1896-A1 p.12]

An insufficiently aerodynamic standard trailer forgoes an incentive for manufacturers to pursue certain improvements in the tractor and elsewhere in the vehicle. As one example, Daimler notes that lower vehicle drag allows greater benefits for its eCoast technology ([http://energy.gov/sites/prod/files/2015/07/f24/arravt080\\_vss\\_rotz\\_2015\\_o.pdf](http://energy.gov/sites/prod/files/2015/07/f24/arravt080_vss_rotz_2015_o.pdf) slide 8). As another example, an aerodynamic trailer will reduce vehicle load, which may permit the use of a smaller engine.

A more representative standard trailer will also yield better estimates of the benefits of various technologies. [EPA-HQ-OAR-2014-0827-1896-A1 p.12]

Updating the standard trailer to include an Advanced Combination (skirt and boat tail) gives delta CdA = 1.0 on average (RIA Table 2-70), which approaches the standard for box trailers in 2027. Alternatively, rather than specifying additional aerodynamic devices for the standard trailer, the agencies could simply increase the required delta CdA for the standard trailer to 1.0 and leave it to the manufacturers to select a test trailer. [EPA-HQ-OAR-2014-0827-1896-A1 p.13]

When updating the standard trailer, the agencies will need to make a corresponding (downward) adjustment to the CdA of the tractor-trailer in the compliance package and hence increase the stringency of the tractor truck standard. Otherwise, the effect of updating the trailer would be to demand less improvement from the tractor, which is counterproductive and not the intent of our comment. If the test trailer had delta CdA = 1, for example, rather than the proposed standard trailer of delta CdA= 0.5, then the high-roof tractor compliance package for 2021 should achieve CdA = 5.24, rather than the CdA = 5.74 of the proposal. This adjustment offsets the aerodynamic benefit from the trailer alone, but recognizes any savings achieved through co-optimization of the tractor and trailer. [EPA-HQ-OAR-2014-0827-1896-A1 p.13]

In addition to incentivizing co-optimization, this change to the standard trailer would make it feasible to achieve drag levels better than those in the compliance package. Volvo asserts (comments p.27; table replicated below) that its SuperTruck tractor would reach only bin IV (CdA = 5.43) with the proposed Phase 2 standard trailer, falling slightly short of the 2027 target (CdA = 5.32). However, the table shows that Volvo's SuperTruck tractor paired with its Super Trailer would achieve CdA = 4.31. A Volvo SuperTruck presentation ([http://energy.gov/sites/prod/files/2014/07/f17/vss081\\_amar\\_2014\\_o.pdf](http://energy.gov/sites/prod/files/2014/07/f17/vss081_amar_2014_o.pdf), slide 10) suggests that this result is achieved through trailer add-on devices followed by co-optimization. The graphic (replicated below) suggests that co-optimization alone reduces CdA by about 0.27, which is more than sufficient to meet the 2027 target, even after the target has been adjusted to reflect the trailer add-on devices. [EPA-HQ-OAR-2014-0827-1896-A1 p.13]

[Figure can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

[Figure, 'Complete Vehicle Aerodynamic Optimization', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1896-A1]

Beyond bringing the standard trailer up to date, the agencies should consider allowing manufacturers to test tractors with still more advanced trailers; this would promote integration of tractor and trailer. In this case, the modeled fuel efficiency of the tractor would need to be adjusted upward to reflect the delta CdA of the aerodynamic trailer (relative to the standard trailer). [EPA-HQ-OAR-2014-0827-1896-A1 p.14]

Hence, we recommend that the agencies redefine the standard trailer as one having delta CdA matching the average for the appropriate model year. The tractor standard stringency should then be adjusted accordingly. In addition, the agencies should consider allowing testing with more advanced/integrated trailers. [EPA-HQ-OAR-2014-0827-1896-A1 p.14]

1 Khan and Langer. 2011. "Heavy-Duty Vehicle Fuel Efficiency and Greenhouse Gas Emissions: The 2014-2019 Standards and a Pathway to the Next Phase." ACEEE Research Report T113. <http://aceee.org/research-report/t113>.

11 Khan, A.S., and Clark, N.N., 'An Empirical Approach in Determining the Effect of Road Grade on Fuel Consumption from Transit Buses,' SAE International Journal of Commercial Vehicle, Vol. 3, No. 1, pp. 164-180, December 2010

<sup>12</sup> EPA GHG Certification of Medium- and Heavy-Duty Vehicles: Development of Road Grade Profiles Representative of US Controlled Access Highways. NREL/TP-5400-63853, May 2015

<sup>13</sup> The agencies should clarify whether the proposed Phase 2 standard trailer is in fact a Bin 3 trailer.

<sup>14</sup> Amar 2014. DOE Annual Merit Review. ([http://energy.gov/sites/prod/files/2014/07/f17/vss081\\_amar\\_2014\\_o.pdf](http://energy.gov/sites/prod/files/2014/07/f17/vss081_amar_2014_o.pdf)).

#### *Tractor aerodynamic selective enforcement audit and confirmatory testing*

In a memo referenced in the NODA, EPA clarified how a vehicle would be determined to pass or fail in selective enforcement audit (SEA) and confirmatory testing of its certified aerodynamic drag (CdA).<sup>3</sup> The EPA memo is responsive to comments of the manufacturers and others regarding the proposed elimination of the compliance margin in these testing processes in Phase 2. It proposes that multiple coastdown tests be performed in SEA or confirmatory testing, and that the vehicle would fail if and only if the testing showed with high statistical confidence that the vehicle lay in a lower-numbered (higher drag) aerodynamic bin than the one to which it had been certified. [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

The proposed approach represents a significant improvement over the one-bin compliance margin in Phase 1. However, it should be further improved by setting the threshold in the statistical test at the bin midpoint, rather than at the upper limit of the bin. Bin limits in the proposal appear to be based on the range of benefits from defined improvements in aerodynamic design or equipment, so a bin midpoint might best represent the result of a typical implementation of those aerodynamic improvements, making it a suitable threshold for the statistical test. Moreover, the bin midpoint is the GEM CdA input for a tractor certified to the given bin, so the midpoint is the proper value for purposes of SEA and confirmatory testing. Using the proposed procedure, by contrast, CdA values could be expected to accumulate around the upper limits of the bins. Tractor bins cover a range of drag values of about 0.5 m<sup>2</sup>, or roughly 10 percent of CdA values; so the half bin between the bin midpoint and upper bin threshold is roughly 5 percent of a typical CdA value. Five percent increase in long-haul tractor-trailer drag increases fuel consumption by about 2 percent. Hence using the upper bin limit in SEA or confirmatory testing would overstate tractor emissions reductions under the standards by about 2 percent. [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

#### Impact on proposal

The proposed SEA and confirmatory testing procedure would improve upon the current procedure but would still overstate the emissions reductions resulting from the standards. To ensure that the real world benefits of the rule are maintained, we recommend that the approach discussed in the EPA memo be revised to require that the average confirmatory or SEA test results be no higher (statistically) than the midpoint, rather than the upper limit, of the appropriate bin. [EPA-HQ-OAR-2014-0827-1896-A1 p.3]

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1 EPA-HQ-OAR-2014-0827-1623/NHTSA-2014-0132-0185.

2 EPA-HQ-OAR-2014-0827-1624/NHTSA-2014-0132-0186

3 EPA-HQ-OAR-2014-0827-1625/NHTSA-2014-0132-0188.

**Response:**

*Chassis Testing*

The agencies are finalizing the tractor chassis test requirement largely as proposed. EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. The recent experience with Volkswagen is an unfortunate instance. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM. Even though there will be no direct compliance liability for the GHG testing, the agencies would still be able to identify differences in performance that resulted (on purpose or inadvertently) from how the powertrain is installed in the chassis.

*Road Grade*

After considering the road grade profile comments and using the NREL database, the agencies have independently developed a road grade profile for the final rules for use in the 55 mph and 65 mph highway cruise duty cycles for the Phase 2 final rulemaking. While based on the same road grade database generated by NREL for U.S. restricted-access highways, its design is predicated on a different approach. The development of this profile is documented in the RIA Chapter 3.4.2.1. The road grade in the final rules includes a stretch with zero percent grade and lower peak grades than the profile presented in the NODA. The minimum grade in the final cycle is -5 percent and the maximum grade is 5 percent. The cycle spends 46 percent of the distance in grades of +/- 0.5 percent. Overall, the cycle spends approximately 66 percent of the time in relatively flat terrain with road gradients of +/- 1 percent. A detailed discussion of the road grade profile is included in RIA Chapter 3.4.2.1.

*Drive Cycle*

After considering these comments and evaluating the final Phase 2 version of GEM, the agencies in the Phase 2 final rules are retaining a constant target speed for the 55 mph and 65 mph cycles, thus continuing this aspect of the Phase 1 approach. However, the addition of road grade to these cruise cycles in Phase 2 marks a significant difference with Phase 1. See Preamble Section III.E.2. The addition of road grade to the cruise cycles brings the GEM simulation of vehicles over the drive cycles closer to the real world operation described by ACEEE. Even though the cruise cycles will continue to have constant target speeds (55 mph or 65 mph), the vehicle may slow down from the target speed of the cycle on an uphill stretch of road due to the addition of road grade in the Phase 2 cycles. If the vehicle does slow down the transmission shift logic built into GEM will downshift the transmission to limit the amount of further vehicle deceleration. Similarly, on the downhill portions of the cycles, the driver control logic built into GEM will allow the vehicle to exceed the target speed by 3 mph prior to braking the vehicle.

*Aerodynamic Test Procedures*

The commenter suggested that the agencies adopt wind averaged drag aerodynamic assessments in Phase 2. We proposed and are adopting aerodynamic test procedures that take into account the wind averaged drag performance of tractors in Phase 2.

Phase 1 Aerodynamics Equation: EPA proposed a different equation with a ratio of 0.8330 in 40 CFR 1037.525(d) for the case of full yaw sweep measurements to determine wind-averaged drag correction as an amendment to the Phase 1 program. Some commenters argued that this change would impact stringency of the Phase 1 standard, but we disagree because manufacturers are already subject to EPA compliance using both methods (full yaw sweep and  $\pm 6$  degree measurements), and this Phase 1 flexibility was not used in setting the level of the Phase 1 standards. Nevertheless, we are adopting the final rule without amending this part of the Phase 1 rules. Commenters persuasively indicated that any such amendment to the Phase 1 rules at this date could upset compliance plans predicated on the rules remaining un-amended. These expectations and reliance are legitimate, and the agencies accordingly are not amending this aspect of the Phase 1 rules. However, the agencies evaluated the status of Phase 1 credit balances in 2015 by sector.<sup>135</sup> For tractors, we found that manufacturers are generating significant credits, and that it appears that many of the credits result from their use of an optional provision for calculating aerodynamic drag. However, we also believe that manufacturers will generate fewer credits in MY 2017 and later when the final Phase 1 standards begin. Still, the agencies believe that manufacturers will have significant credits balances available to them for MYs 2021-2023, and that much of these balances would be the result of the test procedure provisions rather than pull ahead of any technology. Therefore, we are increasing the stringency of the CO<sub>2</sub> and fuel consumption tractor standards for MYs 2021-2023 by 1 percent to reflect these credits (see Preamble Section III.D.1b.xiii).

The agencies re-evaluated the proposal to include trailer skirts on the Phase 2 reference trailer after consideration of the comments. We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer as proposed. However, we also want to recognize that the trailer fleet will continue to evolve over the lifetime of tractors built and certified to Phase 2, especially from MY 2027 and later. Based on testing conducted to support the trailer portion of Phase 2, we found that on average a boat tail added to a dry van trailer with skirts reduces wind averaged C<sub>d</sub>A by 0.6 m<sup>2</sup>. We recognize that if we do not account for reduced aerodynamic loads in the real world, then we may not be appropriately evaluating the tractor powertrain. We considered changing the standard trailer in MY 2027; however, this would lead to significant testing burden for the tractor manufacturers because they would have to determine new C<sub>d</sub>A values for their entire fleet of tractors. Instead, we are adopting Phase 2 GEM that beginning in MY 2027 will take the C<sub>d</sub>A input for each vehicle and reduce it by 0.3 m<sup>2</sup> to reflect the lower aerodynamic loads that are a mix of trailers with skirts and trailers with skirts and boat tails. This change has been accounted for in both the baseline and standard setting of the CO<sub>2</sub> emissions and fuel consumption values.

Unlike the trailer program where the C<sub>d</sub>A assessment is in terms of *differences* in C<sub>d</sub>A, the tractor program utilizes the *absolute* C<sub>d</sub>A result from testing. This difference in program structure requires the agencies to treat the standard tractor in the trailer program and the standard trailer in the tractor program uniquely. The impact of the test procedure allowance in the trailer program to use standard tractors that are Bin III or better is appropriately offset by the fact that the tractor aerodynamic performance is constant between the “A” test with no trailer aerodynamics and the “B” test with the trailer being certified. However, in the tractor program, a similar allowance that permitted tractor manufacturers to test with a standard trailer “with equivalent or better aerodynamic performance” would lead to a direct

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<sup>135</sup> U.S. EPA. Memo to Docket. ‘Phase 1 Credit Balance Analysis.’ Docket # EPA-HQ-OAR-2014-0827.

reduction in the tractor absolute  $C_dA$  performance and unfairly put the tractor in a more aerodynamic bin. Therefore, it is crucial in the tractor program that the standard trailer be well-defined and constant.

With respect to ACEEE's recommendation for the agencies to facilitate the transition to more integrated tractor-trailers, such as those demonstrated with SuperTruck, the agencies believe this would require a significant change in tractor-trailer logistics to encourage more matching of specific tractors to specific trailers in operation. We believe that this would be most appropriately handled through the Off-Cycle Credit program.

The agencies used the aerodynamic test data included in the NODA to determine the Phase 2 aerodynamic bin boundaries. As shown in the RIA Chapter 3.2.1.2, the tractors tested fell into Bins III and IV. From there, the agencies evaluated additional aerodynamic technologies that could be used to move the best performing tractor tested by EPA into the more aerodynamic bins and used this assessment in developing one technology package used in developing the stringency of the tractor standard.

EPA is adopting SEA provisions for aerodynamics that do not include a one bin compliance margin. However, the aerodynamic bin structure was created such that any tractor that has a  $C_dA$  value that fell within the bin boundaries is treated as compliant with that bin. We are not adopting provisions for SEAs that would essentially require manufacturers to only use the more aerodynamic half of the bin. Therefore, we are adopting the SEA provisions that consider the SEA as a "pass" if the results of the test show that the tractor falls at or below the highest  $C_dA$  boundary of the certified bin. See Section III.E.2.a.ix of the Preamble for discussion on the SEA provisions.

**Organization:** American Trucking Associations (ATA)

### **Drive Cycle Weightings Need to be Re-Evaluated**

The proposed rule indicates drive cycle weightings of 5% of the transient cycle, 9% of the constant speed 55 mph cycle, and 86% of the constant speed 65 mph cycle for sleeper cabs. For day cabs, the weightings are 19% of the transient cycle, 17% of the constant speed 55 mph cycle, and 64% of the constant speed 65 mph cycle. ATA believes these weightings are not reflective of real world operations and tend to overestimate the benefits of certain technologies, such as aerodynamics and rolling resistance, and potentially discount others. [EPA-HQ-OAR-2014-0827-1243-A1 p.18]

As discussed in Appendix 2, using 3.6 million spot speed records collected from throughout the U. S. during the month of May 2015, trucks operated at speeds of 55 mph or greater 57% of the time. This is significantly lower than the weightings being used by EPA (95% of the time for sleeper cabs and 81% of the time for day cabs). As shown below, the benefits from a 20% reduction in the aerodynamic drag coefficient ("Cd") diminishes as speed decreases. The power loss (and benefits) associated with the rolling resistance coefficient ("Crr") of tires also diminishes as speed decreases. [EPA-HQ-OAR-2014-0827-1243-A1 p.18]

[Chart, 'Tractor-Trailer Operating Losses', can be found on p.19 of docket number EPA-HQ-OAR-2014-0827-1243-A1]<sup>16</sup>

Given the relationship between vehicle speed and technology benefits, it is imperative that EPA and NHTSA develop drive cycle weightings that are representative of real-world operating conditions. The agencies should consult with the American Transportation Research Institute to determine how available data can be used to characterize the speeds at which trucks actually operate and incorporate this

information into the speed weightings and technology assessments. [EPA-HQ-OAR-2014-0827-1243-A1 p.19]

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16 National Research Council, Transportation Research Board, Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles (2010).

**Response:**

The agencies considered these comments along with the information that was used to derive the drive cycle weightings in Phase 1. The agencies believe that the study cited by ATA includes weightings of speed records, which represent the fraction of *time* spent at a given speed. However, our drive cycle weightings represent the fraction of *vehicle miles traveled* (VMT). The agencies used the vehicle speed information provided in the ATA comments and translated the weightings to VMT. Based on our assessment discussed in RIA Chapter 3.4.3, their findings produce weightings that are approximately 74 percent of the vehicle miles traveled are at speeds greater than 55 mph and 26 percent less than 55 mph. In addition, the study cited by ATA represents “Class 8 trucks” which would include day cab tractors (with drive cycle weightings in Phase 1 and 2 of 19 percent at speeds less than 55 mph and 81 percent at speeds greater than 55 mph), sleeper cab tractors (with drive cycle weightings in Phase 1 and 2 of 5 percent at speeds less than 55 mph and 95 percent at speeds greater than 55 mph), and heavy heavy-duty vocational trucks (with drive cycle weightings in Phase 2 ranging between 20 percent and 54 percent at speeds less than 55 mph). Based on this assessment, the agencies do not believe this new information is significantly different than the drive cycle weightings that were proposed. Therefore, we are adopting the drive cycle weightings for tractors that we adopted for Phase 1 and proposed for Phase 2.

**Organization:** California Air Resources Board (CARB)

**Comment – Making the constant speed test procedure the reference aerodynamic method**

The RIA requests comment whether the constant speed test procedure should be the reference aerodynamic method. CARB staff believes the constant speed test procedure should not be made the reference method until it can be demonstrated to be superior to the coastdown type methods. The constant speed test procedure requires invasive and costly vehicle modifications in preparation for testing. Namely it requires installation of physical torque meters in either multiple wheel hub positions or in a custom driveshaft location. Nevertheless, while CARB staff believes it is pre-mature at this time to deviate from the accepted industry practice of the coastdown method, we also believe the constant speed procedure holds merit as a potential alternative to the coastdown method. CARB staff looks forward to working with U.S. EPA and NHTSA to examine the full potential and applicability of the constant speed procedure. [EPA-HQ-OAR-2014-0827-1265-A1 p.119]

**Response:**

After consideration of all of the comments, the agencies are continuing to use the Phase 1 approach of establishing coastdown testing as the reference method for aerodynamic assessment in Phase 2. See Section III.E.2.a of the Preamble and RIA Chapter 3.2 for the Phase 2 aerodynamic assessment discussion.

**Organization:** Caterpillar Inc., et al.

**Protocols must be clearly defined and accommodate production and test variability**

There are a number of new or updated test procedures in the Phase 2 proposal including aerodynamic coast-down, fuel mapping procedure, powertrain test procedure, rear axle efficiency, Selective Enforcement Audits (SEA), and in-use chassis dyno testing. The current proposal does not include compliance margins for modified or new procedures, such as aerodynamic and engine fuel map audits. To reduce some of the variability that is inherent in the proposed test procedures, we recommend that the agencies perform confirmatory and SEA tests using the same method and location that the manufacturer used to certify the vehicle or component. Furthermore, we have worked with the agencies to improve the accuracy of the procedures, for example we have recommended the inclusion of the yaw angle in the coast-down procedure to reduce the impact of wind conditions. To account for the remaining variability, compliance margins must be included in the Phase 2 regulation. If not corrected, these issues will subject manufacturers to risks simply as a result of expected test variation that can only be mitigated by downgrading our declared certifications to levels significantly worse than the actual test results, so as to cover the range of production and test variability. We estimate these issues have the impact of raising the de facto targets by approximately 12.5%; that is, we need to achieve 36.5% efficiency improvement to meet the stated 24% target for high-rise sleeper tractors. [EPA-HQ-OAR-2014-0827-1215-A1 p.8]

**Response:**

The agencies have made several changes to the aerodynamic test procedures for the final rule to reduce test-to-test variability. Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA$ s and solicited supplemental comment on it. This new structure reflects an approach that would be consistent with the following principles:

- Test-to-test variability for individual coastdown runs can be high, so compliance determinations should be based on average values from multiple runs.
- Coastdown testing of a single vehicle is expensive and time consuming, so testing should focus more on repeat tests for the same vehicle than on tests for multiple vehicles. However, manufacturers should not be required to conduct more than 100 valid coastdown runs on any single vehicle.
- Compliance determinations should be based on whether or not the true value for the  $C_dA$  falls within the bin to which the vehicle was certified, rather than on whether or not the true value for the  $C_dA$  exceeds the value measured for certification.
- Given the limited ability to eliminate uncertainty, compliance determinations should consider the statistical confidence that a true value lies outside a bin.

Commenters were generally very supportive of these principles and the proposed structure.

We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing (or on testing that does not account for legitimately occurring test-to-test and performance variability). Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur.

Under this approach, EPA would select a production vehicle for coastdown testing, and the manufacturer would be required to perform up to 100 valid coastdown runs to demonstrate whether or not the vehicle was certified to the correct bin. EPA will address uncertainty in the measurement using a confidence



interval around the mean  $C_dA$  value. For example, the result of the testing could be a  $C_dA$  value of  $5.9 \pm 0.05$ , which would fall entirely within Bin III. If the vehicle had been certified to Bin III or lower, this would be considered a passing test. If it had been certified to Bin IV or higher, this would be considered a failing test. For each vehicle that fails, the manufacturer would be required to test two additional vehicles up to a maximum of 11 vehicles. Manufacturers would have the option to select the same vehicle configuration, or they could choose to have EPA select another configuration within the family. It is appropriate to allow manufacturers the opportunity to retest the same failed configurations because they would only do so where there had reasonable confidence that the failure did not accurately reflect the true value.

It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility.

In selecting the original configuration and subsequent selections, EPA would likely consider vehicles with measured  $C_dA$  values near the top of the bin since they could be most likely to be mis-certified based on inaccurate results. However, EPA could select any configuration. For subsequent testing if the first vehicle fails, manufacturers would be allowed to retest the same configuration (but not the same exact vehicle). EPA believes this would not decrease the risk of failure for subsequent vehicles, but could allow a manufacturer the opportunity to show its design was actually compliant.

With respect to confirmatory testing, which is testing EPA conducts during certification rather than during production, EPA has generally considered its test results to be the official test results. However, we recognize that we need to treat confirmation of a manufacturer's  $F_{alt-aero}$  differently because small changes in its value would be spread over an entire family. Therefore, EPA is adopting an interim provision that would apply the SEA confidence interval approach for confirmatory testing with respect to  $F_{alt-aero}$ . EPA would also attempt to use the same test trailers, test locations, and instrumentation that the manufacturer. Nevertheless, we expect to revisit this issue in the future.

The agencies have also improved the engine test procedures and compliance provisions to reduce the agencies' and the manufacturers' uncertainty of engine test results. For example, in the agencies' confirmatory test procedures we are requiring that the agencies use the average of at least three tests (i.e., the arithmetic mean of a sample size of at least three test results) for determining the values of confirmatory test results for any GEM engine fuel maps. This is in contrast to the agencies' usual convention of utilizing a sample size of one for confirmatory testing. This at least triples the test burden for the agencies to conduct confirmatory testing, but it also decreases confirmatory test result uncertainty by at least 42 percent.<sup>136</sup> Based on improvements like this one, and others described in Section 1.4 of the RTC, we believe that SET, FTP and GEM's steady-state, cycle-average and powertrain test results will have an overall uncertainty of +/-1.0 percent. To further protect against falsely high emissions results or false failures due to this remaining level of test procedure uncertainty, we have included a +1 percent compliance margin into our stringency analyses of the engine standards and the GEM fuel map inputs

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<sup>136</sup> The statistical formula for standard error, which is a well-accepted measure of uncertainty, is the standard deviation times the reciprocal of the square root of the sample size. For a sample size of three, the reciprocal of the square root of three is approximately 0.58, which results in a 42% reduction in uncertainty, versus a sample size of one.

used to determine the tractor and vocational vehicle standards. In other words we set Phase 2 engine and vehicle standards 1 percent less stringent than if we had not considered this test procedure uncertainty.

**Organization:** Cummins, Inc.

*Cummins supports the development of representative road grades for the vehicle GHG/FE program*  
[EPA-HQ-OAR-2014-0827-1298-A1 p.37]

The initial Phase 2 proposed road grade profiles (see Figure 15) do not contain sufficient grade to fully exercise the vehicle powertrain, and the grade distributions do not match that of real world roads. The data in Figure 15 do not have a normal distribution of grades and only span a range of +/-2%. Data of North American roads suggest a distribution of road grades of +/-6%. The agencies have recently suggested alternative road grades (see Figure 16) that are more representative of the roads that HD vehicles encounter. Cummins supports further Agency discussions to establish more representative road grades that better represent the North American highway system. [EPA-HQ-OAR-2014-0827-1298-A1 p.37]

[Figure 15 and 16 can be found on p.37 and 38 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

**Response:**

After considering the road grade profile comments and using the NREL database, the agencies have independently developed a road grade profile for the final rules for use in the 55 mph and 65 mph highway cruise duty cycles for the Phase 2 final rulemaking. While based on the same road grade database generated by NREL for U.S. restricted-access highways, its design is predicated on a different approach. The development of this profile is documented in the RIA Chapter 3.4.2.1. The road grade in the final rules includes a stretch with zero percent grade and lower peak grades than the profile presented in the NODA. The minimum grade in the final cycle is -5 percent and the maximum grade is 5 percent. The cycle spends 46 percent of the distance in grades of +/- 0.5 percent. Overall, the cycle spends approximately 66 percent of the time in relatively flat terrain with road gradients of +/- 1 percent. A detailed discussion of the road grade profile is included in RIA Chapter 3.4.2.1.

**Organization:** Daimler Trucks North America LLC

**In-use aero testing, § 1037.401(b):** The EPA proposes unrealistic in-use aero tests, contrary to the well-established procedures developed for IUT of engines. In engine IUT, the EPA recognizes that it would be unfair to a manufacturer to test an engine when its owner has improperly maintained it, but in the proposed aero IUT the EPA provides vehicle manufacturers no such protection. Moreover, the EPA proposes to allow itself to use any aero test procedure with no margin for compliance. Truck aero testing is subject to variability and the uncertainty of test results is compounded if the EPA can choose any test procedure--even one that the manufacturer never used. Even in engine IUT, the test procedure (the PEMS) is constrained to something with which manufacturers have familiarity. To expect that, in the case of aerodynamics, manufacturers would either become familiar with all possible test procedures, and their impact on all vehicle, or would build into every vehicle's GEM values a buffer against any aero test--when the EPA did not use such a buffer in setting standards--is not realistic. The EPA should rectify this situation by 1) constraining IUT to the test procedure(s) that the manufacturer used to derive a particular vehicle's bin and 2) assigning a realistic compliance margin of 5%, which (based on the EPA's own data) is the test-to-test variability and in turn the smallest margin that reflects statistical confidence in the differences between the agency's tested value and the manufacturer's. [EPA-HQ-OAR-2014-0827-1164-A1 p.8]

Proposal for aerodynamic Selective Enforcement Audit (SEA) procedures (EPA-HQ-OAR-2014-0827-1625, NHTSA-2014-0132-0188):

We appreciate the EPA's recognition that "[w]ith coastdown testing, ... test-to-test variability is expected to be larger relative to production variability" than for other types of testing subject to SEAs and "[c]oastdown testing of a single vehicle is expensive and time consuming" such that important changes are necessary relative to the longstanding SEA principles. We appreciate the EPA's use of a bin approach that recognizes test-to-test variability by not expecting the SEA test value of a vehicle to exactly mirror the originally submitted test value but instead to fall within the appropriate bin. And we appreciate the agency's having proposed some improved procedures relying only on statistically significant results. Moreover, we agree that similar issues apply to confirmatory tests, so we agree with the EPA's approach of focusing such tests on  $F_{alt-aero}$  and of relying only on statistically significant results. [EPA-HQ-OAR-2014-0827-1918-A2 p.8]

We further appreciate the EPA's willingness to work with us to minimize disruption for customers. Each vehicle is custom built for a purchaser who has waited for the vehicle and needs it to complete a job. We cannot simply grab the next vehicle on the assembly line and give it to the disrupted customer. At the same time, coast-down testing and the preparation for that testing takes a long time and must be done at a specific track, the reservation of which must be done a long time in advance. So finding a way to do the testing yet minimize the disruption is very important. [EPA-HQ-OAR-2014-0827-1918-A2 p.8]

In the proposed regulation § 1037.301(d)(1)(i), the EPA proposes to require that manufacturers coastdown a vehicle "in its production configuration." The data submitted to the agencies as part of certification, however, involve putting each vehicle at a predefined tractor-trailer gap of  $45 \pm 2$  inches, in order to reduce test burden for every actual gap. The regulations should state that we either test at the regulatory gap or use good engineering judgment to correct actual tests to reflect test results if we used the regulatory gap. (We generally have "rule of thumb" estimates for the increase in  $Cd^*A$  due to a particular increase in gap). [EPA-HQ-OAR-2014-0827-1918-A2 p.8]

Making available any  $F_{alt-aero}$  vehicle for EPA audits: We agree with the agencies' approach in 1037.201(g). The agencies recognize that we cannot store indefinitely a large number of test vehicles, nor can we guarantee that on any given day we will have exactly the configuration of vehicle that the EPA demands in 1037.201(g). Rather, if the EPA intends to require testing of a lot of full-scale vehicles, either through coast-down or constant-speed testing, the EPA should understand that we need to sell some of those vehicles. In turn the EPA should agree to work with manufacturers to find acceptable test vehicles at acceptable times, which perhaps means that the EPA's first choice of vehicle is not available on the day the agency requests it. But the agencies have proposed that manufacturers be able to produce similar vehicles, not the original test vehicles. We agree with this approach. 1037.201(g) / 80 FR 40617 [EPA-HQ-OAR-2014-0827-1164-A1 p.10]

#### 1. SEAs, generally

**Aero audits and compliance:** The test procedures dictate the need for additional compliance margins. The agencies propose to authorize audits of vehicles' aerodynamics with no compliance margin. 40 C.F.R. §§ 1037.150(k) and 1037.401(b) (proposed). However, in setting stringencies for vehicle standards, the agencies did not consider the safety margin that manufacturers would need in order to certify under such a regime, thus making the agencies' proposed standards impossibly stringent. The variability of coast-down testing is on the order of  $\pm 5\%$ , based on the EPA's test data using our Cascadia vehicle under very controlled conditions (low wind, the same flat test track, skilled driver, and so on). (See the chart below, showing the EPA's measured data plotted relative to DTNA's measurement

of the same vehicle) If the EPA expects a manufacturer to certify vehicles with no safety margin in the rules to account for this 5% variability, then the manufacturers will have to certify vehicles at 5% above their true Cd\*A. In turn, the agency's stringency numbers need to be decreased to reflect the fact that what the agency believes is achievable improvements in aerodynamic minus the 5% safety margin is all that can go into GEM. Alternatively, and better for the EPA, is to recognize the variability in audit procedures and to say that a vehicle fails an audit if it's Cd\*A is more than 5% above the certified level. 1037.150(k) [EPA-HQ-OAR-2014-0827-1164-A1 p.6-7]

[The graphic, displaying Relative Cd\*A(-) versus Temperature, can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

**Aero SEAs needs to operate in the manner proposed by the EMA** - First, the EPA needs to add in a compliance margin or else to relax the emission standards, as manufacturers would need to use compliance margins to account for the test-to-test variability associated with truck aero testing--yet the EPA did not factor such margins into the standard setting, thus rendering the agency standard values unachievable. In addition, the EPA's proposal to have SEAs involve testing two or six additional vehicles, beyond those originally planned for testing, is untenable. Testing will have to take place at a specific track in Cape Canaveral, Florida, given the constraints on test facilities. There is no guarantee the Cape Canaveral facility will be available for the life of the phase 2 program. And data analysis takes time. For manufacturers to know that vehicles might fail an SEA (e.g., due to test-to-test variability inherent in truck aero procedures) and to get two or six additional vehicles out to the test facility within a test window is not possible. Rather the EPA should 1) assign a realistic compliance margin, as the agency did in Phase 1, and 2) allow realistic SEA procedures like testing another vehicle at a later date. 1037.301(d), 80 FR 40623. [EPA-HQ-OAR-2014-0827-1164-A1 p.7-8]

**Audits using constant speed testing** – Similar to the previous comment, the agencies propose to adopt procedures for constant speed testing and, as we understand the NPRM and our subsequent discussions with the EPA, to allow for confirmatory tests and SEAs using the constant-speed test procedure. Having vehicles auditable through a procedure with which we are not familiar is very problematic: we cannot ensure compliance if we are not familiar with the test. There is no time to properly study if constant speed testing is equivalent or better than coast down testing to determine the aerodynamic drag coefficient. The complex and time consuming test procedure would require multiple studies to determine the reproducibility of the results and comparison to results from coast down test. We recommend that the constant speed as an alternative or allow more time to study the proposed procedure. In the meantime, we recommend that the agencies confirm that the constant speed test is an alternative procedure for use solely at the manufacturer's discretion. [EPA-HQ-OAR-2014-0827-1164-A1 p.55-56]

### **Chassis Dynamometer Tests**

The agencies must find a more reasonable approach for the In-Use Testing (IUT) requirements in § 1037.665. Although we support the agencies' efforts to validate that FE improvements from the regulatory realm translate to actual on-road improvements, the agencies' proposed method is burdensome yet will not get the agencies the information they purport to want. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

· **Unnecessary Burden of In-Use Tractor Testing With Chassis Dyno** - We support auditing vehicles. However, the In-Use Testing (IUT) requirements in § 1037.665 are burdensome and will not get the EPA the information the agency purports to want, a validation that GEM's measured trends are observed in the real world. In particular, regarding burden: the agencies note that there are few heavy-duty chassis test sites in the country. We do not have one, and we are the largest manufacturer of heavy-

duty vehicles in the country. Other manufacturers may have them, and indeed the agencies' state that they "have seen an increased interest in building new sites." 80 FR 40178. However, we are not aware of any of our competitors building them. (They may be doing so, but we are not aware of it). We do know that the "EPA is currently building a heavy-duty chassis dynamometer." Id. If the agency decides to push forward with chassis dyno testing then, with the EPA having a facility and some or all manufacturers not, the best course of action is for the EPA to test vehicles in its facility rather than requiring the manufacturers to do so, or to work with industry on developing other methods of validating GEM results. We would be more than willing to support the agency in performing tests at its facility, helping with the set-up and preconditioning of the vehicles, etc. On a more minor level, the agency should clarify that the stated production volumes are annual, as the time frame over which the 20,000 applies is unstated. 80 FR 40657. [EPA-HQ-OAR-2014-0827-1164-A1 p.11]

· **Chassis Dynamometer Testing Costs** - The agencies request comment on the costs (and efficacy) of the chassis dyno data submission requirement. 80 FR 40178. (Efficacy is addressed in the next comment, below). Although Daimler Trucks North America is the largest heavy-duty vehicle manufacturer in the country and has some of the most expansive test facilities, including the industries only full-scale wind tunnel, we do not have a chassis dyno facility that is capable of the type of measurements that the agencies propose to require of manufacturers. Moreover, we would need to build such a facility and expect that it would cost us the same as it costs the EPA, who is building such a facility right now. While we are not certain how much that is, the agency should know better than us. But in any case, costs are in the millions of dollars, and facilities would be needed to test only five vehicles per year on a test cycle that fails to replicate the on-road operation of vehicles. In other words, this would be a costly way to get data; it is not cost effective. [EPA-HQ-OAR-2014-0827-1164-A1 p.11]

· **Efficacy of Chassis Dyno Testing and Better Alternatives** - The EPA and NHTSA propose chassis dyno testing with the explanations that the agencies 1) need to validate the GEM simulation tool on a continuous basis and 2) foresee the need to continue to track the progress of the Phase 2 program throughout its implementation. We strongly support validating GEM and tracking the Phase 2 program to ensure that real-world FE improvements translate into the regulatory realm and vice versa. The agencies request comment on the efficacy of their proposed requirement that manufacturers conduct and submit data from annual chassis dynamometer tests of three sleeper cabs tractor and two day cab tractors (and provide corresponding GEM results). Although we support validation and correlation to real-world testing, we wish to ensure that the testing actually validates GEM and actually correlates to real-world FE. [EPA-HQ-OAR-2014-0827-1164-A1 p.11]

Unfortunately, the agencies' proposal will not achieve its aims. In order to be able to track incremental improvements, measurement tools must have the capability to measure with requisite accuracy and repeatability, and the test process must be able to emulate the vehicle features that cause those FE gains. The limited number of existing chassis dynamometer facilities are largely of unknown quality relative to their ability to conduct repeatable, comparable or accurate tests for the purposes intended by EPA. Moreover, chassis dyno testing cannot replicate the real-world conditions like intelligent coasting on grades ("eCoast"), predictively adjusting vehicle speed on hills, adapting ride height at speed, using advanced cooling system controls, etc. In other words, the chassis dyno testing will miss many important FE benefits and consequently should not be expected to correlate to real-world FE improvements. [EPA-HQ-OAR-2014-0827-1164-A1 p.12]

Additionally, without conducting separate tests to re-quantify aerodynamic characteristics and tire rolling resistance (which account for more than 70% of a vehicle's load factor) for the trucks being tested, the tests will capture only powertrain impacts. We do not recommend adding to vehicle manufacturers' workload by requiring that they retest aerodynamics and that they delve into tire testing (which is now the

responsibility of tire manufacturers). But without such testing, the chassis dyno test may as well be a simple powertrain test or, because of the limited gear shifting involved in the drive cycles for linehaul vehicles (see our “Detailed proprietary transmission shift logic” comments below), just an engine test. In short, the testing can be done much more simply. [EPA-HQ-OAR-2014-0827-1164-A1 p.12]

As an alternative that will get at fleet-averaged characteristics as the agencies want, we propose tracking of GEM input data. That is, the agencies better achieve their goal of tracking manufacturers’ progress in improving critical vehicle attributes by tracking those attributes, rather than sampling a limited number of vehicle variants, as the agencies proposed. As another alternative, DTNA recommends that agencies and industry revisit the concept of chassis dyno testing and its potential uses in a cooperative manner through a cooperative program similar in nature to past programs, for example those conducted to establish protocols for in-use emissions measurement. [EPA-HQ-OAR-2014-0827-1164-A1 p.12]

**1.8 % DownsPEEDING credit for GEM** - The agencies propose to credit vehicles whose powertrains allow for downsped operation. 80 FR 40221. The agencies propose that the credits would not be part of a pull-down menu-type or post-processing-type credit but 'demonstrated through the Phase 2 GEM inputs of transmission gear ratio, drive axle ratio, and tire diameter' as well as engine fuel map. Id. We agree that this is the correct approach. And to be clear, although the agencies project that downspeeding will 'improve the fuel consumption by 1.8 percent' (Id.), we understand the agencies are not proposing to give a post-processing-type credit for downsped engines. If we understand correctly, then we agree with the agencies. If however the agencies do plan post-processing credits for vehicles somehow characterized as downsped, then we disagree with the agencies' approach, as it will double-count benefits of technologies and will involve a difficult definition of what exactly is a downsped vehicle. [EPA-HQ-OAR-2014-0827-1164-A1 p.20] [redacted] [EPA-HQ-OAR-2014-0827-1164-A1 p.21]

**Continuing the same tractor categorization** – The agencies propose to continue the same tractor categories, except with the improvement of adding a heavy-haul category. We agree with the agencies. 80 FR 40142. [EPA-HQ-OAR-2014-0827-1164-A1 p.31]

**Heavy-haul Regulatory Sub-Category (RSC) added** - We agree with and strongly support the agencies’ proposal to add heavy-haul regulatory categories. This is very important, certainly in the US where heavy-haul vehicles have been mischaracterized and regulated improperly as normal highway, high-speed vehicles, but particularly in Canada which allows higher weights than the US and has a greater fraction of vehicles designed for heavy-haul operation. [EPA-HQ-OAR-2014-0827-1164-A1 p.33]

**Artificially Biasing Drive Cycles and Weightings** - The agencies describe the fact that for tractors the agencies retain the same weightings of the three speed cycles (the 65 mph, 55 mph, and ARB transient cycles) as in Phase 1. The agencies request comment on the need to include segments of lower or variable speed operation in the nominally 55 mph and 65 mph drive cycles used in GEM and how this may or may not impact the strategies manufacturers would develop. We have discussed at length with the agencies the need to match the regulatory drive cycles to real-world driving. We support the agencies' work with NREL to use real-world data measured on a statistically representative sample of vehicles in order to characterize the actual split between operation at high speeds, mid-speeds, and low speeds and then to weight the various drive cycles accordingly. If the work with NREL shows a different weighting is necessary for some regulatory sub-category, then we support changing to that weighting so as to maintain alignment with real-world operation. That said, we do not see a benefit to increasing the amount of low speed operation for tractors. These vehicles consume the largest portion of their fuel at high speeds and are thus designed around such operation. [EPA-HQ-OAR-2014-0827-1164-A1 p.40-41]

On the other hand, we do see a benefit to allowing increased variability in the vehicle speeds during high speed cycles. In particular, with systems such as Soft Cruise and Predictive Cruise Control, vehicles optimize fuel consumption by allowing deviations from a set cruise speed. The tighter a speed band that a vehicle is forced to maintain, the larger the torque excursions are required to maintain the speed within that band. If a vehicle can slow down and speed up within a larger band around the set cruise speed during hill climbs and descents, the better the vehicle can minimize fuel consumption. So when the agencies create a very narrow acceptable speed band and apply it to engine or powertrain testing, the agencies limit manufacturer's ability to apply a known fuel saving strategy. We recommend further discussion about how to constrain speeds within testing. 80 FR 40242. [EPA-HQ-OAR-2014-0827-1164-A1 p.41]

**Representing Traffic** - The agencies request comment on whether we should consider varying the vehicle target speed over the 55 mph and/or 65 mph duty cycles to simulate human driver behavior reacting to traffic congestion. 80 FR 40242. DTNA believes that, for regulatory purposes, using constant speed cycles with representative long haul road grade profiles are appropriate. In fact, DTNA uses the same type of drive cycles for internal development purposes. First, we run actual test vehicles over a number of long-haul routes that we frequently use (and that we have come to understand are representative of nationwide average driving) to prove out the real world effect of each technology's fuel consumption reduction potential. Second, we run simulations on the same routes in various DTNA simulation tools for the purposes of validation as well as projection of future fuel economy improvements. These routes, tested and simulated, are largely highway routes with minimal time spent stuck in traffic. We have found very good correlation between these two development approaches and support the agencies in adopting the proposed approach for the high speed drive cycles in GEM. In short, we do not see any value in implementing traffic related information into GEM. While varying traffic patterns certainly occur in the real world it would be extremely difficult to come up with traffic patterns that represent a national average. We believe that a regulatory simulation tool should not get into this kind of, in this case unnecessary, detail. [EPA-HQ-OAR-2014-0827-1164-A1 p.41]

**Empty Weight and Payload Used in GEM** - The agencies propose to carry over the empty weight and payload from Phase 1 to Phase 2. 80 FR 40242. These weights were based on data from in-use vehicles. There is, of course, a large spread in weights across any one regulatory subcategory given the variety of different features that a vehicle might incorporate, in order to perform its task. So it is difficult to say that the agencies the exact weight correct or to refute the agencies' weight estimates. That said, the agencies' estimated Class 8 sleeper cab tractors are heavier than ours but seem to match with some of our competitors' vehicles. So these seem to be reasonable. The day cab weights, however, might be about 500 lb. too high, perhaps from underestimating the average weight of a sleeper. The deltas from high to mid- and low-roof in both sleeper and day cabs seems reasonable, again given the large variety of vehicles. The payload weight is even harder to pin down, given that weights can change from good economic times to bad, and given that a number of carriers (like [redacted]) are trying to minimize dead volume thus driving weight per load up. Due to this trend, the agencies might consider increasing the payload weight for the regulatory subcategories. [EPA-HQ-OAR-2014-0827-1164-A1 p.50-51]

**Weight reduction credits, specifically** - Hoods and fairings are not credited enough for the difference between steel and thermoplastic; for example, a thermoplastic hood is not a mere 65 lb. less than a steel one. § 1037.520 Table 4. [EPA-HQ-OAR-2014-0827-1164-A1 p.51]

**Weight reduction credit for <15L engines** - The agencies requested comment on the weight reduction credit for engines less than 15L. 80 FR 40249 Table III-36. We oppose the arbitrary credit for DemanDetroit.com. [EPA-HQ-OAR-2014-0827-1164-A1 p.51-52]

**Qualifying a transmission as automatic or automated manuals** – The agencies propose to give a credit to automatics and AMTs based on, among other things, the fact that these transmissions eliminate the problems faced by bad drivers. Then, it should not be necessary for vehicle manufacturers to expend a lot of effort certifying the transmissions as eligible for the credits, as little benefit is added. Rather, the agencies should write into the rule that a transmission qualifies upon a very simple showing that 1) there is no clutch pedal and 2) the driver can leave the transmission in a “drive” position and not have to shift gears as the vehicle accelerates through the gears. [EPA-HQ-OAR-2014-0827-1164-A1 p.78-79]

Additional technologies that should be considered for fuel saving technology credits – The agencies request comment on recognizing additional technologies that should get post-processing credits in GEM. The table 'Vehicle Side Fuel Saving Technologies' can be found on p.82-86 of docket number EPA-HQ-OAR-2014-0828-1164-A1. The technologies include e-Coast, autonomous vehicles, battery APU, fuel fired heater, diesel APU, driver coaching, safety technologies, fan power demand reduction, advanced cooling systems, air compressor and other accessories, cab insulation, high efficiency glass, high efficiency lighting, air conditioning system improvements, reduced tractor-trailer gap, and dynamic ride height. [EPA-HQ-OAR-2014-0827-1164-A1 p.82].

Allowing credits from Phase 1 to be used in Phase 2 is the correct approach to smooth transition into the new program, which would otherwise be very difficult in an industry so complex as HDV manufacturing. That is, with such a variety of products, it is impossible to change over an entire product portfolio at one time, as we have described to the EPA on numerous occasions (e.g., during our staggered transition to aftertreatment devices). If the Phase 2 rules drive large technology changes, it will be crucial for manufacturers to stagger transitions, which means use of credits. Thus the agency's choice to continue credit carry-over is the correct approach. 1037.701(j) [EPA-HQ-OAR-2014-0827-1164-A1 p.116]

#### **Aerodynamics (wind average drag, coast down, constant speed testing)**

**Aero test procedures** - The agencies requested comments on aero test procedures. We have worked with the EMA on our comments about 1) improving the coast-down test procedures, 2) minimizing the number of F\_alt\_aero tests required, and 3) delaying the constant-speed test procedures for another rulemaking. We incorporate those comments as if they were our own. [EPA-HQ-OAR-2014-0827-1164-A1 p.55]

· **Constant speed testing** – The agencies request comment on the need to change the reference method for the Phase 2 final rule to constant speed testing, including comparisons of aerodynamic test results using both the coast down and constant speed test procedures. 80 FR 40244. The EPA should not change the reference method for Phase 2 to constant speed testing. More time is required to determine if constant speed testing would be a better alternative to the coast down test procedure. We propose to keep constant speed testing only as an alternative to the coast down test, for use at a manufacturer's discretion. [EPA-HQ-OAR-2014-0827-1164-A1 p.55]

· **CFD Procedures** - The agencies proposed some revisions to the CFD procedures in § 1037.531 and requested comment on them. The agencies proposed to change certain aspects of the CFD regulation but to leave unchanged the simulated vehicle speed of 55 mph. We recommend changing to 65 mph to align with the coast-down testing's high speed range and to better align with the regulatory drive cycles. Otherwise, the agencies' changes are fine. [EPA-HQ-OAR-2014-0827-1164-A1 p.56]

· **Additional Aero Components On The Reference Trailer** - The agencies propose to add side skirts to the trailer used for tractor certification and request comment on whether to add other aerodynamic features. 80 FR 40245. First, we strongly agree with the agencies' proposal to add side skirts. We see the industry heading toward trailers with skirts, and we design our tractors to perform



optimally with such features. So it is appropriate that the agencies test the tractors that way. To do otherwise would be to lock in old style trailers with future aerodynamic tractors, which would compromise tractor designs, as the agencies note. Second, on the question of additional features, we think that trailer features need to be addressed as part of the larger aero package that we discuss in the present comments and in the EMA comments. In particular, given that the agencies' current aero bin and penetration rate proposals (in the NPRM) create impossible targets--for example, putting Super Truck's tractor in Bin V because of the use of the regulatory trailer, as we have explained to the agencies--we could rectify this problem by either a) correcting the aero bin  $C_d \cdot A$  entry criteria or b) adding trailer aero features like a boat tail, in either case to align with the agencies' desired qualitative criteria. (These proposals are discussed more fully below). After all, as we explained earlier, the Super Truck tractor and trailer will fall in Bin VII (assuming no compliance margin is needed) as the agency had expected, so the lack of trailer features is part of the misalignment problem. That said, we would prefer option a, to correct the aero bins and keep the trailer as the agencies proposed in the NPRM, thereby minimizing cost and complexity of testing. If the agencies choose option b, we need more specifics about the trailer to understand what the agencies propose and whether that aligns with real-world trailers. [EPA-HQ-OAR-2014-0827-1164-A1 p.56]

**Full Yaw Sweep versus Surrogate Angle for Wind Average Drag** - The agencies request comment on whether to use a full yaw sweep to determine the wind averaged drag, as specified in Appendix A of the SAE recommended practice number J1252 'SAE Wind Tunnel Test Procedure for Trucks and Buses.' 80 FR 40245. As we have discussed with the agencies since the NPRM's publication, the use of a full yaw sweep is not overly burdensome when a manufacturer is testing a vehicle in a scale model wind tunnel; rather, the model may be turned and measured very easily. So we agree with the use of a full yaw sweep (or at least a number of important yaw angles, omitting unimportant ones at large yaw angles) at a scale model wind tunnel. On the other hand, in CFD, where a full yaw sweep is very resource- and cost-intensive, we believe that use of a surrogate angle is the better approach. The reason for this is that, although in theory a surrogate angle is potentially less accurate than a full yaw sweep, we and other manufacturers found through analysis of aero data that most vehicles have a wind-averaged drag  $C_d$  that fall extremely close to the  $C_d$  at 4.5 degrees yaw, when measured at 65 mph. (See table below). Therefore that angle is sufficiently accurate that we believe the minor deviation from the true wind-averaged drag is a small price to pay for the great savings in resources and money for testing. We should note that we had told the agencies in Phase 1 that 6 degrees yaw is an appropriate surrogate angle. That was for 55 mph vehicle speed. But as we focus on 65 mph, the wind angle becomes smaller, and 4.5 degrees is appropriate.

[Table, listing yaw angle for various vehicle configs, can be found on p.61 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

These are six DTNA sleeper configurations, multiple model years of various technology levels, all with the yaw angle for wind averaged drag within 0.3 degrees of the 4.5 degree surrogate that we suggest. In short, we believe that for scale model wind tunnels, a full yaw sweep or abbreviated yaw sweep is appropriate, while for CFD the use of a surrogate angle is best. [EPA-HQ-OAR-2014-0827-1164-A1 p.61]

**No carryover of aero data from Phase 1 to Phase 2:** Given the changed test procedures and trailer specifications, this seems appropriate. 1037.150(r) [EPA-HQ-OAR-2014-0827-1164-A1 p.61]

We agree with the agencies' proposal to continue a procedure where we can use high-roof test data in lieu of testing mid-/low-roof vehicles; we strongly support continuing that.

## **Aero bin boundaries and penetration rates –**

The agencies must resolve problems with aerodynamic test procedures and binning, as the problems make the agencies' proposed standards impossible. [EPA-HQ-OAR-2014-0827-1164-A1 p.5]

Proposal A: The bottom line is that we propose to align the agencies' aero bins with the agencies' expectations of where the aero bins should be, and we propose to align penetration rates with aggressive but hopefully achievable rates. Note that this proposal is contingent on 1) revised aero testing procedures and 2) some compliance margin in the case of SEAs. If the agencies do not agree to these related proposals, then the whole package falls apart and we cannot ensure that the present proposal remains reasonably achievable. Below are the landmarks that we used in setting our proposed aero bins for raised roof Class 8 sleepers:[EPA-HQ-OAR-2014-0827-1164-A1 p.57]

[Table, with Cd\*A values for various vehicle types, can be found on p.57 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

Note that we set Bin III as we understood the agencies intended to set it: we took the vehicle that the agencies used in setting Phase 1 targets (2010 vehicles) and translated its Cd\*A into the wind-averaged drag space, added the implicit compliance margin, and put this in the middle of Bin III. Note that the baseline remains Bin III, as the agencies intended. To provide upper and lower bounds for our bins, we 1) put classic styled vehicles in Bin I and 2) assumed that a Super Truck was in Bin VII, as the agencies intended to allow room for improvement from ST. Since improvement is not possible from there, we think ST should be in Bin VII. [EPA-HQ-OAR-2014-0827-1164-A1 p.57]

Note additionally that we included a compliance margin in the landmark vehicles, because we are not yet certain that the agencies will amend the NPRM proposal to allow a compliance margin on confirmatory tests or SEAs. [EPA-HQ-OAR-2014-0827-1164-A1 p.57]

Using these landmarks, and trying to keep the aero bins to approximately the same widths as the agencies' proposed ones (wider in the worse bins, narrower in the better bins, reflecting the increasing difficulty of making improvements as one improves through the bins), we get the following proposed bin targets, which we show next to the original proposal for the sake of comparison: [EPA-HQ-OAR-2014-0827-1164-A1 p.57]

[Table, showing BIN targets of EPA and DTNA proposals, can be found on p.57 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

Note that we are essentially just shifting approximately one bin (e.g., where Bin I was 7.3 m<sup>2</sup> or worse, now Bin II is now at 7.3 m<sup>2</sup> or worse) and trying to keep the bin widths approximately the same as originally proposed. [EPA-HQ-OAR-2014-0827-1164-A1 p.58]

Also in that table are the inputs to GEM that would correspond. Note that by changing the inputs to GEM from those in the NPRM, the agencies will have to change the stringency levels by rerunning GEM to determine the corrected g CO<sub>2</sub>/ton-mile numbers. If the agencies determine that there is sufficient penetration in the market of trailers with boat-tails, then the agencies would not change the test trailer for certification but would update the Cd\*A results of each bin, bumping them down by 0.5 m<sup>2</sup> to reflect in GEM the actual on-road aero load. This is reflected in the rightmost column of the chart, as compared to the second-to-right. [EPA-HQ-OAR-2014-0827-1164-A1 p.58]

Proposal B: Another alternative is to re-define the test trailer to include a boat tail. This would effectively shift all tractors one bin better than in the current NPRM. The EPA can then maintain the bin definitions and the baselines as proposed in the NPRM. This also achieves their stated goal of Super Truck being in Bin VII. Further, it has the effect of providing GEM the correct aero loads when boat tails do become widely adopted, such that GEM in turn calculates an accurate engine torque and fuel consumption rate. The boat tail adoption rate issue can be addressed in a manner similar to Proposal A above, but the  $C_d \cdot A$  inputs into GEM are adjusted upwards by  $\sim 0.5 \text{m}^2$  only for a first period of Phase II (“Step 1”), after which time boat tails are relatively widespread and we shift to Step 2: [EPA-HQ-OAR-2014-0827-1164-A1 p.58]

[Table, hi-roof sleepers for Phase II NPRM and Proposal B, can be found on p.59 of docket number EPA-HQ-OAR-2014-0827-1164-A1]

There are two advantages to this proposal:

- 1) It defines the trailer up front without the risk of changes mid-way through Phase II [EPA-HQ-OAR-2014-0827-1164-A1 p.59]
  - a. The EPA has hinted at this and maybe forced by boat tail adoption rates
  - b. This would add certification burden via reference test and an updated Falt-aero
- 2) It forces the EPA to reconcile the test trailer with a “Super Truck” based stringency [EPA-HQ-OAR-2014-0827-1164-A1 p.59]
  - a. The trailer has a majority contribution to the aero improvement in Super Truck
  - b. It’s impossible to achieve Super Truck aerodynamics without a “Supertrailer”
  - c. [redacted]

We propose working with the agencies on setting bin boundaries for the other RSCs in the same manner as above: [EPA-HQ-OAR-2014-0827-1164-A1 p.59]

**Post Useful Life Modifications** - The EPA clarifies that 1) it is allowable to modify a vehicle prior to the end of its regulatory Useful Life in the case that the modification does not increase regulated emissions and 2) the agency specifically wrote 1037.655 to allow modifications after the UL where the modifier has a good faith reason to believe that the modification will improve the vehicle's efficiency in its operation. 80 FR 40252. But the agency requests comment on the continuation of the provision that it is generally prohibited for any person to remove or render inoperative any emission control device installed to comply with the requirements of part 1037. We think that the agency has the correct approach in allowing modifications where there is a good reason to believe that it will provide improved the fuel efficiency in use, and we think that this should not be limited until after the UL--as the EPA clarifies in the NRPM. That is, a vehicle may be used for many different tasks, it may have many different sets of equipment on it, and it may have different tires according to driving conditions. And where these choices improve actual in-use fuel efficiency, the agency should not interpret the law to prohibit such improvement--certainly not if it is done before the arbitrary time of the UL. We think that the agency is correct to clarify that if regulated emissions do not increase, a modification is legal, and we think that the agency should go further by allowing modifications in good faith before the UL. [EPA-HQ-OAR-2014-0827-1164-A1 p.120]

**Response:**

*In-use Aerodynamics Testing*

The agencies considered the comments related to the proposed in-use aerodynamic testing regulations (40 CFR 1037.401). Any in-use testing would be limited to full-scale testing and would be required to be correlated to coastdown testing. Thus, the likely testing would be coastdown testing. The provisions of 40 CFR 1037 subpart F would apply, along with the compliance margin built into the aerodynamic bins. With respect to the “improperly maintained” comment, the agencies note that any recall action under the provisions in 40 CFR 1068.505 would require EPA to make a determination that a “substantial number of properly maintained” engines or equipment do not conform to the regulations.

*SEAs*

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA$ s and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA’s need to provide strong incentives for manufacturers to act in good faith with manufacturers’ need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility. Additional discussion is included in Section III.E.2.a of the Preamble to the final rule.

EPA adopted SEA provisions that state that we may conduct aerodynamic testing using either the coastdown (reference) test method or the aerodynamic method used by manufacturer to certify the tractor. We would not conduct a constant speed test for SEA if it was not used by the manufacturer to certify the tractor.

In Section III.E.2.ix, the agencies state that although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility.

With respect to the comment regarding trailer gap, EPA specified the tractor-trailer gap in 40 CFR 1037.501 of less than or equal to 45 inches. However, we also note in 40 CFR 1037.525(b)(6), that if the tractor-trailer cannot be configured to meet the gap requirements, then manufacturers should use good engineering judgment.

The agencies are adopting provisions in 40 CFR 1037.201(g) that provides the manufacturers to choose to deliver another vehicle or component that is identical in all material respects to the test vehicle or component, or a different vehicle or component that we determine can appropriately serve as an emission-data vehicle for the family.

#### *Tractor Chassis Dyno Testing*

After consideration of the comments, the agencies are requiring tractor manufacturers to annually chassis test five production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production. See 40 CFR 1037.665. We do not expect absolute correlation between GEM results and chassis testing. GEM makes many simplifying assumptions that do not compromise its usefulness for certification, but do cause it to produce emission rates different from what would be measured during a chassis dynamometer test. Given the limits of correlation possible between GEM and chassis testing, we would not expect such testing to accurately reflect whether a vehicle was compliant with the GEM standards. Therefore, we are not applying GHG compliance liability to such testing. Rather, this testing will be for informational purposes only. However, we do expect there to be correlation in a relative sense. Vehicle to vehicle differences showing a 10 percent improvement in GEM should show a similar percent improvement with chassis dynamometer testing. Nevertheless, manufacturers will not be subject to recall or other compliance actions if chassis testing did not agree with the GEM results on a relative basis. Rather, the agencies will continue to evaluate in-use compliance by verifying GEM inputs and testing in-use engines. (Note that NTE standards for criteria pollutants may apply for some portion of the test cycles).

EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM.

As also noted in Section II. B. (1), it can be expensive to build chassis test cells for certification. However, EPA has structured this pilot-scale program to minimize the costs. First, this chassis testing will not need to comply with the same requirements as will apply for official certification testing. This will allow testing to be performed in developmental test cells with simple portable analyzers. Second, since the program will require only five tests per year, manufacturers without their own chassis testing facility will be able to contract with a third party to perform the testing. Third, EPA is applying this testing to only those manufacturers with annual production in excess of 20,000 vehicles. Finally, 40 CFR 1037.665(c) states that we may approve a request to perform alternative testing that will provide equivalent or better information compared to the specified testing. We may also direct you to do less testing than we specify in this section.

EPA estimates that the cost to conduct chassis testing at a third party facility would be approximately \$30,000 per tractor, for a total of \$150,000 per year per manufacturer. RIA Chapter 7.2.1.2 includes the compliance costs of the program, including the increased level of reporting in the tractor program.

#### *Downspeeding*

Daimler is correct in their assessment of downspeeding. The agencies proposed and adopted provisions to account for the gearing of vehicles such that CO<sub>2</sub> emissions and fuel consumption benefits of a downsped vehicle operation would be recognized in GEM.

#### *Tractor Subcategories*

The agencies are adopting a standards for a set of ten tractor subcategories, aligned with Daimler's comment.

#### *Drive Cycle*

The agencies considered these drive cycle comments along with the information that was used to derive the drive cycle weightings in Phase 1. The agencies did not receive any new drive cycle weighting data for tractors from the EPA-NREL work. Based on our assessment on the only comment that included speed data (i.e. the comment from ATA, addressed above), the agencies do not believe this new information is significantly different than the drive cycle weightings that were proposed (as explained in that comment response). Therefore, we are adopting the drive cycle weightings for tractors that we adopted for Phase 1 and proposed for Phase 2.

After considering the comments on the use of constant speeds in the 55 and 65 mph cycles and evaluating the final Phase 2 version of GEM, the agencies are adopting in the Phase 2 final rules constant target speed for the 55 mph and 65 mph cycles, as adopted in Phase 1. We are not adopting drive cycles that include traffic congestion, which is consistent with Daimler's recommendation. One key difference in Phase 2 is the addition of road grade in these cruise cycles. The addition of road grade to the cruise cycles brings the GEM simulation of vehicles over the drive cycles closer to the real world operation described by Daimler. Even though the cruise cycles will continue to have constant target speeds (55 mph or 65 mph), the vehicle may slow down from the target speed of the cycle on an uphill stretch of road due to the addition of road grade in the Phase 2 cycles. If the vehicle does slow down the transmission shift logic built into GEM will downshift the transmission to limit the amount of further vehicle deceleration. Similarly, on the downhill portions of the cycles, the driver control logic built into GEM will allow the vehicle to exceed the target speed by 3 mph prior to braking the vehicle. The agencies also note that the technologies noted in the comment regarding the recommendation to increase the variability of the vehicle speed will not be simulated over the drive cycles. The impact of predictive cruise control will be applied as a fixed percent reduction in CO<sub>2</sub> emissions and fuel consumption after the simulation is complete, but still within GEM, for Phase 2.

#### *Curb Weight and Payload*

In the absence of newer data or other compelling comments, the agencies continue to believe that it is appropriate to continue using the Phase 1 tractor payloads and tractor curb weights for all of the Class 7 and 8 tractors, as proposed, except for heavy-haul.

#### *Weight Reduction*

In the absence of additional details, the agencies are not adopting different weight reduction values for hoods and fairings. The manufacturers have the option of requesting off-cycle credits for weight reductions that differ from those included in 40 CFR 1037.520. Also, in Phase 2, we recognize the potential CO<sub>2</sub> emission reduction opportunities in the powertrain and drivetrain systems as part of the vehicle inputs into GEM. Therefore, we believe it is appropriate to also recognize the weight reduction associated with both smaller engines and 6x2 axles.

#### *Transmissions*

EPA is adopting simple definitions of AMTs and ATs in 40 CFR 1037.801. The manufacturers only need to utilize transmissions that meet these definitions as their demonstration for certification.

### *Additional Technologies*

The agencies considered the additional fuel saving technologies that Daimler suggested in their comments. For the technologies where the agencies could determine, for each of the ten tractor subcategories, the baseline 2017MY vehicle architecture, clearly define what qualifies as the technology, the effectiveness of the technology, and the current and potential adoption rates of the technology, we adopted specific values for post-processing in GEM. This set of technologies includes Neutral Coast, diesel APU, battery APU, and fuel fired heater. For the other technologies enumerated in the comment, the agencies could not appropriately determine some aspect of the technology. Therefore, the manufacturers may consider applying for off-cycle credits for some of these technologies. There may be technologies, such as some safety technologies that would not be considered under off-cycle technology credits (see 49 CFR 535.7(F)).

### *Phase 1 Credits*

The agencies are allowing Phase 1 vehicle credits to be used in Phase 2. However, the existing five year credit life still applies for heavy heavy-duty vehicle credits. See Preamble Section I.C.1.b.i for details.

### *Aerodynamic Test Procedures*

- After consideration of the comments, the agencies are continuing to use the Phase 1 approach of using coastdown testing as the reference method for aerodynamic assessment in Phase 2, which is consistent with Daimler's recommendation. We believe that there are practical implications of selecting a different reference method, such as CFD or scaled wind tunnel testing. Coastdown testing and constant speed testing are the only two options that allow testing of the actual tractor. While the agencies have conducted a significant amount of constant speed testing, we agreed with the manufacturers' potential concerns about developing robust constant speed test procedures in time for the final Phase 2 rule. Instead, we focused our activities on developing more robust coastdown test procedures for the final rule. We have made enhancements to the Phase 2 coastdown procedures to improve the robustness of the results when compared to Phase 1 or those proposed for Phase 2. See RIA Chapter 3.2.
- The agencies are adopting provisions to align the speed at which CFD is conducted in Phase 2 (65 mph) with the average of the coastdown high speed range.
- Phase 2 reference trailer: We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer with a trailer skirt, as proposed. However, we also want to recognize that the trailer fleet will continue to evolve over the lifetime of tractors built and certified to Phase 2, especially from MY 2027 and later. We recognize that if we do not account for reduced aerodynamic loads in the real world, then we may not be appropriately evaluating the tractor powertrain. We considered changing the standard trailer in MY2027; however, this would lead to significant testing burden for the manufacturers because they would have to determine new  $C_dA$  values for their entire fleet of tractors. Instead, we are adopting Phase 2 GEM that beginning in MY2027 will take the  $C_dA$  input for each vehicle and reduce it by  $0.3 \text{ m}^2$  to reflect the lower aerodynamic loads that are a mix of trailers with skirts and trailers with skirts and boat tails. This change has been accounted for in both the baseline and standard setting of the  $\text{CO}_2$  emissions and fuel consumption values. We are not electing Daimler's (b) suggestion to address the Phase 2 aero bin concerns, and instead have aligned the definition of the Phase 2 aero bins to the final aerodynamic test procedures and lowered the adoption rates of Bins VI and VII to zero for the final rule. The agencies discuss our response to

Daimler's specific comments regarding the aero bin penetration rates in Section 4.3 of this RTC document.

- The agencies are adopting aerodynamic testing provisions that use a 4.5 degree surrogate angle in lieu of a full yaw sweep because it is technically equivalent to the full yaw sweep but it also reduces the testing burden for aerodynamic assessments (see RIA Chapter 3.2.1.1.3). Our approach in the final rule is consistent with the recommendation from Daimler.

The agencies are adopting the provision that allows manufacturers to use high-roof test data in lieu of testing mid-/low-roof vehicles. *Aerodynamic Bins*

The agencies have refined the aerodynamic test procedures, developed a new SEA approach, revised aerodynamic bin boundaries, and adjusted aerodynamic bin adoption rates in the technology packages for the final rule. This package of changes as a whole is in response to the set of detailed comments from stakeholders. The changes to the coastdown test procedures reduce the test-to-test variability of the CdA results (See RIA Chapter 3.2). The new SEA approach appropriately balances EPA's need to assure that manufacturers are acting in good faith and meaningful incentives to do so with manufacturers' need to avoid compliance actions based on inaccurate testing. The high roof bin values being adopted in the HD Phase 2 final rulemaking differ from those proposed due to the changes in the coastdown and other aerodynamic test procedures. However, in both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that a tractor that performed as a Bin III in Phase 1 would also perform as a Bin III tractor in Phase 2. Please see RIA Chapter 3.2.1.2 for the derivation of the aerodynamic bins.

#### *Post Useful Life Modifications*

In 40 CFR 1037.655 EPA clarifies that certain vehicle modifications are allowed after a vehicle reaches the end of its regulatory useful life. This section applies for all vehicles subject to 40 CFR part 1037 This section states (as examples) that it is generally allowable to remove tractor roof fairings after the end of the vehicle's useful life if the vehicle will no longer be used primarily to pull box trailers, or to remove other fairings if the vehicle will no longer be used significantly on highways with vehicle speed of 55 miles per hour or higher. More generally, this section clarifies that owners may modify a vehicle for the purpose of reducing emissions, provided they have a reasonable technical basis for knowing that such modification will not increase emissions of any other pollutant. This essentially requires the owner to have information that will lead an engineer or other person familiar with engine and vehicle design and function to reasonably believe that the modifications will not increase emissions of any regulated pollutant. Thus, this provision does not provide a blanket allowance for modifications after the useful life.

This section also makes clear that no person may ever disable a vehicle speed limiter prior to its expiration point, or remove aerodynamic fairings from tractors that are used primarily to pull box trailers on highways. It is also clear that this allowance does not apply with respect to engine modifications or recalibrations.

This section does not apply with respect to modifications that occur within the useful life period, other than to note that many such modifications to the vehicle during the useful life and to the engine at any time are presumed to violate section 202 (a)(3)(A) of the Act. EPA notes, however, that this is merely a presumption, and it does not prohibit modifications during the useful life where the owner clearly has a reasonable technical basis for knowing that the modifications would not cause the vehicle to exceed any applicable standard.



**Organization:** Exa Corporation

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 261-266.]

We are pleased to see in the proposed ruling that computational fluid dynamics, also known as CFD, will continue to be one of the allowed methods for heavy vehicle aerodynamic assessment. The confidence our customers have in our tool has been built from many years of experience performing correlations to other test methods, including the full- and reduced-scale wind tunnel testing, SAE type II fuel economy testing, coast-down testing, constant speed aerodynamic testing, and full-scale drag meter testing. Thus, the decision to certify the use of CFD for the regulation of greenhouse gas and fuel efficiency will fit well within the aerodynamic design processing used today, help our customers to be efficient and to deliver superior products to the benefit of society.

The proposed ruling does, however, introduce challenges from the variations that we expected in the predicted drag coefficients, from not only the allowed methods, coast-down, wind tunnel, and simulation, but also within these tools themselves. For example, wind tunnel drag coefficients are highly dependent on the facility chosen. And wind average drag, the drag associated with varying ambient wind conditions may vary by as much as 10 percent between wind tunnel facilities.

It is not clear that the proposed aerodynamic bin structure and the F-alt factor, the aerodynamic factor for alternate tools, will alleviate these challenges as we expect the absolute drag values will differ substantially between different test methods and different facilities.

Correlating simulation results with any non-road physical testing requires accounting for many specific details of the test setup that are not representative of the on-road conditions. CFD offers the advantage of creating a virtual test environment that is more representative of the on-the-road performance.

The preferred setup used by our customers for design and development is a domain that replicates the open road, including a moving ground, rotating tires, open grill with realistic engine, bay details, and other factors.

Further, our customers also regularly evaluate different wind conditions by considering yaw flow. They can even evaluate the impact of the real-world conditions due to the environmental or traffic-generated winds. The setup details are necessary for producing results that are representative of on-the-road performance.

It is our suggestion that the EPA and NHTSA require a certification procedure for an alternate tool that includes broad validation suite, including different vehicle types from aerodynamic sleepers to less aerodynamic day cabs. In the proposed program, the coast-down method is a proposed standard to measure the vehicle aerodynamic performance. However, we feel this test procedure does not relate closely to real- world fuel efficiency.

Since these types of vehicles experience significant changes in aerodynamic drag with relatively small changes in wind, a better predictor of real-world fuel economy is used as a use of wind average drag. Coast-down testing is limited to near-zero wind yaw angle and does not accurately represent the aerodynamics experienced on the road due to wind.

Because of the significant impact of real-world efficiencies due to the wind yaw effects, we feel it is imperative that wind effects be part of the standard for both tractors and trailers.

The negative consequences of not adopting wind effects into the standard for tractors and trailers include truck and trailer buyers, not realizing the fuel savings implied by the levels of which the truck and trailers are certified and the overall emission reductions promised for the program will not be achieved.

Some of the proposals attempt to address the inadequacies of the coast-down results by adjusting the coast-down results through the use of alternate tools for when they have the drag. We feel, as stated above, that the variations of wind average drag between the tools and facilities themselves is too significant and it would be an adverse consequence to allowing alternative tools for adjusting coast-down results. A standard that holds all the tools accountable to a real-world measure of the wind average drag performance of a vehicle, such as constant speed aerodynamic testing, is imperative in ensuring predictable behavior.

**Response:**

After consideration of the comments, the agencies are continuing to use the Phase 1 approach of establishing coastdown testing as the reference method for aerodynamic assessment in Phase 2. We believe that there are practical implications of selecting a different reference method, such as CFD or scaled wind tunnel testing. Coastdown testing and constant speed testing are the only two options that allow testing of the actual tractor. While the agencies have conducted a significant amount of constant speed testing, we agreed with the manufacturers' potential concerns about developing robust constant speed test procedures in time for the final Phase 2 rule. Instead, we focused our activities on developing more robust coastdown test procedures for the final rule. We have made enhancements to the Phase 2 coastdown procedures to improve the robustness of the results when compared to Phase 1 or those proposed for Phase 2. See RIA Chapter 3.2.

We are adopting aerodynamic assessments that consider the real world wind conditions through the use of wind averaged drag. We are also continuing to allow alternative test methods, such as CFD, while correlating the results to the reference method using Falt-aero. We are requiring manufacturers to determine Falt-aero using both sleeper cabs and day cabs. Manufacturers also are required to determine a unique Falt-aero value for each wind tunnel facility and each type of CFD software that they use for certification to account for variability between the methods.

**Organization:** International Council on Clean Transportation (ICCT)

**Compliance and real-world validation**

Per agency discussion within the proposed rulemaking, there appears to be some discrepancies across various companies regarding the precise times when model years fall within a given calendar year (e.g., engines within tractors could have differing model years). Importantly, the agencies' analysis is based on a thorough investigation of the ability to introduce, and deploy in larger percentages, technologies in future years. We support the agencies' approach to technology implementation timing, without including any delay in implementation due to industry-adopted convention for model years that differs across various regulated vehicle and engine manufacturers. Especially considering companies' latitude in selling products of given model years, that are independent of calendar year, any delay in technology deployment or stringency determination due to how companies' decisions about naming and marketing products by model year would be unwarranted. [EPA-HQ-OAR-2014-0827-1180-A4 p.16]

The agencies propose a production vehicle chassis dynamometer testing program to complement the new full vehicle standards. This is consistent with recommendations from Sharpe, Delgado, Muncrief (2014) that CO2 reductions over the certification tests correlate to reductions in the real world, as it is extremely important that end users and other stakeholders have confidence that the benefits from the rule are real. In order for the real-world testing program to be successful it is critical that results from the program are shared publicly and that the program start as soon as possible (as discussed in the proposal, the purpose of the data collection program is to look for trends, not absolute values). If possible, the program start date would be the same year the rule is finalized (2016) in order to maximize the amount of data that is collected. There is no reason to delay the start of the testing program, since the data is not being used for regulatory compliance and sufficient testing facilities are readily available. In addition, we suggest that the agencies give more detailed guidance to the OEMs on the precise vehicles selected for production testing. This data collection effort will be the most useful if similar, best-in-class models are tested year to year. [EPA-HQ-OAR-2014-0827-1180-A4 p.16]

**Response:**

Phase 2 is requiring a significant number of changes that apply to both the engine and the vehicle so it is necessary for alignment of model years between engines and tractors. In the final standards, stringency of the vehicle reflects in part engine improvements. See Section III.D.1.b of the Preamble. By aligning the model years of the tractors with the engines, this essentially provides some additional lead time for the tractor manufacturers. The current practice among tractor manufacturers is that the tractor model year starts in the January-April timeframe in the year preceding the calendar year. This additional lead time was considered by the agencies in setting the tractor stringency levels. For example, the technology package developed by the agencies for setting the 2027 MY tractor standards included both a relatively high adoption rate of waste heat recovery and new engine platforms that will require some modifications to the vehicle; therefore, the vehicle standard cannot take effect before the engine standards.

The agencies are finalizing the tractor chassis test requirement largely as proposed. Past experience has shown us that including a broad range of testing discourages manufacturers from focusing their development efforts on a single narrow test procedure. Even though there will be no direct compliance liability for the GHG testing, the agencies would still be able to identify differences in performance that resulted (on purpose or inadvertently) from how the powertrain is installed in the chassis. We are starting this requirement in 2021 MY to allow manufacturers time to either build chassis dynamometer cells or identify locations to conduct the testing.

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Review Lightweighting and Aerodynamics in GEM [EPA-HQ-OAR-2014-0827-1274-A1 p.8]**

Aerodynamics – MEMA supports the agencies’ expanded recognition of aerodynamics as it allows the GEM to be more closely aligned with actual performance on the road. The additional bins offer a wider range of drag coefficient values and incentivizes adoption of aerodynamic improvements. The agencies asked for input regarding the proposed constant speed testing. Because research has demonstrated that constant speed tests offer stability, reliability and repeatability as compared to coast down tests and since a constant speed test is required in European aerodynamic test protocols, MEMA supports the inclusion of a constant speed test. [EPA-HQ-OAR-2014-0827-1274-A1 p.8]

Suppliers with specific products and materials impacted by these categories will submit detailed commentary on the Phase 2 NPRM. [EPA-HQ-OAR-2014-0827-1274-A1 p.8]

**Response:**

The agencies are adopting additional aerodynamic bins for Phase 2 to recognize improvements in the future. After consideration of the comments, the agencies are continuing to use the Phase 1 approach of establishing coastdown testing as the reference method for aerodynamic assessment in Phase 2. We believe that there are practical implications of selecting a different reference method, such as CFD or scaled wind tunnel testing. Coastdown testing and constant speed testing are the only two options that allow testing of the actual tractor. While the agencies have conducted a significant amount of constant speed testing, we agree with the manufacturers' potential concerns about developing robust constant speed test procedures in time for the final Phase 2 rule so that it could be used as the reference aerodynamic test method. Instead, we were able to focus our activities on developing more robust coastdown test procedures for the final rule. We have made enhancements to the Phase 2 coastdown procedures to improve the robustness of the results when compared to Phase 1 or those proposed for Phase 2.

**Organization:** Navistar, Inc.

The Proposed Rule requires in-use testing utilizing a chassis dynamometer in order to correlate to GEM. We understand that this considerable extra cost is proposed to assist with future regulatory development and not to confirm compliance with current rules. While we support the agencies collecting data in support of future rules, we think that the agencies ought to bear the cost of this regulatory development. This is very similar to the testing EPA conducts through its contractors; with the single difference being that here it would not pay for the proposed new testing. We do not think this is fair or appropriate. [EPA-HQ-OAR-2014-0827-1199-A1 p.16]

Moreover, this data will not correlate exactly to GEM as the impacts of many technologies will not show up in the dynamometer test (e.g., predictive cruise and tire pressure management). Requiring five tests a year from each manufacturer is an excessive burden and cost with no direct benefit to the agencies. While we oppose this requirement in its entirety, the same goal could be achieved by chassis testing the best configuration from each manufacturer in the chassis dyno during the compliance years (when significant changes will be made to both the engine and vehicle). If this requirement is maintained, Navistar proposes this burden be reduced to one vehicle in each of the following years: MY2021, MY2024, and MY2027. This correlation to GEM will demonstrate a downward trend with this proposal. [EPA-HQ-OAR-2014-0827-1199-A1 p.16]

To be implemented successfully, MD/HD chassis testing requires a significant staffing, time and capital commitment. The availability and capability of existing facilities are limited and expensive when compared to an equivalent engine dynamometer facility which is commonplace at most engine OEMs. In addition, the typical test constraints for a chassis dynamometer are not easily and cost effectively controlled. [EPA-HQ-OAR-2014-0827-1199-A1 p.17]

The Proposed Rule requires the measurement of gaseous emissions. There is simply no good reason to require any data other than CO<sub>2</sub> and/or fuel consumption data for comparison to GEM outputs. Any requirement for measurement of NO<sub>x</sub>, PM, CO, NMHC, CH<sub>4</sub>, and N<sub>2</sub>O emissions should be dropped from the requirements of this section. The additional cost burden for either powertrain or chassis testing will be considerable, when compared to stand alone engine testing. In addition, the RIA does not appear at all to take into account the costs of this testing. This provision should be dropped from the Proposed Rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.17]

The NPRM discusses proposed changes to §1037.135(c)(6) to remove the requirement for emission control information from the vehicle GHG labels. Navistar supports the elimination of the requirement to list emission control information on vehicle labels. [EPA-HQ-OAR-2014-0827-1199-A1 p.19]

Navistar supports coastdown as the only certification input procedure in this rule. However, we are concerned with test variability, trailer gap and other elements of the test procedure. In general, Navistar echoes EMA's comments and concerns regarding the coastdown test procedure. In particular, we are concerned with the assumption of zero yaw angle, an assumption that the test will be conducted in near windless conditions.<sup>26</sup> We recommend the yaw correction detailed in the EMA comments. If held to this test procedure without such a correction, manufacturers will be forced, due to that assumption of zero wind speed, to wait for a very calm day in order to ensure accurate measurements. We are also concerned that if EPA conducts confirmatory testing, it will not necessarily wait for that condition and may test under windier conditions, thus arriving at a different result than the manufacturer, simply due to the test conditions. EPA's number would then become the de facto input. [EPA-HQ-OAR-2014-0827-1199-A1 p.26]

There should not be a set trailer gap or range. EPA should have the authority to approve an open range of trailer gaps proposed by the manufacturer. Trailer gap should be defined by manufacturer depending on the truck configuration and the manufacturer's recommendation to customers. As technology and designs evolve, the trailer gaps will be tighter for real-world fuel economy improvements. Alternatively, a maximum trailer gap could be defined in the regulation, but the minimum for the aero test should be driven by manufacturer vehicle recommendations. Confirmatory and SEA testing must utilize the manufacturer's certified trailer gap. [EPA-HQ-OAR-2014-0827-1199-A1 p.26]

As in Phase 1, only one aerodynamic adjustment factor,  $F_{alt-aero}$ , should be required. Proposed section 1037.525(b)(3) would require determining separate adjustment factors for "a high-roof day cab and a high-roof sleeper cab corresponding to each major tractor model." This additional test burden is not necessary as the  $F_{alt-aero}$  factors will be the same. Navistar has tested a daycab ProStar and sleeper ProStar at the same facility using the Phase 2 methods and found the  $F_{alt-aero}$  to be less than 1%. In addition, EPA's data in the RIA for 3 different sleepers tested at the same facility show  $F_{alt-aero}$  values within 0.4%. See Table 3-21, below (from RIA) There is no data included in the proposal or available from our experience that supports the need for more than one  $F_{alt-aero}$ . Navistar recommends that the requirement should remain as the requirement currently is in the Phase 1 regulatory text (1037.525 (b) (1)-(2)) and eliminate the new Phase 2 requirement for multiple  $F_{alt-aero}$  values.  $F_{alt-aero}$  is not vehicle dependent. [EPA-HQ-OAR-2014-0827-1199-A1 p.26-27]

[Table 3-21, Wind Average Equivalent Coastdown Values, can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-1199-A1]

The standard trailer as defined in the coastdown test procedures must be more aerodynamic. The Proposed Rule currently adds only side skirts over the assumed Phase 1 trailer. This certainly cannot be an accurate reflection of the trailers over the life of this Proposed Rule, due in part to the Proposed Rule itself. The hypothetical test-only trailer incorporated into the procedure ensures that no tractor will achieve bins V through VII. [EPA-HQ-OAR-2014-0827-1199-A1 p.29]

The issues with the standard trailer go to the feasibility of the emission standard for tractors as well. The standard trailer must be modified to reflect the more efficient trailers expected to be in use during the time the rule is in effect. [EPA-HQ-OAR-2014-0827-1199-A1 p.29]

Navistar, in general, agrees with EMA's comments on constant speed testing. Navistar does not believe that constant speed testing should be adopted as a compliance test at this point, even as an alternative. However, with significant further work, constant speed testing may be suitable as an optional test in the future. For example, among other refinements: [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

- There would need to be an effective definition of what constitutes a windy day;
- A full yaw curve should be defined;
- Preconditioning procedures including instrument calibrations should be developed; and
- Torque sensors should be added. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

We do not think the development of the method is sufficient mature at this point to even include it as an optional test as part of this Proposed Rule. Navistar believes that a future rulemaking is the appropriate method for the adoption of this test in the future. We therefore request that this be dropped from the final rule and considered only in the future in a subsequent rulemaking. [EPA-HQ-OAR-2014-0827-1199-A1 p.30]

Aerodynamic testing, such as coastdown, is inherently variable. There are a number of conditions that can cause test result variations even when controllable parameters are unchanged from test to test. Navistar agrees with EMA's comments related to aerodynamic compliance margin. The lack of any accounting for test variability effectively increases the stringency of the rule. EPA's own data shows the level of variation that is possible when testing vehicles. [EPA-HQ-OAR-2014-0827-1199-A1 P.27]

For sleeper cabs, the agencies justified this elimination of a compliance margin in the Proposed Rule based on coastdown testing of one sleeper from each manufacturer. That is not a sufficient data set upon which to eliminate the compliance margin from the rule. We note that while the agencies may point out that the bins themselves constitute a compliance margin, it is more accurate to characterize the bin structure as a design limitation, rather than a compliance margin. Manufacturers will design the tractors to fit within a particular bin and the potential for manufacturing variation will be accounted for in that design. It is too much to also assume that the bin structure would also account for test variation. [EPA-HQ-OAR-2014-0827-1199-A1 P.27]

We should again repeat that, while aerodynamic testing of vehicles has been around for some time, it has only been about 21 months since it has been used across the heavy duty industry for compliance purposes. Navistar does not believe we are yet at a place where we can state that simple test variation has been reduced, or even understood, to the point where it can be essentially ignored in certification tests. [EPA-HQ-OAR-2014-0827-1199-A1 p.27-28]

Navistar's recommendation is to maintain the one bin compliance margin from the Phase 1 regulation to account for this variability. [EPA-HQ-OAR-2014-0827-1199-A1 p.28]

### **III. Selective Enforcement Audit and Confirmatory Testing for Aerodynamics**

Another example of this issue is the difference between the coastdown test procedure done for certification and the SEA procedure. Manufacturers certify their vehicles utilizing the alternative aerodynamic test methods (wind tunnel or CFD); however, the regulation allows for SEA testing of a vehicle using the reference method (coastdown) which introduces significant variability (grade corrections, road surface, instrumentation, wind, temperature, driver, etc.). As the manufacturer did not certify the vehicle configuration with coastdown, the SEA should not be utilizing coastdown due to the variability. The compliance margin to account for these differences should be sufficient to account for

that variability. SEA should validate the method of certification that the manufacturer utilized. [EPA-HQ-OAR-2014-0827-1199-A1 p.11]

In short, an SEA must be conducted under conditions representative of the process the manufacturer used to certify. For example, if the manufacturer conducted the test with zero winds, EPA should conduct the test under zero winds. It is the same with other test parameters; they should be representative of the testing that was conducted, not just within those parameters allowed by the rules. Beyond that, as noted, the rule should account for normal test variability. Anything else would lead to an unfair, unrepresentative and arbitrary result. [EPA-HQ-OAR-2014-0827-1199-A1 p.11]

Confirmatory testing is an area where the Proposed Rule must provide that testing be done in a manner consistent with and representative of the conditions the manufacturer used to certify. Coastdown testing, in particular, includes several variables that are beyond the manufacturer's control (e.g. wind, temperature, and driver) as well as variables from differences in particular facilities (e.g. grade, road surface). A confirmatory test allows EPA to test with up to 6 mph winds, which can result in a significant increase in Coefficient of drag-area (CdA) due to yaw effect. The manufacturer cannot make any adjustment for wind and has to assume zero yaw during the test procedure. Several of these factors could be eliminated if SEA and confirmatory testing were held at the same facility that the manufacturer used for certification. In addition, variation from instrumentation and the trailer could also be reduced by utilizing the manufacturer's trailer and anemometer. Compliance margin is necessary to account for all other variations that cannot be controlled. [EPA-HQ-OAR-2014-0827-1199-A1 p.11-12]

Navistar has reviewed the Memorandum entitled "Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters for Combination Tractors and for Trailers" identified in the NODA ("SEA Memorandum") and has the following comments. The SEA Memorandum discusses potential approaches to Selective Enforcement Audits (SEAs) and confirmatory testing. [EPA-HQ-OAR-2014-0827-1919-A2 p.4-5]

Of initial concern, the memorandum states that "EPA is considering applying some or all of these approaches to the Phase 1 tractor program." That is, the agencies apparently intend to change the approach in the Phase 1 rule, which is currently in place and has been since model year 2014. However, there is no method to account for Yaw correction in the Phase 1 coast down method. Therefore, any SEA performed would not account for Yaw and could have very large test variability involved. Navistar believes the Phase 1 coast down method is not conducive to a fair SEA test process due to the large test variability as discussed in the referenced Memo and no Yaw correction in the test method. SEA coast down testing should not be performed in the Phase 1 program. [EPA-HQ-OAR-2014-0827-1919-A2 p.5]

As noted in the memo the constants "a" and "b" are yet to be defined. The value of these numbers have a large effect on the ability to meet an SEA with all of the test variability as discussed in the Memo. Therefore, until the value of the constants are defined and can be evaluated Navistar cannot support the adoption of the strawman outlined. When the values are know we can then evaluate the concept and comment if the method is indeed reasonable and realistic given the large variability inherent in coast down testing and other aerodynamic test methods. [EPA-HQ-OAR-2014-0827-1919-A2 p.5]

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26 1037.527-1. We are also concerned that despite this assumption in the coastdown test procedure, the Selective Enforcement Procedure allows EPA to test with up to 6mph of winds.

**Response:**

*Chassis Dyno Testing*

After consideration of the comments, the agencies are requiring tractor manufacturers to annually chassis test five production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production. See 40 CFR 1037.665. We do not expect absolute correlation between GEM results and chassis testing. GEM makes many simplifying assumptions that do not compromise its usefulness for certification, but do cause it to produce emission rates different from what would be measured during a chassis dynamometer test. Given the limits of correlation possible between GEM and chassis testing, we would not expect such testing to accurately reflect whether a vehicle was compliant with the GEM standards. Therefore, we are not applying compliance liability to such testing. Rather, this testing will be for informational purposes only. However, we do expect there to be correlation in a relative sense. Vehicle to vehicle differences showing a 10 percent improvement in GEM should show a similar percent improvement with chassis dynamometer testing. Nevertheless, manufacturers will not be subject to recall or other compliance actions if chassis testing did not agree with the GEM results on a relative basis. Rather, the agencies will continue to evaluate in-use compliance by verifying GEM inputs and testing in-use engines. (Note that NTE standards for criteria pollutants may apply for some portion of the test cycles).

EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM.

As also noted in Section II. B. (1), it can be expensive to build chassis test cells for certification. However, EPA has structured this pilot-scale program to minimize the costs. First, this chassis testing will not need to comply with the same requirements as will apply for official certification testing. This will allow testing to be performed in developmental test cells with simple portable analyzers. Second, since the program will require only five tests per year, manufacturers without their own chassis testing facility will be able to contract with a third party to perform the testing. Third, EPA is applying this testing to only those manufacturers with annual production in excess of 20,000 vehicles. Finally, 40 CFR 1037.665(c) states that we may approve a request to perform alternative testing that will provide equivalent or better information compared to the specified testing. We may also direct you to do less testing than we specify in this section.

EPA estimates that the cost to conduct chassis testing at a third party facility would be approximately \$30,000 per tractor, for a total of \$150,000 per year per manufacturer. RIA Chapter 7.2.1.2 includes the compliance costs of the program, including the increased level of reporting in the tractor program.

*Emission Control Labels*

The number of emission control systems for greenhouse gas emissions in Phase 2 has increased significantly. Due to the complexity in determining greenhouse gas emissions as in Phase 2, the agencies do not believe that we can unambiguously determine whether or not a vehicle is in a certified condition through simply comparing information that could be made available on an emission control label with the components installed on a vehicle. Therefore, EPA proposed to remove the requirement to include the emission control system identifiers required in 40 CFR 1037.135(c)(6) and in Appendix III to 40 CFR part 1037 from the emission control labels for vehicles certified to the Phase 2 standards. After considering the comments, EPA is finalizing the proposed tractor labeling requirements. This approach is consistent with the recommendation in Navistar's comments.



## *Aerodynamics*

- The agencies are keeping the reference aerodynamic test method as coastdown for Phase 2.
- The agencies also received comments from other HD manufacturers stressing that coastdown testing does not produce  $C_dA$  values at zero yaw. Even at calm test conditions, the resulting yaw angle is something greater than zero degrees. The agencies evaluated our aerodynamic test data and agree with the manufacturers. Therefore, we are adopting Phase 2 provisions that use the effective yaw angle determined by the actual testing (instead of an assumed zero degree) from coastdown testing to determine the Falt-aero value (see 40 CFR 1037.525). See RIA Chapter 3.2.1 for additional detail.
- Trailer gap: The agencies believe that it is necessary to specify a range for the trailer gap used in aerodynamic testing. It is well-accepted that gap influences the overall  $C_dA$  value, with smaller gaps producing lower  $C_dA$  values. Therefore, EPA specified the tractor-trailer gap in 40 CFR 1037.501 of less than or equal to 45 inches. However, we also note in 40 CFR 1037.525(b)(6), that if the tractor-trailer cannot be configured to meet the gap requirements, then manufacturers should use good engineering judgment.
- Falt-aero: The agencies determined the Falt-aero values for all of the tractors tested using different aerodynamic methods for Phase 2 using the aerodynamic test procedures and data analysis finalized for Phase 2. As shown in further detail in RIA Chapter 3.2.1, the Falt-aero values ranged between 1.13 to 1.20 for multiple sleeper and day cab tractors tested with the same CFD software. Therefore, the agencies concluded that a single Falt-aero value is not sufficient for determining the correlation of test methods for all tractors. Based on the comments and further refinement of our selective enforcement audit (SEA) provisions in the Phase 2 final rule, we are adopting provisions that require manufacturers to determine Falt-aero for a minimum of one day cab and one sleeper cab in MYs 2021, 2024, and 2027. The Falt-aero testing requirements in the final rule are less than the number proposed, but still balance the need for accuracy with the associated test burden.
- Phase 2 standard trailer: We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer with a trailer skirt, as proposed. However, we also want to recognize that the trailer fleet will continue to evolve over the lifetime of tractors built and certified to Phase 2, especially from MY 2027 and later. We recognize that if we do not account for reduced aerodynamic loads in the real world, then we may not be appropriately evaluating the tractor powertrain. We considered changing the standard trailer in MY2027; however, this would lead to significant testing burden for the manufacturers because they would have to determine new  $C_dA$  values for their entire fleet of tractors. Instead, we are adopting Phase 2 GEM that beginning in MY 2027 will take the  $C_dA$  input for each vehicle and reduce it by  $0.3 \text{ m}^2$  to reflect the lower aerodynamic loads that are a mix of trailers with skirts and trailers with skirts and boat tails. This change has been accounted for in both the baseline and standard setting of the  $\text{CO}_2$  emissions and fuel consumption values. The agencies respond to Navistar's more detailed comments on Bins V through VII in RTC Section 4.3.
- Constant Speed Testing: The agencies conducted a significant number of constant speed tests both prior to issuing the NPRM and between the NPRM and FRM. See RIA Chapter 3.2.1.1.3.3. While constant speed testing is not the reference aerodynamic method for Phase 2, it is allowed as an alternative method under both Phase 1 and Phase 2. The agencies addressed Navistar's specific suggestions for refinements in 40 CFR 1037.534. Additional requirements were included for testing on a windy day through constraints on the yaw angle distribution. Our analysis showed that meeting these requirements resulted in a yaw characteristic with sufficient confidence. Torque instruments must also be calibrated and zeroed as specified in 40 CFR

1037.534. Many aspects of the constant speed test procedure, including preconditioning procedures and road/track characteristics, refer to the coastdown test procedure detailed in 40 CFR 1037.528.

*SEA and Confirmatory Aerodynamic Testing*

With respect to Navistar's concern about changing the Phase 1 tractor program related to aerodynamic testing of tractors, EPA is not revising the Phase 1 tractor aerodynamics provisions in terms of SEA or confirmatory testing. The agencies note that we maintained the provision in 40 CFR 1037.150(k) which allows a one bin compliance margin for in-use testing.

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA_s$  and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. We are adopting provisions in 40 CFR 1037.305 that detail the SEA procedures for aerodynamic testing, including the definition of "a" and "b." We set "a" equal to 1.5 and "b" equal to 0.03 (the middle of the range discussed in the NODA). These provisions also define the top of the bin boundary to be the value specified in 40 CFR 1037.520 plus 0.05 m<sup>2</sup> to account for rounding. We are also adopting provisions in 40 CFR 1037.150(s) which states that EPA will make our determination using a statistical analysis consistent with the principles of SEA testing in 40 CFR 1037.305. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility. EPA adopted SEA provisions that state that we may conduct aerodynamic testing using either the coastdown (reference) test method or the aerodynamic method used by manufacturer to certify the tractor. Additional discussion is included in Section III.E.2.a of the Preamble to the final rule.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Furthermore, it is imperative to note that fuel economy has a non-linear relationship with the percent of fuel consumed. The agencies have created confusion on this topic which must be addressed. "Fuel economy" is not used in reference to heavy-duty vehicles as it can be misleading based on the type of freight hauled, route, traffic conditions, speed limits, driver skill, etc.<sup>5</sup> Therefore, a technology which might increase the fuel economy by 24% does not necessarily equate to fuel consumption savings. In fact, there is a higher probability that the fuel consumption savings will be much less. While the agencies claim that the Phase II regulations will be based upon performance standards, they still do not properly address the diversity which exists in the trucking industry and in the various duty cycles (type of freight, weight, routes, etc.). According to NAS 2010 research analysis entitled Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, "in [h]eavy vehicles the most meaningful metric of fuel efficiency must be viewed in relationship to the work performed." They call

this load-specific fuel consumption (LSFC). This vital metric is missing in the agencies testing and analysis. According to the NAS study, “Regulators need to use a common procedure to develop a baseline LSFC data for various applications, to determine if separate standards are required for different vehicles that have a common function.”<sup>6</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.6-7]

The Oak Ridge National Laboratory performed a study in 2011 in partnership with the Department of Energy (DOE) and industry to research the impact real-world conditions can have on the fuel efficiency of Class 8 trucks (trucks with a gross vehicle weight rating (GVWR) of 33,001 pounds). Oak Ridge collected data on over 1,000 trips covering some 700,000 miles of primarily highway travel. When looking at the fuel efficiency of Class 8 trucks by weight over flat terrain and traveling 65 miles per-hour (“mph”), the result demonstrates that fuel economy/mpg is not an appropriate measure of fuel efficiency for the heavy-duty industry due to the effects of the weight of the load.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.7-8]

The Oak Ridge study also monitored the weight, speed, fuel efficiency, and actual road location/grade of certain trucks. When the fuel economy of the same truck carrying the same load over different terrain was analyzed, results show that fuel economy can vary substantially even for the same truck. On severe uphill sections of terrain, fuel economy of the same truck can be 60 percent worse, while on severe downhill grades, the same truck’s fuel economy is 221 percent better. The opportunities for inappropriate mpg claims to be made for heavy-duty vehicles are almost infinite, especially when operational differences are factored in. For example, using the data from Figure 1 it can be shown that the gain/loss from going uphill or downhill is not equivalent. This means that a truck traveling up and back down a hill with no net elevation change will only get approximately 70 percent of the fuel economy as the truck would on level ground.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.8]

**Response:**

*Metric*

The agencies agree with the commenter that fuel economy is not the appropriate metric for heavy-duty vehicles. The metrics used in the rules are grams of CO<sub>2</sub> per ton-mile and gallons per 1,000 ton-mile. These metrics align with the load-specific fuel consumption metric recommended by NAS. In addition, the agencies discussed the non-linearity between fuel economy and fuel consumption and more details on the metric in the Preamble to Phase 1. 76 FR 57148. We are retaining the same metrics between Phase 1 and Phase 2.

*Grade*

The agencies agree with the commenter’s concern that the program should reflect real world operation. As discussed in Section III.E.2.b of the Preamble to the final rules, the agencies have adopted drive cycles that include road grade. The agencies also cite the study conducted by Oak Ridge National Laboratory discussed in the comments.

**Organization:** PACCAR, Inc.

**The Wind-Averaged Drag Assessment can be Greatly Simplified and Still Provide Accurate Measurements of Aerodynamic Drag**

The agencies have proposed to require wind-averaged drag evaluation to include nine separate wind angles. Due to the broad number of cab/sleeper combinations that make up PACCAR's product offerings, conducting eight additional evaluation points will be extraordinarily burdensome. PACCAR currently conducts simulations on just under 250 combinations offered under the Kenworth and Peterbilt brands, totaling nearly 500 simulation points. If the agencies finalize the proposal and requires nine different wind angles for each of these combinations, PACCAR would be conducting approximately 4,000 additional simulations, as well as several dozen additional mid-point simulations. [EPA-HQ-OAR-2014-0827-1204-A1 p.12]

Instead of requiring a 9-angle wind averaged drag evaluation, PACCAR recommends that the agencies allow manufacturers to use a surrogate angle of 4.5 degrees. PACCAR and other OEM analysis has demonstrated that this approach provides nearly identical test results as the more burdensome 9-angle sweep, within a minimal margin of error. The chart and table below show the data and findings. In the charts below, PACCAR has provided more information regarding our tests and assessments that result in the recommended 4.5 degree wind angle, which compares very favorably to the 9-angle sweep. PACCAR can provide more information to the agencies on this subject as needed and is willing to work with the agency on other possible methods of reducing the wind-averaged drag testing burden. [EPA-HQ-OAR-2014-0827-1204-A1 p.12]

[Graphics, Aerodynamic Drag Polar and Surrogate Yaw Angles Evaluated, can be found on p.12-13 of docket number EPA-HQ-OAR-2014-0827-1204-A1]

### **Low- and Mid-roof Tractor Compliance Effort Should be Reexamined**

In the review of the NPRM tractor stringency levels, it was determined that the compliance effort to meet low- and mid-roof tractor configurations is not consistent with the effort that is needed on high-roof tractors. It is expected that the change of a vehicle spec from a high-roof tractor to a low- or mid-roof tractor should not require additional vehicle GHG-reducing technologies for the lower roof vehicle configuration to be compliant to the GHG regulation. [EPA-HQ-OAR-2014-0827-1204-A1 p.22-23]

Currently the GEM output for a low- and mid-roof vehicle in Phase 2 Aero Bin II, III, or IV will require some-to-significant levels of additional technology to make up the 3-5 g/ton-mile shortfall as compared to the high-roof equivalent. The added cost of the technologies for vehicles operating tankers, flatbeds, and low-boys could lead to the unintended consequence of the purchase of a high roof vehicle to operate in a low- or mid-roof application. This would clearly be an adverse impact as a result of this GEM assessment. [EPA-HQ-OAR-2014-0827-1204-A1 p.23]

Performance of a low- and mid-roof aero Bin III tractor should have the same or near same performance as its equivalent aero Bin VI tractor when the same technologies are applied to both configurations. PACCAR requests the agencies review the low- and mid-roof relationship to high-roof tractors in order to balance the compliance effort for these tractors. [EPA-HQ-OAR-2014-0827-1204-A1 p.23]

### **The Proposed Coastdown Testing Requirements Should be Streamlined**

The agencies have proposed to require coastdown for each major model in both a day cab and sleeper-cab configuration and would require manufacturers to test up to six models, or up to 12 vehicles, per year, until all models have been tested. Due to the large number of models and configurations that PACCAR companies offer, this would impose an extremely high testing burden on our operations. PACCAR would be faced with at least three or four years of testing, which may have to be repeated as models change or new models are introduced. [EPA-HQ-OAR-2014-0827-1204-A1 p.20]

PACCAR has provided EPA with testing results that shows that coastdown test-to CFD analysis results yield extremely similar comparisons for the aerodynamic adjustment factor,  $F_{\text{alt-aero}}$ , across three different truck models. The spread of the  $F_{\text{alt-aero}}$  values is less than 0.3%. PACCAR recommends that a single coastdown test can be used to represent multiple models, if not the entire model lineup from an OEM. The aero adjustment factor compares favorably when assessed with a given OEM's coastdown test process and alternate aero assessment method (i.e. CFD, or reduce scale model wind tunnel testing). [EPA-HQ-OAR-2014-0827-1204-A1 p.20]

PACCAR strongly recommends that the agencies reduce the number of coastdown tests that must be conducted each year to a single vehicle, as well as provide coastdown testing flexibilities. PACCAR suggests that the agencies allow OEMs the option to extrapolate coastdown test data and  $F_{\text{alt-aero}}$  determination for each alternative aerodynamic test method from one model to all other models. [EPA-HQ-OAR-2014-0827-1204-A1 p.20]

### **The Agencies Should Not Penalize The Industry if it Corrects an Error in the Phase 1 Aerodynamics Equation**

As part of the Phase 1 rule, the agencies issued an equation for calculating wind-average drag that included a factor which the agency now believes results in overly generous wind-average drag values. The agencies have proposed to correct this factor as part of the Phase 2 rule, which would increase vehicle CdA values by 3.3%. This change would effectively move many vehicles to a lower aerodynamic bin designation. While PACCAR agrees that the agencies did not use this equation or factor in calculating the stringency of the standards, PACCAR does not agree that the agencies should revise the factor now and retroactively lower the bin designations, i.e. higher CdA value GEM input, for many PACCAR vehicles. We estimate that approximately 50% PACCAR tractors would move from Bin V to Bin IV if this change is made. These lower bin classifications would affect our overall ability to comply with the Phase 1 standards and to generate credits that may be necessary for compliance with the Phase 2 program. PACCAR and other OEMs have relied on the current equation for three model years and future product plans have been based on the Bin designations using the current equation. If the agencies revise the factor now for future model years, it will have serious implications for our product planning and future compliance. A retroactive application of a revised factor would have a devastating effect on our overall compliance strategy. [EPA-HQ-OAR-2014-0827-1204-A1 p.13]

PACCAR understands that the agencies now believes the factor to result in slightly lower numerical wind-averaged drag values than what the agencies would like to have used for aero bin determination. However, the agencies should not make any changes now that affect credits that PACCAR and other companies have already generated, nor should the agencies make changes to an equation that has large implications for our compliance planning. PACCAR recommends that the agencies leave this factor unchanged. To do otherwise would undermine the existing program and greatly complicate compliance, and the agencies should not retroactively penalize the industry. [EPA-HQ-OAR-2014-0827-1204-A1 p.13]

### **ii. A Compliance Margin is Required for Aerodynamic Confirmatory Testing**

The agencies have proposed to narrow the Bin ranges in the Phase 2 rule, which has significant implications for confirmatory and Selective Enforcement Audit (SEA) testing. All testing has variability. This variability, combined with narrowed compliance Bins, could mean that a vehicle might be dropped to a lower bin (higher CdA) in confirmatory testing, when in fact it conforms to a higher bin. PACCAR has compiled the range of high roof sleeper cab and day cab CdA values of tractors since the start of the year. These are seen in the charts below. The agencies' proposed compliance margin of requiring the

aerodynamic CdA during the confirmatory or SEA test to fall in the same bin as the OEM's stated bin for that chassis does not take into account the testing variabilities. Any testing variation could cause the aerodynamic CdA value to be slightly higher, pulling vehicles that are near a bin boundary into a worse aero bin, thus making them non-compliant. This is an unacceptable outcome. [EPA-HQ-OAR-2014-0827-1204-A1 p.10]

[Graphs, Sleeper Bin Concentration, Day Cab Bin Concentration, can be found on p.10-11 of docket number EPA-HQ-OAR-2014-0827-1204-A1]

EMA's comments provide extensive details on the sources and extent of variability in aerodynamic test runs. As this supporting information shows, moderate variability can be expected, but the agencies should not finalize a rule that does not account for this aspect of testing. Without such compliance margin PACCAR will be required to move a large section of vehicles that tested in a higher Bin to a lower Bin, i.e. from Bin IV or Bin V, to enforce an internal compliance margin. This compliance margin would need to be applied to all PACCAR vehicles in bins above Bin I. [EPA-HQ-OAR-2014-0827-1204-A1 p.11]

In the Phase 1 rule, the agencies provided a 1-Bin compliance margin for confirmatory testing. If manufacturers certified vehicles to a particular Bin designation, the agencies would consider the vehicle in compliance as long as the confirmatory or SEA testing did not show the vehicle as moving down more than a single Bin. PACCAR recommends that the agencies continue to provide the same compliance margin in the Phase 2 rule, or provide another type of compliance margin to reflect the variability in confirmatory or SEA test results. This could be in the form of an allowable CdA value or percentage difference from the certification standards. PACCAR is willing to work with the agencies on establishing the proper compliance margin for this testing; a compliance margin cannot be specified that is smaller than the variability of the test process executed within weather and other constraints. [EPA-HQ-OAR-2014-0827-1204-A1 p.11]

### **In-Use Vehicle Testing Should be Eliminated**

The agencies have proposed highly burdensome in-use testing that is intended only to generate data to validate the GEM model used by EPA and NHTSA. The proposed in-use testing will largely replicate the powertrain integration testing that manufacturers are already highly motivated to conduct as part of the certification process. These in-use testing requirements are not aimed at confirming compliance and the agencies have existing and effective tools for ensuring that in-use performance is consistent with certification test results. PACCAR therefore recommends that the agencies eliminate the in-use vehicle testing requirement in its entirety. At minimum, the agencies should reduce the number of vehicles that must be tested, share the expense and effort of the testing program, or conduct a one-time GEM validation test program. In addition, PACCAR supports EMA's comments on in-use testing burdens. [EPA-HQ-OAR-2014-0827-1204-A1 p.23]

### **Rear Axle Efficiency**

The agencies recognize that this technology has benefits; however, the requirement to conduct testing to demonstrate the benefit of rear axle efficiencies that are reflective of real world products is quite burdensome given the amount of credit that might be generated. PACCAR recommends that the agencies eliminate the testing burden by providing credit amounts based on calculated values. [EPA-HQ-OAR-2014-0827-1204-A1 p.25]

### **Continue Phase I Approach for Class 7 Cabs**

There are few Class 7 sleeper-cabs produced each year. PACCAR has produced less than 50 each year since GHG regulations began. Vehicles that have sleepers added should be allowed to comply with Class 7 day cab standards as is the case in Phase 1. PACCAR agrees with the agencies that no change in policy is needed. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Response:**

*Aerodynamics*

Wind Average Drag Assessment: Consistent with the commenter's suggestion, the agencies are adopting aerodynamic testing provisions that use a 4.5 degree surrogate angle in lieu of a full yaw sweep.

Low/Mid Roof Tractors: In Phase 1, the agencies adopted only two aerodynamic bins for low and mid roof tractors. The agencies limited the number of bins to reflect the range of aerodynamic technologies effective in low and mid roof tractor applications. High roof tractors are consistently paired with box trailer designs, and therefore manufacturers can design the tractor aerodynamics as a tractor-trailer unit and target specific areas like the gap between the tractor and trailer. In addition, the high roof tractors tend to spend more time at high speed operation which increases the impact of aerodynamics on fuel consumption and GHG emissions. On the other hand, low and mid roof tractors are designed to pull variable trailer loads and shapes. They may pull trailers such as flat bed, low boy, tankers, or bulk carriers. The loads on flat bed trailers can range from rectangular cartons with tarps, to a single roll of steel, to a front loader. Due to these variables, manufacturers do not design unique low and mid roof tractor aerodynamics but instead use derivatives from their high roof tractor designs. As Phase 2 looks to further improve the aerodynamics for high roof sleeper cabs, we believe it is also appropriate to expand the number of bins for low and mid roof tractors too. For Phase 2, the agencies proposed to differentiate the aerodynamic performance for low and mid roof applications with four bins, instead of two, in response to feedback received from manufacturers of low and mid roof tractors related to the limited opportunity to incorporate certain aerodynamic technologies in their compliance plan. However, upon further discussions with EMA, it became evident to the agencies that the most straightforward approach would be to include the same number of low and mid roof aero bins as we have for high roof tractors.<sup>137</sup> Therefore, we are adopting seven aero bins for low and mid roof tractors in Phase 2. In addition, we proposed and are adopting provisions in 40 CFR 1037.520(b)(3) that allow low and mid roof tractor aerodynamic bins to be determined based on the aerodynamic bin of an equivalent high roof tractor. These modifications, along with the adjustments to the adoption rates of the low and mid roof aerodynamic bins discussed in RTC Section 4.3, should address the concerns raised by the commenter.

Coastdown Test Requirements: The agencies determined the Falt-aero values for all of the tractors tested using different aerodynamic methods for Phase 2 using the aerodynamic test procedures and data analysis finalized for Phase 2. As shown in further detail in RIA Chapter 3.2.1, the Falt-aero values ranged between 1.13 to 1.20 for multiple sleeper and day cab tractors tested with the same CFD software. Therefore, the agencies concluded that a single Falt-aero value is not sufficient for determining the correlation of test methods for all tractors. Furthermore, based on the comments and further refinement of our selective enforcement audit (SEA) provisions in the Phase 2 final rule, we are adopting provisions that require manufacturers to determine Falt-aero for a minimum of one day cab and one sleeper cab in MYs 2021, 2024, and 2027.<sup>138</sup> While this significantly reduces the test burden from the levels proposed, it also only represents a minimum requirement.

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<sup>137</sup> Memo to Docket. Aerodynamic Subteam Meetings with EMA. July 2016. Docket EPA-HQ-OAR-2014-0827.

<sup>138</sup> See Section III.E.2.a.ix for details on the SEA requirements.

Phase 1 Aerodynamics Equation: EPA proposed a different equation with a ratio of 0.8330 in 40 CFR 1037.525(d) for the case of full yaw sweep measurements to determine wind-averaged drag correction as an amendment to the Phase 1 program. Some commenters argued that this change would impact stringency of the Phase 1 standard, but we disagree because manufacturers are already subject to EPA compliance using both methods (full yaw sweep and  $\pm 6$  degree measurements), and this Phase 1 flexibility was not used in setting the level of the Phase 1 standards. Nevertheless, we are adopting the final rule without amending this part of the Phase 1 rules. Commenters persuasively indicated that any such amendment to the Phase 1 rules at this date could upset compliance plans predicated on the rules remaining un-amended. These expectations and reliance are legitimate, and the agencies accordingly are not amending this aspect of the Phase 1 rules.

#### Aerodynamics Compliance Margin:

The widths of the aerodynamic bins represent a balance between narrower bins to further differentiate the performance of aerodynamic technologies versus wider bins to allow less test burden (more tractors fall within a given bin). The range of Phase 1 aero Bin IV is  $0.5 \text{ m}^2$ . The agencies set the Phase 2 aerodynamic bin boundaries in the final rule with a range of  $0.5 \text{ m}^2$  for Bins I through III and  $0.4 \text{ m}^2$  for Bins IV through VI. The agencies held discussions with the tractor manufacturers to discuss bin widths post-proposal to help us achieve the proper balance.<sup>139</sup>

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor  $C_dA_s$  and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. We are adopting provisions in 40 CFR 1037.305 that detail the SEA procedures for aerodynamic testing, including the definition of "a" and "b." We set "a" equal to 1.5 and "b" equal to 0.03 (the middle of the range discussed in the NODA). These provisions also define the top of the bin boundary to be the value specified in 40 CFR 1037.520 plus  $0.05 \text{ m}^2$  to account for rounding. We are also adopting provisions in 40 CFR 1037.150(s) which states that EPA will make our determination using a statistical analysis consistent with the principles of SEA testing in 40 CFR 1037.305. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility. EPA adopted SEA provisions that state that we may conduct aerodynamic testing using either the coastdown (reference) test method or the aerodynamic method used by manufacturer to certify the tractor. Additional discussion is included in Section III.E.2.a of the Preamble to the final rule.

#### *In-Use Testing Requirement*

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<sup>139</sup> U.S. EPA. Memo to Docket. Aerodynamic Subteam Meetings with EMA. EPA Docket # EPA-HQ-OAR-2014-0827.



After consideration of the comments, the agencies are requiring tractor manufacturers to annually chassis test five production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production. See 40 CFR 1037.665. We do not expect absolute correlation between GEM results and chassis testing. GEM makes many simplifying assumptions that do not compromise its usefulness for certification, but do cause it to produce emission rates different from what would be measured during a chassis dynamometer test. Given the limits of correlation possible between GEM and chassis testing, we would not expect such testing to accurately reflect whether a vehicle was compliant with the GEM standards. Therefore, we are not applying compliance liability to such testing. Rather, this testing will be for informational purposes only. However, we do expect there to be correlation in a relative sense. Vehicle to vehicle differences showing a 10 percent improvement in GEM should show a similar percent improvement with chassis dynamometer testing. Nevertheless, manufacturers will not be subject to recall or other compliance actions if chassis testing did not agree with the GEM results on a relative basis. Rather, the agencies will continue to evaluate in-use compliance by verifying GEM inputs and testing in-use engines. (Note that NTE standards for criteria pollutants may apply for some portion of the test cycles).

EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM.

As also noted in Section II. B. (1), it can be expensive to build chassis test cells for certification. However, EPA has structured this pilot-scale program to minimize the costs. First, this chassis testing will not need to comply with the same requirements as will apply for official certification testing. This will allow testing to be performed in developmental test cells with simple portable analyzers. Second, since the program will require only five tests per year, manufacturers without their own chassis testing facility will be able to contract with a third party to perform the testing. Finally, 40 CFR 1037.665(c) states that we may approve a request to perform alternative testing that will provide equivalent or better information compared to the specified testing or we may also direct you to do less testing than we specify in this section.

#### *Rear Axle Efficiency*

The agencies' assessment of axle improvements found that axles built in the Phase 2 timeline could be 2 percent more efficient than a 2017 baseline axle. In lieu of a fixed value for low friction axle lubricants, the agencies are adopting an axle efficiency test procedure (40 CFR 1037.560), as discussed in the NPRM. The axle efficiency test is optional, but will allow manufacturers to recognize in GEM reductions in CO<sub>2</sub> emissions and fuel consumption through improved axle gear designs and/or mandatory use of low friction lubricants. We believe the testing approach better differentiates the effectiveness of the variety of axle technology improvement paths, such as lubricants or low friction gears, than developing a fixed improvement value and trying to define what technologies qualify.

#### *Phase 1 Approach to Class 7 Tractors*

The agencies have not changed the approach of requiring Class 7 tractors with sleepers to comply with the Class 7 all cab style standards in 40 CFR 1037.106.

**Organization:** Plastics Industry Trade Association (SPI)

## Recognizing Aerodynamic Improvements

The Phase 2 proposal suggests the addition of two additional bins for aerodynamic metrics (drag coefficient). This will provide increased incentive to adopt aerodynamic advances. Additionally, the increased yaw angles added to wind tunnel testing and an average wind coefficient of drag will enhance the ability to simulate drag under real life highway and wind conditions. [EPA-HQ-OAR-2014-0827-1225-A1 p.3]

The new requirements for constant speed tests may also help isolate aerodynamic drag from the vibration, mechanical and friction encountered at low speeds<sup>3</sup> because constant speed tests provide better repeatability than coast down tests.<sup>4</sup> Finally, this will provide an opportunity for harmonization with European testing which already requires constant speed tests. [EPA-HQ-OAR-2014-0827-1225-A1 p.3]

The proposed rule also seeks to model tractors with a standardized trailer, and model trailers with a standardized tractor, which is a wise approach to encourage improved aerodynamics. The proposed reference trailer, with skirts between the fifth wheel and the trailer body to restrict underbody air flow, is representative of trailer aerodynamic improvements likely to emerge during the term of Phase 2. [EPA-HQ-OAR-2014-0827-1225-A1 p.3]

### **Response:**

The agencies are adding two additional aerodynamic bin definitions (Bins VI and VII) in the Phase 2 regulations with the understanding that aerodynamics will continue to improve over the next ten years until the full phase-in of the Phase 2 program and to provide a value to be input to GEM should they do so. However, we considered the comments and discuss the adoption rates of the more aerodynamic bins in Section III.D.1.c.i of the Preamble, which ultimately concludes that the standards should be predicated only on performance of aerodynamic technologies reflecting up to Bin V. We are also adopting an aerodynamic assessment at a yaw angle of 4.5 degrees, which is representative of a wind averaged value. The agencies are adopting constant speed testing as an alternative aerodynamic testing method in Phase 2, which will allow manufacturers to harmonize with their European testing. We are also adopting as proposed the standard trailer for tractor aerodynamic testing that includes a skirt for Phase 2.

### **Organization:** SABIC Innovative Plastics US LLC

Under Phase 2, the measured frontal drag area (CdA), which is drag coefficient (Cd) multiplied by frontal area (A), would be calculated rather than predefined. This should help capture the reduction in drag achieved by tractor designs with optimized frontal areas. [EPA-HQ-OAR-2014-0827-1207-A1 p.3]

Likewise, the agencies propose using several yaw angles to better approximate highway and wind conditions that introduce drag on the side areas of the vehicle. It is particularly important to account for lateral yaw in this rulemaking because of the relatively large lateral areas of a tractor-trailer combination. As Exa Corporation testified at the Long Beach public hearing: [EPA-HQ-OAR-2014-0827-1207-A1 p.3]

Because of the significant impact to real world efficiencies due to wind yaw effects; we feel it is imperative that wind effects be part of the standard ...<sup>4</sup> [EPA-HQ-OAR-2014-0827-1207-A1 p.3]

The agencies note that a 'wind averaged drag coefficient is about 15 percent higher than the zero degree coefficient of drag.' This is directionally consistent with findings from SABIC's work with Exa to model the aerodynamic benefits of the optimized Class 8 Day Cab roof fairing.<sup>6</sup> That research showed an 8-10 percent higher wind-averaged drag coefficient, based on the use of both zero degree and 6 degree yaw in

CFD modelling.<sup>7</sup> We believe the proposal to include yaw effects in CFD modelling for Phase 2 will result in more realistic estimates of on-road aerodynamic performance. [EPA-HQ-OAR-2014-0827-1207-A1 p.3-4]

#### Revised Aerodynamic Bin Structure

Under the Phase 2 proposal, wind-averaged measured frontal drag area (WACdA) would replace Cd as the aerodynamic input into the GEM. WACdA will be used to place tractors into bins with similarly performing tractors. The boundaries of the Phase 1 bins have been modified and additional bins proposed to 'recognize further advances in aerodynamic drag reduction beyond what was recognized in Phase 1.' SABIC supports adjustment of the bin structure to accommodate coming advances in tractor aerodynamics. [EPA-HQ-OAR-2014-0827-1207-A1 p.4]

SABIC's research with Exa included close to 100 roof fairing design concepts and were modeled using CFD. Significantly, multiple designs demonstrated in excess of 2 percent fuel savings compared to a baseline roof fairing representative of the current market. [EPA-HQ-OAR-2014-0827-1207-A1 p.4]

The best performing concept is pictured in Figure 1 and utilizes a double-walled thermoplastic construction featuring internal air ducts to accelerate airflow through the fairing and around the trailer. In CFD analysis, this model achieved a 5.8 percent reduction in drag compared to the baseline roof fairing and thereby yields a fuel efficiency improvement of nearly 3 percent. SABIC plans to fabricate a full-scale prototype to undergo on-road testing to corroborate CFD results. [EPA-HQ-OAR-2014-0827-1207-A1 p.4]

[Figure 1, Optimized Fairing with internal Ducting, can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1207-A1]

A noteworthy finding from this research was the potential for a single, critically placed component (in this case, a roof fairing) to provide significant aerodynamic benefits. SABIC is confident that other areas along the tractor and trailer present opportunities for drag reduction, resulting in substantial cumulative improvements in mileage and emissions. Given this, the revised bin structure should help incentivize adoption of advanced aerodynamic features and packages. [EPA-HQ-OAR-2014-0827-1207-A1 p.4-5]

#### Constant Speed Testing

Also for Phase 2, the agencies have for the first time proposed specific requirements for conducting the constant speed test, which would remain an alternative to coast-down testing. Constant speed testing may help isolate aerodynamic drag from the vibration, mechanical and friction encountered at low speeds. Research suggests that constant speed tests may provide better repeatability than coast-down tests.<sup>10</sup> Also, the constant speed test is required in European aerodynamic testing for trucks, and its use in the U.S. could promote harmonization. [EPA-HQ-OAR-2014-0827-1207-A1 p.5]

#### Trailer Aerodynamics

Consistent with the 2010 National Research Council report,<sup>11</sup> the agencies recognize that aerodynamic efficiencies can best be obtained through the optimized pairing of trailers and tractors. The agencies note some challenges in modelling the large number of combinations that might occur in the marketplace (e.g., due to different manufacturers, useful lives and owners). Because the matching of tractor and trailers on any given vehicle—or any given run—is impossible to predict, the agencies have wisely proposed to model tractors with a standardized trailer, and model trailers with a standardized tractor. The proposed

reference trailer features aerodynamic improvements likely to emerge during the term of Phase 2, including skirts between the fifth wheel and the trailer body to restrict underbody airflow. [EPA-HQ-OAR-2014-0827-1207-A1 p.5]

SABIC supports the recognition of trailer aerodynamics in the GEM program, and the expansion of the bin structure to accommodate anticipated improvements in tractor and trailer aerodynamics during Phase 2. [EPA-HQ-OAR-2014-0827-1207-A1 p.6]

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4 Testimony of Kevin Golsch, Exa Corporation, U.S EPA Public Hearing on Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 18, 2015.

6 Pereira, C. et al., Drag Reduction through Optimization of an Aerodynamic Day Cab Roof Fairing, SAE 2015 Commercial Vehicle Engineering Congress, October 6-8, 2015, 15CVA-0026 2015-012892 PPRES.

7 U.S. EPA, NHTSA, Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (Phase II), Draft Regulatory Impact Analysis, EPA-420-D-15-900 (June 2015), pp. 2-19 and 2-20.

10 Institute for Internal Combustion Engines and Thermodynamics, Evaluation of fuel efficiency improvements in the heavy-duty vehicle (HDV) sector from improved trailer and tire designs by application of a new test procedure, Report No. 1-24/2011 Hb-Em 18/11/679 (2011).  
[http://www.theicct.org/sites/default/files/publications/Final\\_ReportiCCT\\_VDA\\_FINAL2.pdf](http://www.theicct.org/sites/default/files/publications/Final_ReportiCCT_VDA_FINAL2.pdf).

11 National Research Council; Transportation Research Board, Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, ISBN: 978-0-309-14982-2 (2010).

**Response:**

The agencies are adopting aerodynamic testing provisions that represent wind averaged drag, but are also adopting the use of a 4.5 degree surrogate angle in lieu of a full yaw sweep.

The agencies appreciate the information and data shared by SABIC in terms of opportunities for aerodynamic improvements. The agencies included this information in the RIA of the final rule in Chapter 2.4.2.1.2.

The agencies are keeping the reference aerodynamic test method as coastdown for Phase 2, while allowing constant speed testing as an alternative aerodynamic test method. We believe this is the appropriate approach because the agencies were able to develop more robust coastdown test procedures for Phase 2 and it builds on the experience that the agencies and tractor manufacturers have gained during Phase 1 aerodynamic testing.

Phase 2 reference trailer: We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer with a trailer skirt, as proposed.

HD Phase 1 included five aerodynamic bins to cover the spectrum of aerodynamic performance of high roof tractors. Since the development of the Phase 1 rules, the manufacturers have continued to invest in aerodynamic improvements for tractors. This continued evolution of aerodynamic performance, both in production and in the research stage as part of the SuperTruck program, has consequently led the agencies to propose and adopt two additional aerodynamic technology bins (Bins VI and VII) for high roof tractors. However, we have not predicated the use of either Bins VI or VII in setting the stringency of the Phase 2 standards.

**Organization:** SmartTruck

As an Aerodynamic Device Manufacturer, SmartTruck is keenly aware of the challenges that are inherent in aerodynamic testing protocols and have dedicated countless hours of research in this area with our aerodynamic scientists and engineers. SmartTruck's Chief Science Officer and aerodynamicist, Michael Henderson, spent 32 years at Boeing in senior engineering and management positions as well as helping to develop one of the first Computational Fluid Dynamics (CFD) programs (Naiver-Stokes). Since founding SmartTruck, our aerodynamic engineers have conducted over 1,000 coastdown test runs and have over 75 years of combined experience with CFD analysis. We therefore direct these comments to the Supplemental Aerodynamic Data from EPA Testing Docket No. EPA-HQ-OAR-2014-0827-1624, specifically the testing methods used to determine the performance of aerodynamic devices on medium and heavy duty vehicles. [EPA-HQ-OAR-2014-0827-1923-A1 p.1-2]

We support the use of various test methods such as Coastdown, CFD, Wind Tunnel, and Constant Speed in order to provide aerodynamic device manufacturers the option to use their preferred method and as a way to achieve alignment with the tractor regulations in the Phase 1 rule. However, to ensure accuracy and comparability between all parties regardless of testing methodology we believe testing protocols across all methods should include calibration standards, that coastdown testing protocols should account and correct for non-linear speed related mechanical drag, and that there should be more test facilities and technology types involved in the comparison between different testing methods. [EPA-HQ-OAR-2014-0827-1923-A1 p.2]

All testing methods have strengths and weaknesses related to assumptions that are utilized in each test. For example, coastdown and constant speed testing are dependent upon the data regression techniques used for their analysis.<sup>1</sup> CFD is dependent upon its grid density and its location on the model to ensure accurate results. Wind Tunnel testing utilizing scaled models can produce Reynolds Number Effects, Wall Effects, and Jet Effects that influence the test results of components that interact with the boundary layer.<sup>2</sup> [EPA-HQ-OAR-2014-0827-1923-A1 p.2]

CFD and wind tunnel testing methods could both be calibrated with an Ahmed Body style analysis to ensure both separation predictions and wake drag are accurately accounted for. A two stage drag spoiler analysis could be used with coastdown and constant speed testing to ensure that a difference in drag is predicted accurately with minimal cost to users. Using a calibration process across all testing methodologies would also provide a more accurate comparison between tests. [EPA-HQ-OAR-2014-0827-1923-A1 p.2]

The current coastdown methodology, specifically SAE J1263 and SAE J2263, has two fatal flaws; it is assumed that rolling resistance, or more aptly denoted as Mechanical Drag, is constant over the course of a coastdown test session and Mechanical Drag is linear with speed. Firstly, current coastdown methodology tests for the complete road load force or total drag, which is the sum of the Aerodynamic Drag and the Mechanical Drag. Current methodology assumes the Mechanical Drag is constant during a test and therefore a change in Aerodynamic Drag is equivalent to the change in Total Drag. Therefore a

simple test is performed to calculate the Road Load Force. At SmartTruck we have seen first-hand that this method leads to inaccurate results. If the vehicle's oil, lubrications, metals, tires, and brakes are not completely warmed up and maintained at a near consistent state for an entire test session (eight Baseline Segments and eight Aerodynamic Segments as outlined in CFR 1066.310) the Mechanical Drag is subject to change, or creep, throughout the day. [EPA-HQ-OAR-2014-0827-1923-A1 p.2]

Secondly, the Mechanical Drag is not just the rolling resistance of the tires. During a coastdown test when the vehicle is shifted into neutral, the vehicle is not only experiencing aerodynamic drag and tire rolling resistance, but it is also back driving the transmission and differential gears in addition to all the bearings between the tires, axels, and drive shafts. The back driving of the mechanical drive components of the vehicle is highly non-linear with speed. For example, with the differential gear there is a ring gear engaged to a pinion gear which are suspended in oil and/or air. As they are being back driven, and spinning within their case, they are rotating through oil and through the air and thusly subject to two separate sources of drag. These sources of drag are well known and vary with speed to the order of velocity squared, not linearly.<sup>3</sup> In addition to the two separate sources of drag, the differential gear will be subject to wet friction while the teeth are engaged in the oil. With two rear gears, a transmission, a multitude of bearings, axles and drive shafts all being driven, all having their own Wet Friction and/or Aerodynamic Drag, the final Mechanical Drag will be a combination of the tire's rolling resistance and the non-linear drag associated with the drive components of the vehicle. [EPA-HQ-OAR-2014-0827-1923-A1 p.3]

If current coastdown methodology does not account for both the creep of Mechanical Drag throughout a test session as well as its non-linear variation with speed, any and all Aerodynamic Drag associated will be subject to unknown non-measured errors rendering its solutions unreliable. There are reliable, inexpensive ways of accomplishing this. [EPA-HQ-OAR-2014-0827-1923-A1 p.3]

Also, while the agencies have proposed a formula for normalizing wind tunnel, CFD, and constant speed to coastdown testing, specifically relating to Docket Number EPA-HQ-OAR-2014-0827 concerning Selective Enforcement Audits (SEAs), that formula is based solely on the results of one wind tunnel facility to the results of one coastdown facility.<sup>4</sup> Due to the variables and assumptions that are utilized at different locations we would prefer to see multiple testing facilities used in normalizing data from one method to another. For example, CFD calibrations could be done similar to the American Institute of Aeronautics and Astronautics' Drag Prediction Workshop (DPW). Also, for further refinement and correlations, more technology types, such as boundary layer manipulation devices, should be utilized in normalization to further strengthen claims. [EPA-HQ-OAR-2014-0827-1923-A1 p.3]

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1 Cornbleet, P. Joanne, and Nathan Gochman. 'Incorrect Least-squares Regression Coefficients in Method-Comparison Analysis.' *Clinical Chemistry* 25, no. No. 3 (1979).

2 Schewe, Guneter. 'Reynolds-number Effects in Flow around More-or-less Bluff Bodies.' *Journal of Wind Engineering and Industrial Aerodynamics* 89 (2001).

3  $CDA = D/(0.5\rho V^2)$

4 U.S. Environmental Protection Agency. Office of Transportation and Air Quality. Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles- Phase 2 Draft Regulatory Impact Analysis. Accessed February 19, 2016. <http://www3.epa.gov/otaq/climate/documents/420d15900.pdf>

**Response:**

As noted in the comments, coastdown testing measures all of the losses associated with the vehicle, including aerodynamics, rolling resistance, and driveline losses. To isolate the aerodynamic  $C_dA$ , it is important to remove the losses for the driveline and tire rolling resistance. For the final Phase 2 rules, the agencies are incorporating into the coastdown procedure a modified SAE J2452 test procedure that requires manufacturers to measure the speed dependence of the tire rolling resistance for each of the steer, drive, and trailer tire models used on the article undergoing a coastdown test. The tire rolling resistance must be adjusted to the ambient temperature during the coastdown test using the correction mentioned in ISO 28580. The agencies are also requiring that manufacturers measure the speed dependence of the spin losses of the model of the drive axle(s) used on the article undergoing a coastdown test. We did not observe strong evidence of mechanical drag creep in our testing and did not receive data to correct for this. The testing we conducted was overnight with minimal fluctuations in ambient temperature. Repeat testing of tractors on different days showed acceptable repeatability. Testing requires a warming up phase as well as driving at high speeds, which help to keep the vehicle warmed up.

Due to the various technologies and geometries that we would expect to be implemented from this rule, the agencies are finalizing wind tunnel and CFD test procedures based largely on industry standards SAE J1252 and SAE J2966, respectively. We believe that adopting industry standards is a sound basis for these complex areas of testing, which encompass many facilities and software codes. Modest exceptions to the SAE standards are required for greater precision or to align with specific aspects of the rulemaking. The CFD test procedure can be found in 40 CFR § 1037.532. Furthermore, for the tractor program, CFD and wind tunnel tests are required to be adjusted to a coastdown equivalent value using  $F_{alt-aero}$  determined from a reference coastdown test. Any modifications to simulation parameters would require a recalculation of this adjustment factor, leading to corresponding changes in the certification drag area values for non-reference tractors.

**Organization:** Truck & Engine Manufacturers Association (EMA)

**Standard Trailer**

As referenced above, the configuration of the standard trailer proposed for use in Phase 2 coastdown testing should be more aerodynamic. Proposed section 1037.501(g) specifies that the standard trailer for coastdown testing will be similar to the Phase 1 standard trailer, with the sole addition of aerodynamic side skirts. A more aerodynamic trailer, however, would better reflect the trailers expected in 2027 and beyond, and would be better suited for the advanced tractor-trailer aerodynamic performance assumed and required under the Proposed Phase 2 Standards. As it stands, the agencies have failed to demonstrate that any tractor can achieve aerodynamic Bins V through VII when pulling the defined test trailer. To the contrary, all designs envisioned for achieving those Bins are matched with a highly streamlined trailer. [EPA-HQ-OAR-2014-0827-1269-A1 p.15]

**Aerodynamic Compliance Margin**

EPA also has proposed to narrow the Bin ranges in the Phase 2 program, which has significant implications for confirmatory testing. All testing has variability. This variability, combined with narrowed compliance Bins, could result in a vehicle appearing to have dropped into a lower Bin in confirmatory testing. One OEM has compiled the range of high-roof sleeper-cab and day-cab  $C_dA$  values from wind-averaged and non-yaw averaged vehicle tests conducted since the start of 2015. Those  $C_dA$  values are plotted in the charts below. EPA's proposed compliance requirement - that the aerodynamic  $C_dA$  during any confirmatory test or SEA must fall in the same Bin as the OEM's stated Bin - does not take into

account the several relevant testing variabilities. Current testing variation could cause the aerodynamic CdA value to be slightly higher, pulling vehicles that are near a Bin boundary into a lower Bin, thereby making them “non-compliant.” This is an unacceptable situation that could result in an infeasible rule. A 1-Bin compliance margin is necessary. [EPA-HQ-OAR-2014-0827-1269-A1 p.12]

EMA’s comments below regarding the coastdown test procedure provide extensive details on the sources and extent of variability in aerodynamic testing. As that information shows, the agencies should not finalize a rule that does not account for known sources of testing variability. Without an adequate compliance margin, OEMs will be required to move a large section of vehicles that tested in a higher Bin to a lower Bin to allow themselves the necessary compliance margin. That will result in making the Phase 2 Standards that much more infeasible. [EPA-HQ-OAR-2014-0827-1269-A1 p.14]

A compliance margin is necessary for the proposed aerodynamic certification measurements. However, proposed section 1037.401(b) does not include any compliance margin whatsoever for an audit of aerodynamic certification, despite the fact that coastdown testing includes a great deal of variability – significantly more than in Phase 1 where the agencies did include a compliance margin. If the agencies hold manufacturers to the certified CdA during an audit without providing any compliance margin, manufacturers would have to compensate for the lack of a test margin by raising their GEM CdA input by approximately one Bin to provide themselves with the necessary margin to account for the variability inherently associated with compliance testing. Such a forced increase of manufacturers’ aerodynamic CdA GEM inputs would make achieving the Proposed Phase 2 Standards, in effect, a full-Bin more difficult, which amounts to a hidden stringency increase, further exacerbating the infeasibility of the Proposed Phase 2 Standards for heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.16]

The variability of coastdown testing is on the order of +/- 5%, based on EPA's own test data under very controlled conditions (i.e., same flat test track, same vehicle and time-of-day, low wind, skilled driver, etc.). (See Daimler Trucks North America’s SAE ComVEC 2013 Presentation). If EPA expects manufacturers to certify vehicles with no compliance testing margin provided in the rules to account for that 5% variability, then manufacturers will have to certify vehicles at 5% above their true CdA. In turn, the agencies’ stringency numbers will need to be increased to reflect the fact that the agencies projected aerodynamic improvement targets – plus 5% – would be the necessary inputs into GEM. The alternative and better option is for the agencies to recognize the variability inherent in the proposed audit procedures, and to provide that a vehicle would fail an audit only if its CdA is more than 5% above the certified level. [EPA-HQ-OAR-2014-0827-1269-A1 p.16]

EPA also is proposing to allow aerodynamic audits under methods of the Agency’s choosing. For example, EPA is proposing that in auditing a vehicle’s aerodynamic performance, the Agency “may use any of the procedures specified in § 1037.525 for measuring drag area.” See Proposed § 1037.401(b). As a practical matter, this would force manufacturers to consider the variability among all of the methods referenced in section 1037.525 in order to determine the maximum CdA that the Agency might calculate with any one of them, and to include additional margins of compliance into all vehicles’ declared CdA’s to protect against the variability that may occur when a vehicle is tested using a procedure that the manufacturer did not use. This would make already-difficult aerodynamic targets that much more unachievable. [EPA-HQ-OAR-2014-0827-1269-A1 p.16]

To remedy this unreasonable result, EMA recommends as follows for any audit, whether for aerodynamics or for any engine-related or vehicle-related parameter input into GEM: the Agency should (first) inquire about the method that the manufacturer used in its certification testing, and (second) assuming that method is authorized under the Phase 2 regulations, then the Agency should use that same method for its audit. The underlying rationale is that if a manufacturer has selected a proper test method,



then the Agency should not, in effect, second-guess the manufacturer. Rather, the audit should merely be a test of whether the manufacturer's results under that authorized method are valid. To that end, the agencies should utilize the same test methods and testing location as used by the manufacturer. The agencies also should use the same reference test tractor and trailer as used by the manufacturer to eliminate potentially significant sources of variability. Under EPA's proposal, however, the Agency could confound natural variations arising from different test procedures with test-to-test variations, thus increasing the likelihood of the Agency erroneously concluding that the manufacturer submitted invalid or improper test results. EPA should not second-guess manufacturers or misapply the results from differing test method and measurement errors to challenge manufacturers' otherwise proper certifications. The agencies' proposed test methods need to be revised and improved substantially, as discussed further below. [EPA-HQ-OAR-2014-0827-1269-A1 p.16-17]

On the other hand, EPA's proposal to conduct SEAs that involve testing two or six additional vehicles, beyond those originally planned for testing, is untenable. Testing will in all likelihood have to take place at a specific track (for example, in Cape Canaveral, Florida), given the limited number of suitable test facilities. In addition, data analysis takes time. For manufacturers to know that vehicles might fail an SEA (e.g., due to test-to-test variability inherent in the aerodynamic testing procedures) and to arrange to get two or six additional vehicles out to the test facility within a narrow test window is not reasonable. Rather, EPA should (i) assign a realistic compliance margin to SEAs, as the Agency did in Phase 1, and (ii) adopt realistic and reasonable SEA procedures, such as testing another vehicle at a later date. [EPA-HQ-OAR-2014-0827-1269-A1 p.19]

- For confirmatory tests, the agencies should use the same tractor, trailer, and wind instrumentation, at the same testing facility as used by the vehicle manufacturer
- For SEAs, use the same test method, test facility and trailer, as well as the same instrumentation, if applicable. [EPA-HQ-OAR-2014-0827-1269-A1 p.18-19]

With respect to other confirmatory testing issues, EMA agrees with the agencies' approach in proposed section 1037.201(g). The agencies have recognized that manufacturers cannot store a large number of test vehicles for an indefinite period, nor can they guarantee that on any given day they will have exactly the configuration of vehicle that the agencies request under proposed section 1037.201(g). Rather, if EPA intends to require testing of a number of full-scale vehicles, EPA should understand that manufacturers may need to sell some of those vehicles. Consequently, EPA should agree to work with manufacturers to find acceptable test vehicles at acceptable times, which perhaps could mean that EPA's first choice of vehicle is not available on the day the Agency requests it. The agencies have proposed that manufacturers would be able to produce similar vehicles, not necessarily the original test vehicles. EMA agrees with this approach. [EPA-HQ-OAR-2014-0827-1269-A1 p.19]

#### Coastdown Test Procedure

There are a number of fundamental problems with the proposed aerodynamic testing requirements. In particular, the proposed coastdown test procedures are not sufficiently defined and do not adequately address many key issues, such as yaw angle, type and number of sensors (i.e., anemometers), test speeds, and test sequence. The test procedures also fail to provide any compliance margin, which creates basic feasibility concerns given the many sources of significant testing variability. [EPA-HQ-OAR-2014-0827-1269-A1 p.4]

The proposed coastdown test procedure (see Proposed § 1037.527) will produce inherently inaccurate results. The proposed test procedure assumes 0° yaw wind conditions, a completely unrealistic assumption. When coastdown testing is conducted, there always will be some wind, which necessarily

increases the CdA. Additionally, the non-aerodynamic losses during a coastdown test (such as tire rolling resistance and driveline friction) are underestimated in the proposed test procedure, which will further increase the measured CdA. Finally, the proposed test procedure does not include a method of correction for pavement surface variability of the test track. All of those factors need to be addressed. [EPA-HQ-OAR-2014-0827-1269-A1 p.17]

Chief among those test procedure issues is the agencies' unrealistic assumption of zero yaw conditions (= no cross-wind). EPA and NHTSA are assuming that a coastdown test will yield a 0 degree CdA value (the lowest point on the drag polar), whereas in reality manufacturers measure something that is higher up the drag polar (at a non-zero point). Theoretically, manufacturers could attempt to wait at the test track for zero-wind conditions, but EPA is authorized to conduct confirmatory coastdown tests with wind speeds up to 6 mph. Consequently, it is necessary for manufacturers and EPA to assign and account for an average yaw angle in any given coastdown test. [EPA-HQ-OAR-2014-0827-1269-A1 p.17]

With a complete drag polar determined through the alt-aero method (CFD or wind tunnel), it is possible to calculate the ratio between two values at two different yaw conditions. That way, manufacturers could measure at 2 degrees and EPA could measure at 3 degrees (depending on the wind conditions during the test) and then the manufacturers could adjust its value to EPA's test condition (or vice versa) and actually have two comparable test values. Given the shrinking (if not disappearing) compliance margin, it is critically important to ensure as close to an "apples-to-apples" comparison as possible. Thus, including yaw angle is important to the implementation of a fair and reasonable coastdown test. [EPA-HQ-OAR-2014-0827-1269-A1 p.17]

Another problem associated with the proposed coastdown test is its failure to properly account for the various non-aero losses (driveline/axle losses, rolling resistance). The "low speed" test may not be as accurate as it needs to be due to the inaccurate estimation of axle losses/rolling resistance. Specifically, rolling resistance is known to increase significantly between the "low speed" test and the "high speed" test, but that is not accounted for in the proposed coastdown test procedure. The underestimated non-aero losses "bleed" into the aerodynamic load estimation, leading to an overestimation of the CdA. [EPA-HQ-OAR-2014-0827-1269-A1 p.17]

With respect to the actual running of a coastdown test, there are multiple sources of test-to-test variability. More specifically, all of the following variables will need to be accounted for in any final regulatory coastdown test. [EPA-HQ-OAR-2014-0827-1269-A1 p.17]

Coastdown Test Variables [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

Test Conditions (up to +10% increase in CdA) [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

– Wind (head, tail, yaw)

– Temperature (including tire impacts)

Track (up to 5% increase in CdA due to surface difference) [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

– Grades

– Pavement surface

– Pavement temperature

Tractor (up to 5% increase in CdA due to newer truck and/or tires) [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

– Tire model and wear

– Axle friction

Measurement Accuracy and Variability [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

– Vehicle speed

– Wind speed and direction

Trailer Gap [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

- Many trucks cannot achieve the regulated gap due to long wheel base or short cab (especially day cabs)
- +/- 2” tolerance
- Trailer skirt location relative to tractor bogie

Trailer [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

- Corners
- Skirt tolerances
- Skirt stiffness
- Tires

Since improved aerodynamic performance is a cornerstone of the Proposed Phase 2 Standards, the test methods to assess that performance need to be correct, repeatable and accurate. Otherwise, the foundation of the Phase 2 program could be subject to challenge. To strengthen and enhance the test methods at issue, and in addition to accounting for the sources of variability noted above, the agencies should implement the following improvements: [EPA-HQ-OAR-2014-0827-1269-A1 p.18]

- Tighten the wind constraints to  $\leq 2$  mph crosswind (maintain the other constraints)
- Include a tire rolling resistance offset between low and high-speeds to account for the speed dependency of the rolling resistance term
- Add yaw measurement (not just air speed) and define the tolerance to +/- 0.5 degrees
- Change the location of the anemometers to at least 1.5 meters above the trailer’s leading edge
- Change the proposed test sequence to high-low, high-low in matched pairs
- Increase the required number of tests to  $>30$  valid high-low pairs in a test day
- Determine average yaw during each high-speed coast
- Plot CdA vs. yaw, where each high-speed coast generates a data point
- Define objective data-acceptance criteria based on statistical results
- Define minimum grade and elevation survey data requirements to ensure that any change in velocity due to grade can be captured during high and low-speed runs
- Obtain an effective mean CdA at an effective mean yaw angle for the test
- “F<sub>alt-aero</sub>” then should be defined at the yaw angle for the reference test
- Vehicle manufacturers should provide the yaw curve for the reference vehicle through the “alt aero” method; this could be used by the agencies to account for any differences in wind condition/yaw angle between a reference test and a confirmatory test [EPA-HQ-OAR-2014-0827-1269-A1 p.18-19]

In addition, the agencies should commit to review the current trailer-gap specification and tolerance (i.e., 45” +/- 2”); *see* section 1037.501(g)). In that regard, tighter trailer-gaps may be appropriate in the future for assessing aerodynamic performance, as well as compliance with the Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.19]

#### Changes to CFD Certification

Since the highway test cycle in GEM assumes that heavy-duty vehicles spend 86% of the time traveling at 65 mph, EMA recommends that the agencies raise the test speed for Computational Fluid Dynamics (“CFD”) certification from 55 mph to 65 mph to be consistent with GEM. In addition, EMA recommends that the agencies replace the full yaw sweep, as generated through SAE J1252, with a single surrogate yaw angle of 4.5 degrees, which represents the intended (SAE J1252) wind-averaged condition. [EPA-HQ-OAR-2014-0827-1269-A1 p.19-20]

EMA recommends that these amendments be included in proposed section 1037.531. [EPA-HQ-OAR-2014-0827-1269-A1 p.20]

### Aerodynamic Adjustment Factors

One core issue relates to the proposed test procedures and data assessment methods to determine a heavy-duty vehicle's certification to and compliance with the proposed aerodynamic standards for each major tractor model. The agencies' proposed procedures would include, among many other requirements, a requirement that vehicle manufacturers test up to six (6) vehicle models each year in both the day-cab and sleeper-cab configurations, resulting in a total of twelve (12) coastdown tests per year. [EPA-HQ-OAR-2014-0827-1269-A1 p.4]

Only one aerodynamic adjustment factor,  $F_{alt-aero}$ , should be required. This is confirmed by the data set forth in RIA Table 3-21 (reproduced above at page 7) which shows that the  $F_{alt-aero}$  values are extremely close (1.11-1.15) among the tested vehicles. (*See also* Agency data, reproduced below, showing  $F_{alt-aero}$  factors of 1.09 +/- 0.02 for three tested vehicles). [EPA-HQ-OAR-2014-0827-1269-A1 p.20]

Data that vehicle manufacturers have provided to the agencies also establish that the relevant  $F_{alt-aero}$  values are within a range of three-tenths of 1% (0.30%). However, proposed section 1037.525(b)(3) would require determining separate adjustment factors for "a high-roof day cab and a high-roof sleeper cab corresponding to each major tractor model." The coastdown testing needed to establish such multiple adjustment factors would be a time-consuming, costly and unreasonable burden. Additionally, there would not be any need for such multiple adjustment factors if the aerodynamic test procedure is made sufficiently robust to produce comparable results at different facilities on different days. Simply stated, the aerodynamic adjustment factor should not be vehicle dependent. [EPA-HQ-OAR-2014-0827-1269-A1 p.20]

### Constant-Speed Testing

The agencies are considering the adoption of a constant-speed test for assessing aerodynamic performance in lieu of the proposed coastdown test. EMA cannot support this proposal at this juncture. There is insufficient time in this rulemaking process to properly study whether constant-speed testing is equivalent to or better than coastdown testing in determining the aerodynamic drag coefficient. The complex and time-consuming test procedure would require multiple studies to determine the reproducibility of the results and their comparison to results from coastdown tests. Accordingly, EMA recommends that the constant-speed test be included only as a potential alternative to be phased-in at a future date, if appropriate, to allow more time to study the proposed procedure. In that regard, a number of considerations will need to be studied in evaluating the potential merits of a constant-speed test, including the following: [EPA-HQ-OAR-2014-0827-1269-A1 p.70]

- There should be a requirement for either axle or wheel-end torque sensors (wheel-end torque sensors on front-drive axles with unpowered, shortened half-shafts on rear-drive axles have been shown to be effective and cost-efficient)
- There should be a requirement for equal data (time) in each direction at each speed
- Onboard anemometer calibrations ( $V_r$ ) should be required using the SAE J2263 method with all valid 50 and 70-mph constant-speed data; zero-offset (yaw calibration) should be performed using equal 70-mph data in each direction
- Requirements should be defined for preconditioning prior to each steady-state speed and throughout the data-collection process

- Speed-dependent tire RR terms should be included (ISO or SAE tire data depending on test process precondition constraints – steady-state or transient)
- A correction should be included for non-zero inertial terms in each 10-sec segment
- Corrected force tolerance should be specified (include gravity and inertial corrections) rather than drive-torque consistency to validate data
- A minimum requirement for yaw distribution should be specified before curve-fitting to determine drag polar
- Given the error with low speed measurement in high wind conditions, a 1<sup>st</sup> order wind speed/direction force correction should be adopted [EPA-HQ-OAR-2014-0827-1269-A1 p.70]

In sum, the foregoing issues, along with many others, will need to be carefully considered before the agencies move to adopt a constant-speed test as a designated reference test method. [EPA-HQ-OAR-2014-0827-1269-A1 p.70]

#### 4x2 Axle Configurations

The agencies should specify that any vehicle with a “4x2” axle configuration and that also is equipped with a heavy-duty powertrain should be classified as a Class 8 vehicle, regardless of GVWR. If such a vehicle has a heavy-duty certified engine, it should be treated as a Class 8 vehicle, and so should be able to generate Class 8 credits. In that regard, 4x2 tractors are typically purchased to pull multiple trailers and, as a result, normally pull heavier loads than a typical 6x4 tractor, even if the GVWR of the tractor is less than 33,000 pounds due to the reduced number of axles. [EPA-HQ-OAR-2014-0827-1269-A1 p.43]

#### Phase 1 Changes

The proposed changes to the Phase 1 wind-average drag aerodynamic certification calculation should not be finalized. As it stands, proposed section 1037.525(d)(2)(iii) would establish a new equation for calculating the wind-averaged drag area for model year 2018 and later vehicles. Such a Phase 1 change – in effect, a retroactive change – would require recertification of all heavy-duty tractors that utilized the alternative yaw-sweep correction factor (which alternative has been relied on by virtually all manufacturers to demonstrate compliance), and would increase the aerodynamic drag inputs into GEM starting in 2018, effectively increasing the stringency of the Phase 1 standards for model years 2018-2020. That is fundamentally unfair and, from an administrative rulemaking perspective, invalid. If EPA and NHTSA want to alter the stringency of the Phase 1 program, they will need to provide the requisite leadtime and stability periods. [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

More specifically, pursuant to the equation in the current version of section 1037.525(d)(2)(iv), the corrected drag area to be used to determine the Phase 1 aerodynamic bins is calculated by multiplying the zero-yaw drag area by “CF<sub>y</sub>s,” which is a yaw-sweep correction factor. Current Phase 1 regulatory section 1037.521(f)(2) provides the option to calculate wind-average drag, as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

(f) *Yaw sweep corrections.* You may optionally apply this paragraph (f) for vehicles with aerodynamic features that are more effective at reducing wind-averaged drag than is predicted by zero-yaw drag. You may correct your zero-yaw drag area as follows if the ratio of the zero-yaw drag area divided by yaw sweep drag area for your vehicle is greater than 0.8065 (which represents the ratio expected for a typical aerodynamic Class 8 high-roof sleeper cab tractor): [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

(1) Determine the zero-yaw drag area and the yaw sweep drag area for your vehicle using the same alternate method as specified in this subpart. Measure drag area for 0°, -6°, and 6°. Use the arithmetic mean of the -6° and 6° drag areas as the ±6° drag area. [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

(2) Calculate your yaw sweep correction factor (CF<sub>ys</sub>) using the following equation: [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

$$CF_{ys} = (\pm 6^\circ \text{ drag area}) \times 0.8065 / (\text{Zero Yaw Drag Area})$$

Subparagraph (5) of current section 1037.521(f) also provides as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

(5) As an alternative, you may choose to calculate the wind-averaged drag area according to SAE J1252 (incorporated by reference in §1037.810) and substitute this value into the equation in paragraph (f)(2) of this section for the ±6° yaw-averaged drag area. [EPA-HQ-OAR-2014-0827-1269-A1 p.21]

This regulatory flexibility has proved to be critical to the cost-effective implementation of Phase 1, and heavy-duty vehicle manufacturers have expressly relied on the alternative set forth in section 1037.521(f) in certifying their heavy-duty tractors. However, in the proposed Phase 2 regulations, and without any proper notice or study, EPA and NHTSA are proposing to replace the option set forth in subparagraph (f)(5) with a new equation in proposed section 1037.525(d)(2), which increases the target ratio of zero-yaw drag area to wind-averaged drag area from 0.8065 to 0.8330 (when using the SAE J1252 wind-averaging) after MY 2017. [EPA-HQ-OAR-2014-0827-1269-A1 p.21-22]

The effect of this unilateral revision by the agencies is an increase in CF<sub>ys</sub> by a factor of 0.833/0.8065, which amounts to an increase of 3.3% in the CdA used for certification. This will necessarily shift tractors to lower, less aerodynamic bins, which again effectively increases the burden of compliance and the stringency of the Phase 1 standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

For example, the Phase 1, Bin IV CdA range for high-roof sleepers is 5.6-6.2, but effectively will become 5.42-6.00 under EPA's revision. Consequently, all trucks currently above 6.00 CdA will shift down to Bin III. The net result is that approximately 36% of Bin IV sleeper trucks will shift to the lower Bin. Similarly, the current Bin III CdA range for high-roof sleepers is 6.3-6.7, but will effectively become 6.1-6.48 under the agencies' retroactive changes to the Phase 1 Standards, causing a corresponding reversion to Bin II. Additionally, since mid- and low-roof tractors can be binned based on their high-roof equivalents, and since the low- and mid-roof subcategories for both sleepers and day-cabs typically are in applications with lower penetrations of aerodynamic devices due to operational considerations, those factors also will drop many Phase 1 tractors that are in those low- and mid-roof subcategories from Bin II (which will reduce the vehicles' FEL) into Bin I. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

EPA and NHTSA argue that since the correction factor at issue is an option, the announced regulatory change is not a stringency increase. But all manufacturers are using this "option," and, in effect, are required to do so given the impossibility of meeting the agencies' automatic engine shutdown ("AES") system targets (discussed further below at page 52). Consequently, the revision at issue is, in fact, an unacceptable, essentially retroactive Phase 1 stringency increase that will significantly impact credit balances and feasibility. It is also a change with near-zero leadtime to certify MY 2018 vehicles, since those vehicles can begin production on Jan. 2, 2017. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

For its part, NHTSA is proposing to amend the stringency of its Phase 1 program, and to expand the NHTSA standards to four decimal places. The expanded precision would be required in calculating

vehicle FELs. EMA supports this amendment, since it will correct the current error in the calculation of GHG/FE credits. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

That said, EMA is concerned that there is no reference in the NPRM that the agencies will use the corrected method to recalculate the 2013 and 2014 model year credits, which manufacturers have earned based on the year-end reports that they have already submitted. The agencies should allow for those recalculations of earned credits. In addition, the agencies will need to account for this in their release of an updated version of GEM. [EPA-HQ-OAR-2014-0827-1269-A1 p.23]

#### In-Use Tractor Testing

A second core issue relates to the proposed requirement that vehicle manufacturers conduct chassis dynamometer testing of three sleeper-cab tractors and two day-cab tractors each year to verify the results simulated through the updated GEM Model. Simply stated, vehicle manufacturers do not have sufficient testing facilities to run all of those required verification tests, which would not be cost-effective even if sufficient facilities were available. In addition, the proposed test methods are (again) not sufficiently defined. More fundamentally, EMA questions the need for the proposed chassis dynamometer testing. If EPA and NHTSA believe that such testing is sufficiently important, the agencies are, of course, free to undertake that testing on their own. However, the agencies have not proposed any rational basis for imposing such a significant cost on manufacturers, with little or no corresponding environmental or societal benefit. [EPA-HQ-OAR-2014-0827-1269-A1 p.4]

Proposed section 1037.665 would require annual chassis dynamometer testing and reporting of emissions (including NO<sub>x</sub>, PM, CO, NMHC, CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions) from “three sleeper cabs and two day cabs” for the informational purpose of comparing “real world” test results with GEM-based results. Such annual testing would impose a very significant burden on manufacturers and could result in a shortage of available heavy-duty chassis dynamometer test facilities, all while yielding no corresponding benefit. In particular, testing five vehicles is insufficient to identify or confirm fleet trends. Moreover, testing on a chassis dynamometer would not discern “real-world” fuel efficiency improvements like those resulting from AMTs, predictive technologies or other systems that improve the way a driver drives, and that are recognized in GEM – but are impossible to recreate on a chassis dynamometer. In other words, the results would be unrepresentative of the full fleet of vehicles and further unrepresentative of real-world driving, so the results would not fully reflect a vehicle’s compliance with Phase 2 Standards. Moreover, the costs for this proposed “informational” testing would be inordinately high and have not been fully accounted for in the agencies’ cost-benefit analysis for the Proposed Phase 2 Standards. In addition, EPA lacks the legal authority to compel manufacturers to test in-use, non-new motor vehicles and engines. Accordingly, while EMA is willing to work with the agencies to explore means to assess the in-use performance of Phase 2 vehicles, the proposed chassis-dynamometer testing is not a valid, reasonable or cost-effective approach for generating such in-use data. [EPA-HQ-OAR-2014-0827-1269-A1 p.28]

There are better, less burdensome ways for the agencies to gather the Phase 2 data at issue. One option would be for EPA to do its own testing or to work with manufacturers to develop a collaborative in-use testing research program. As an additional alternative, the agencies should consider using data that manufacturers already generate as part of their ongoing development processes. Product validation engineering groups regularly run vehicles through modified fuel economy tests to verify the real-world fuel-saving potential of new technologies. Those tests are conducted in a controlled way, are documented in detail, and yield very reliable results. Those data could provide the agencies with the information they are looking for in a far more cost-effective manner. Further, the agencies could consider tracking manufacturers’ inputs into GEM as a means of monitoring improvements in GHG/FE technologies. Alternatively, if chassis dynamometer testing is utilized to develop comparative information, it should be

limited to testing only one vehicle configuration and only during model years when the underlying GHG/FE standards change. [EPA-HQ-OAR-2014-0827-1269-A1 p.28-29]

#### Chassis Dynamometer Testing

The agencies have asked for comment on the utilization of chassis dynamometer testing for certification instead of relying on GEM. EMA opposes any mandate for chassis dynamometer testing for medium-duty and heavy-duty vehicles. There are far too many certifiable vehicle configuration and far too few chassis dynamometer testing facilities to make it possible to implement such a dynamometer-based certification program. Furthermore, it should be recognized that a chassis dynamometer test would require separate inputs for aerodynamic performance and rolling resistance, loads that compromise over 70% of a typical vehicle's load factors. In addition, such testing is subject to other significant variables, such as driver differences, rolling resistance on the chassis dynamometer rolls, tire temperature, and many other variable factors. [EPA-HQ-OAR-2014-0827-1269-A1 p.63]

Accordingly, given the potential variability between GEM-based certification and dynamometer-based certification, EPA needs to specify that the Agency will only utilize a chassis-dynamometer-based audit test where the underlying certification test was conducted at a chassis-dynamometer testing facility. In all other cases, the Agency's audits should be GEM-based to match the certification method that the manufacturer has used. In that regard, EMA supports setting the cut point for chassis-based certification testing at 14,000 pounds GVWR. [EPA-HQ-OAR-2014-0827-1269-A1 p.63]

#### **Response:**

##### *Standard Trailer*

The agencies re-evaluated the proposal to include trailer skirts on the Phase 2 reference trailer with consideration of the comments. We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer as proposed. However, we also want to recognize that the trailer fleet will continue to evolve over the lifetime of tractors built and certified to Phase 2, especially from MY 2027 and later. Based on testing conducted to support the trailer portion of Phase 2, we found that on average a boat tail added to a dry van trailer with skirts reduces wind averaged  $C_dA$  by  $0.6 \text{ m}^2$ . We recognize that if we do not account for reduced aerodynamic loads in the real world, then we may not be appropriately evaluating the tractor powertrain. We considered changing the standard trailer in MY 2027; however, this would lead to significant testing burden for the manufacturers because they would have to determine new  $C_dA$  values for their entire fleet of tractors. Instead, we are adopting Phase 2 GEM that beginning in MY 2027 will take the  $C_dA$  input for each vehicle and reduce it by  $0.3 \text{ m}^2$  to reflect the lower aerodynamic loads that are a mix of trailers with skirts and trailers with skirts and boat tails. This change has been accounted for in both the baseline and standard setting of the  $\text{CO}_2$  emissions and fuel consumption values.

##### *Aerodynamic Compliance Margin/SEA*

The agencies have refined the aerodynamic test procedures, developed a new SEA approach, revised aerodynamic bin boundaries, and adjusted aerodynamic bin adoption rates in the technology packages for the final rule. This package of changes as a whole is in response to the set of detailed comments from stakeholders. The changes to the coastdown test procedures reduce the test-to-test variability of the  $C_dA$  results. The new SEA approach appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on



inaccurate testing. The high roof bin values being adopted in the HD Phase 2 final rulemaking differ from those proposed due to the coastdown and other aerodynamic test procedures changes. However, in both the NPRM and this final rulemaking, we developed the Phase 2 bins such that there is an alignment between the Phase 1 and Phase 2 aerodynamic bins after taking into consideration the changes in aerodynamic test procedures and reference trailers required in Phase 2. The Phase 2 bins were developed so that a tractor that performed as a Bin III in Phase 1 would also perform as a Bin III tractor in Phase 2.

The widths of the aerodynamic bins represent a balance between narrower bins to further differentiate the performance of aerodynamic technologies versus wider bins to allow less test burden (more tractors fall within a given bin). The range of Phase 1 aero Bin IV is 0.5 m<sup>2</sup>. The agencies set the Phase 2 aerodynamic bin boundaries in the final rule with a range of 0.5 m<sup>2</sup> for Bins I through III and 0.4 m<sup>2</sup> for Bins IV through VI. The agencies held discussions with the tractor manufacturers to discuss bin widths post-proposal to help us achieve the proper balance.<sup>140</sup>

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor C<sub>d</sub>A s and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. It is important to note that, although SEAs are directed by EPA, the actual testing is conducted by the manufacturer at their chosen facilities. This minimizes many potential causes of test variability, such as differences in test trailers, test tracks, or instrumentation. Thus confidence intervals need only reflect true test-to-test variability. Also, manufacturers generally rent facilities for coastdown testing as needed, which means EPA will need to provide some advance notice to allow the manufacturer to reserve the appropriate facility.

Aerodynamic compliance will be determined by comparing the certification CdA bin with the bin determined from the SEA. Variability in the coastdown tests are addressed partially through the implementation of a bin structure, as opposed to using the test result directly. However, there may be tractors whose results are near the edge of a bin for which the SEA result could be in the neighboring less aerodynamic bin. To address this issue, the agencies are finalizing a confidence interval to apply to the top of the CdA bin, within which an SEA result would be considered to be in compliance. The basis for this confidence interval,  $z$ , is  $a \cdot \sigma \bar{x} + b$ , where  $\sigma \bar{x}$  is the standard error of the SEA result,  $a$  is a t-value, and  $b$  is an offset to account for testing variability. Details of this approach and the SEA process for aerodynamic performance are discussed in RIA Chapter 3.2.2.2.2 and Section III.E(2)(a)(ix) of the Preamble.

The agencies determined that a value of 1.5 was appropriate for  $a$ . This critical t-value for a failure of 1.5 means that, from the precision error alone, the agencies must have a confidence level of 93 percent that

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<sup>140</sup> U.S. EPA. Memo to Docket. Aerodynamic Subteam Meetings with EMA. EPA Docket # EPA-HQ-OAR-2014-0827.

the test results is above the boundary of the bin declared for that tractor configuration. This comes from the (one-tailed) probability of approximately 7 percent that a result falls in the tail of a normal distribution for a t-value of 1.5.

In addition to the precision component, the agencies are allowing an offset,  $b$ , to be applied to account for test-to-test variability. The variability of multiple tests of the same tractor was used to consider value  $b$ . As mentioned earlier, Sleeper Cab 3 was tested on multiple days. Wind conditions varied between each of these tests, causing different effective yaw angles. To compare the tests with each other, the wind-averaged CdA values were used, after adjustment to  $4.5^\circ$  as described in RIA Chapter 3.2.1.1.3. For a given alternate method used for the yaw adjustment, the wind-averaged CdA values varied by a range of  $0.11 \text{ m}^2$ .

The coastdown testing at NRC was used to investigate site-to-site variability to inform the  $b$  value. While the agencies anticipate that the manufacturers would use the same test facilities that they used for their reference tractor tests, they could choose a different site based on availability or other factors. The coastdown analysis process the agencies are finalizing could not exactly be used on the NRC data because wind conditions were not always favorable, and an unequal numbers of runs were conducted in each direction. A matched pair analysis (instead of a low-pair mean) was used along with the alternate method adjustments that were performed for the SwRI data in order to compare all results in the wind-averaged drag domain. The wind-average CdA estimated using the NRC data differed by  $0.15 \text{ m}^2$  from that using the SwRI data.

As shown in Figure 3-9 of the RIA, the standard error of test decreases as the number of runs in a test increases. At 24 runs, the standard error is on average, approximately 0.84 percent (not the  $\pm 5$  percent noted by the commenter). For a given distribution, increasing the number of runs to 100 would roughly halve the standard error to 0.42 percent, as the standard error decreases with the square root of the number of runs. With an  $a$  value of 1.5, the contribution to the confidence interval,  $z$ , of the precision error at the Bin III/IV boundary of  $5.6 \text{ m}^2$  is approximately  $0.04 \text{ m}^2$ .

Since the bin boundaries are expressed to one decimal place, the SEA provision also allows for rounding, which provides an additional  $0.049 \text{ m}^2$ . Finally, the agencies selected a  $b$  value of  $0.03 \text{ m}^2$ . Combining the selected  $a$  and  $b$  values, the estimated standard error after 100 tests, and the rounding margin; the estimated confidence interval for a tractor at the Bin III/IV boundary is  $0.12 \text{ m}^2$ . This is in the  $0.11\text{-}0.15 \text{ m}^2$  range estimated by the repeat tests done on Sleeper Cab 3 at SwRI and NRC and is around 30 percent of the width of Bin IV. The agencies are finalizing a confidence interval of  $z=1.5 \cdot \sigma_{\bar{x}} + 0.03$ , which would be applied to the SEA result when determining compliance as per SEA test procedures in 40 CFR 1037.305.

The agencies have limited the types of aerodynamic methods that would be used for SEAs in the final rule. 40 CFR 1037.305 states that EPA would require manufacturers to use the reference method (coastdown) or the method used by the manufacturer for certification.

40 CFR 1037.150(s) states that EPA will conduct confirmatory testing of Falt-aero using a statistical analysis consistent with the principles of SEA testing in 40 CFR 1037.305.

With respect to the proposed language in 40 CFR 1037.401 (in-use testing), we are adopting language that is very similar to the proposal. CAA section 206 provides EPA with broad discretion to conduct in-use testing. EPA notes that in-use aerodynamic testing would likely be limited to full-scale testing, such as coastdown. We believe EMA's comment are primarily related to recall determinations. In this context, we note that EPA's policy has been to generally use the specified test procedures (which would be coastdown in this case) to evaluate compliance with the standards. To the extent EPA were to use other

test procedures, they would likely to be used evaluate compliance with requirements other than the GHG standards, such as the prohibition against defeat devices.

Consistent with EMA's comment, EPA is adopting 40 CFR 1037.201(g) language that allows manufacturers to choose to deliver another vehicle or component that is identical in all material respects to the test vehicle or component, or a different vehicle or component that we determine can appropriately serve as an emission-data vehicle for the family.

### *Coastdown Test Procedures*

The agencies, after further consultation with EMA, have made a number of changes to the coastdown test procedures for the final rule (see 40 CFR 1037.528).<sup>141</sup> The items below summarize the responses to EMA's comments.

- The agencies have taken into account that the coastdown testing is typically not conducted under zero wind (zero yaw) conditions in the final rule. The Phase 2 regulations in 40 CFR 1037.525 now use the CdA at the "effective yaw angle" of the coastdown testing instead of assuming zero yaw. This provides an "apples-to-apples" comparison.
- As noted in the comments, coastdown testing measures all of the losses associated with the vehicle, including aerodynamics, rolling resistance, and driveline losses. To isolate the aerodynamic CdA, it is important to remove the losses for the driveline and tire rolling resistance. For the final Phase 2 rules, the agencies are incorporating into the coastdown procedure a modified SAE J2452 test procedure that requires manufacturers to measure the speed dependence of the tire rolling resistance for each of the steer, drive, and trailer tire models used on the article undergoing a coastdown test. The agencies are also requiring that manufacturers measure the speed dependence of the spin losses of the model of the drive axle(s) used on the article undergoing a coastdown test.
- The agencies set the recommended wind constraints to  $\leq 6$  mph. The required constraints are as proposed with one additional constraint that the wind component parallel to the direction of travel must not exceed 6 mph.
- EPA adopted regulations that require yaw measurement (not just air speed) with a tolerance of  $\pm 0.5$  degrees.
- EPA adopted regulations that require the location of the anemometers must be at least 1.5 meters above the trailer's leading edge. EPA requires pairs of high-low testing for coastdown, but allows some flexibility in the order that the tests are run.
- The agencies have developed a process of identifying and removing coastdown test outliers for the determination of data acceptance. First, the CdA and yaw angle data can be plotted and then the median yaw angle of the data is determined. All results differing by more than  $1^\circ$  from the median are removed. Then the mean CdA value of the remaining data points is determined. CdA values that differ by more than two standard deviations from this mean CdA are removed. At least 24 data points are needed after removal of outliers for the results to be valid. Finally, the mean CdA and mean effective yaw angle are calculated from the remaining points. The  $F_{alt-aero}$  is determined at the effective yaw angle of the coastdown test. These values are then used to adjust to reflect a 4.5 degree yaw angle result based on an alternate method yaw curve results.
- EPA adopted provisions in 40 CFR 1037.528 that require if the road grade is greater than 0.02 %

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<sup>141</sup> U.S. EPA. Memo to Docket. Aerodynamic Subteam Meetings with EMA. EPA Docket # EPA-HQ-OAR-2014-0827.

over the length of the test surface, you must determine elevation as a function of distance along the length of the test surface and incorporate this into the analysis. In addition, road grade may exceed 0.5 % for limited portions of the test surface as long as it does not affect coastdown results, consistent with good engineering judgment.

- EPA adopted provisions in 40 CFR 1037.525 that require vehicle manufacturers to provide the CdA results for a minimum set of yaw angles from any alternative method for the reference vehicle.
- The agencies believe that it is necessary to specify a range for the trailer gap used in aerodynamic testing. It is well-accepted that gap influences the overall CdA value, with smaller gaps producing lower CdA values. The agencies will not allow a variation in test procedure to be used to artificially lower CdA values. 40 CFR 137.501 states that the king pin located with its center  $36 \pm 0.5$  inches from the front of the trailer and a minimized trailer gap (no greater than 45 inches). 40 CFR 1037.525 provides an allowance for a scenario where a tractor and trailer cannot be configured to meet the gap requirements. Manufacturers are to test with the trailer positioned as close as possible to the specified gap dimension and use good engineering judgment to correct the results to be equivalent to a test configuration meeting the specified gap dimension.

### *Changes to CFD Certification*

The agencies are adopting provisions to align the speed at which CFD is conducted in Phase 2 (65 mph) with the average of the coastdown high speed range.

### *Aerodynamic Adjustment Factor*

The agencies determined the Falt-aero values for all of the tractors tested using different aerodynamic methods for Phase 2 using the aerodynamic test procedures and data analysis finalized for Phase 2. As shown in further detail in RIA Chapter 3.2.1, the Falt-aero values ranged between 1.13 to 1.20 for multiple sleeper and day cab tractors tested with the same CFD software. Therefore, the agencies concluded that a single Falt-aero value is not sufficient for determining the correlation of test methods for all tractors. Furthermore, based on the comments and further refinement of our selective enforcement audit (SEA) provisions in the Phase 2 final rule, we are adopting provisions that require manufacturers to determine Falt-aero for a minimum of one day cab and one sleeper cab in MYs 2021, 2024, and 2027.<sup>142</sup> While this significantly reduces the test burden from the levels proposed, it also only represents a minimum requirement.

### *Constant Speed Testing*

The agencies are not finalizing constant speed as the reference aerodynamic method. The agencies investigated the use of constant speed testing as the reference method to achieve a wind-averaged CdA result, which would have eliminated the need to rely on alternate methods for yaw curves. We received comments from manufacturers that they did not have enough experience in constant speed testing and recommended that the agencies not use it as a reference method. Though the agencies believe that the potential for a wind-averaged CdA from constant-speed testing exists, we agree with the manufacturers' potential concerns about developing a robust constant speed test procedure as a reference method in time for the final Phase 2 rule. However, a constant speed test procedure has been developed for use as an alternate method based on significant testing conducted by EPA (see RIA Chapter 3.2). The constant

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<sup>142</sup> See Section III.E.2.a.ix for details on the SEA requirements.

speed test procedures are described in 40 CFR 1037.534. Below is a summary of responses to EMA's comments.

- The procedure requires wheel torque measurements on each of the drive wheels. If some drive wheels can be disabled and unpowered, then only the powered wheels may be instrumented.
- The procedure requires testing at 50 and 70 mph in both calm and windy conditions to obtain data over a wide range of yaw angles. Testing is conducted over a sequence of test segments at constant vehicle speed as follows:
  - (i) 300±30 seconds in each direction at 10 mi/hr.
  - (ii) 450±30 seconds in each direction at 70 mi/hr.
  - (iii) 450±30 seconds in each direction at 50 mi/hr.
  - (iv) 450±30 seconds in each direction at 70 mi/hr.
  - (v) 450±30 seconds in each direction at 50 mi/hr.
  - (vi) 300±30 seconds in each direction at 10 mi/hr.
- An onboard anemometer is required for testing. The air speed measurement correction is based off of the roadside/trackside weather station, similar to the coastdown procedure.
- Required preconditioning is similar to the coastdown procedure.
- Speed dependence of tire rolling resistance must be determined using the modified SAE J1269 test procedure at multiple speeds.
- Corrections for inertial forces were not included because tolerances limit the speed variation allowed during testing and because the vehicle is likely to both accelerate and decelerate during the ten-second periods, which can have offsetting effects over many data points.
- The wind conditions must be such that 80 percent of the values of yaw angle,  $\bar{\psi}_{air}$ , from the 50 mi/hr and 70 mi/hr test segments are between 4° and 10° or between -4° and -10°.
- The agencies set the drive torque validation criteria as follows - All ten of the 1 second mean torque values used to calculate a corresponding 10 second mean torque value must be within ± 50 % of that 10-second mean torque value.
- The onboard anemometer measurements for air speed are corrected using onboard measurements and measured ambient conditions as described in 40 CFR 1037.528(f).
- The output of the procedure is an average  $C_dA$  value at ±4.5°.

#### *4x2 Tractors*

EPA adopted language in 40 CFR 1037.106 that allows manufacturers to optionally certify 4×2 tractors with heavy heavy-duty engines to the standards and useful life for Class 8 tractors, with no restriction on generating or using emission credits within the Class 8 averaging set.

#### *Phase 1 Changes*

Phase 1 Aerodynamics Equation: EPA proposed a different equation with a ratio of 0.8330 in 40 CFR 1037.525(d) for the case of full yaw sweep measurements to determine wind-averaged drag correction as an amendment to the Phase 1 program. Some commenters argued that this change would impact stringency of the Phase 1 standard, but we disagree because manufacturers are already subject to EPA compliance using both methods (full yaw sweep and ± 6 degree measurements), and this Phase 1 flexibility was not used in setting the level of the Phase 1 standards. Nevertheless, we are adopting the final rule without amending this part of the Phase 1 rules. Commenters persuasively indicated that any such amendment to the Phase 1 rules at this date could upset compliance plans predicated on the rules remaining un-amended. These expectations and reliance are legitimate, and the agencies accordingly are not amending this aspect of the Phase 1 rules. NHTSA Standards: NHTSA is finalizing its standards and method for calculating performance values for the Phase 1 and 2 programs with increased significant

digits as the only option for compliance. Retaining the previous method would result in ongoing differences in credit plans and balances, and continue the associated burden on manufacturers. Since manufacturers already have and will continue to develop compliance strategies for the EPA GHG program, the change will enable those strategies to also directly comply with the NHTSA fuel efficiency program, creating a more aligned National Program. Compliance with the EPA GHG program is unaffected by the change. EPA will modify the single interface used by manufacturers for certification to include increased significant digits for NHTSA's values. The new interface will apply retroactively starting in 2013 MY and will require each manufacturer's to recalculate their credit balances using the new approach.

#### *In-Use and Chassis Dynamometer Testing*

After consideration of the comments, the agencies are requiring tractor manufacturers to annually chassis test five production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production. See 40 CFR 1037.665. We do not expect absolute correlation between GEM results and chassis testing. GEM makes many simplifying assumptions that do not compromise its usefulness for certification, but do cause it to produce emission rates different from what would be measured during a chassis dynamometer test. Given the limits of correlation possible between GEM and chassis testing, we would not expect such testing to accurately reflect whether a vehicle was compliant with the GEM standards. Therefore, we are not applying compliance liability to such testing. Rather, this testing will be for informational purposes only. However, we do expect there to be correlation in a relative sense. Vehicle to vehicle differences showing a 10 percent improvement in GEM based only on the technologies that can be simulated in the chassis dynamometer (aerodynamic loads, rolling resistance loads, axle efficiency, transmission type and efficiency, engine fuel maps, axle ratio, etc.) should show a similar percent improvement with chassis dynamometer testing. Nevertheless, manufacturers will not be subject to recall or other compliance actions if chassis testing did not agree with the GEM results on a relative basis. Rather, the agencies will continue to evaluate in-use compliance by verifying GEM inputs and testing in-use engines. Note that NTE standards for criteria pollutants may apply for some portion of the test cycles.

EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM.

As also noted in Section II. B. (1) of the Preamble, it can be expensive to build chassis test cells for certification. However, EPA has structured this pilot-scale program to minimize the costs. First, this chassis testing will not need to comply with the same requirements as will apply for official certification testing. This will allow testing to be performed in developmental test cells with simple portable analyzers. Second, since the program will require only five tests per year, manufacturers without their own chassis testing facility will be able to contract with a third party to perform the testing. Finally, 40 CFR 1037.665(c) states that we may approve a request to perform alternative testing that will provide equivalent or better information compared to the specified testing, therefore the agencies may consider testing such as suggested by the commenter. We may also direct the manufacturers to do less testing than we specify in this section.

EPA estimates that the cost to conduct chassis testing at a third party facility would be approximately \$30,000 per tractor, for a total of \$150,000 per year per manufacturer. RIA Chapter 7.2.1.2 includes the compliance costs of the program, including the increased level of reporting in the tractor program.

Perplexingly, EMA states (without further discussion) that “In addition, EPA lacks the legal authority to compel manufacturers to test in-use, non-new motor vehicles and engines.” Section 207 (b) (1) of the Act authorizes EPA establish “methods and procedures’ if EPA determines that “there are available testing methods and procedures to ascertain whether, *when in actual use throughout its warranty period* ... each vehicle ... to which regulations under [section 202] apply comply with the emission standards of such regulations.” That is precisely what EPA has done here. Moreover, section 207 (b)(2) provides for substantial enforcement authority if EPA determines that vehicles are not meeting section 202 standards “when in actual use.” Under EMA’s apparent theory, that authority applies to a null set since any vehicle in actual use is by definition non-new.

In its comments, Volvo slightly expanded on EMA’s argument, stating that “we do not believe EPA has the authority to compel emissions testing of non-new vehicles simply for collecting information to compare to the regulatory approach.” But EPA seeks the information as an assurance that in-use performance is being adequately evaluated through the certification process. So this information is directly related to assuring that in use performance is consistent with certification, and thus is directly related to compliance with the section 202 (a) standards. (EPA, must, of course, develop standards that apply in use, see section 202 (a), and therefore can require testing designed ultimately to assure that standards are met in use).

With respect to the certification of tractors, the agencies are not adopting chassis dynamometer testing to demonstrate compliance with the Phase 2 tractor CO<sub>2</sub> and fuel consumption standards. Instead, the agencies are adopting a compliance structure that includes component testing and GEM. Therefore, the audits would be based on the components, not on chassis testing

**Organization:** Union of Concerned Scientist

#### MODEL-YEAR ALIGNMENT

Some concerns have been raised in public by vehicle manufacturers regarding the industry’s convention of introducing vehicles of a particular model year ahead of the calendar year. In particular, it has been cited that common practice for engines is to tie them to the calendar year, thus creating a potential misalignment between engine and vehicle model year. [EPA-HQ-OAR-2014-0827-1329-A2 p.13]

Currently, EPA and NHTSA allow significant latitude for vehicle manufacturers to determine for purposes of compliance their own model year of vehicles sold—a model year may begin as early as Jan 2 of the preceding year and can extend through December 31, effectively a two-year window. If a vehicle manufacturer is concerned that its ability to comply with a regulation is dependent on the availability of a particular engine aligned with the calendar year, there is already ample flexibility for a manufacturer under this definition. It does not seem sensible to allow a common industry practice to interfere with regulations, since no single manufacturer is bound by convention and, if the standards were weakened in response, may choose to align the model years anyway. We appeal to the agencies not to adjust the stringency or timing of tractor vehicle regulations in response to these concerns, as it could lead to the unnecessary postponement of environmental benefits. [EPA-HQ-OAR-2014-0827-1329-A2 p.13]

#### CALCULATION OF WIND-AVERAGED DRAG

In the Phase 2 regulations, the agencies recognized that it is important for manufacturers to consider yaw angle when designing a vehicle, as wind can have significant effect on fuel energy lost to aerodynamics—as such, they are now requiring that wind-averaged drag be input into GEM. In Phase 1, however, the manufacturers had the flexibility to adjust the zero-yaw aerodynamic drag coefficient by a correction

factor to reflect this design characteristic (40 CFR 1037.521(f)). The agencies are now proposing an adjustment to this factor based on additional data (Draft RIA Table 3-7). [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

The Phase 1 stringency did not include the use of the correction factor, which we now know based on additional data was much too low, thus giving manufacturers more credit than is appropriate for the fuel and emissions savings attained. The new data clearly show that the flexibility of being able to use the correction factor results in a 3.3 percent lower value than is appropriate. We strongly support adjusting this factor to accurately reflect real world reductions in fuel consumption and global warming emissions. [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

Aerodynamic inputs into GEM are determined by which bin the manufacturers' CdA value corresponds to. A CdA reduction of 3.3 percent corresponds to an average of 30 percent of an aerodynamic bin—on average, this could mean that about 30 percent of vehicles are being run in GEM with a higher aerodynamic bin than is justifiable. Given the effect of aerodynamic bin on the GEM model, this could mean a credit of about 4 g CO<sub>2</sub>/ton-mile per affected high-roof sleeper—that is approximately 5.5 percent of the average value that these vehicles are supposed to achieve over the Phase 1 rule. The agencies estimated that about 80 percent of all sleeper cabs are high-roof, which roughly means that these vehicles are responsible for about one-third of all HDV emissions (Phase 1 RIA, Figure 1-5). If 30 percent of those vehicles are getting an artificially inflated credit of 5.5 percent, this would mean an erosion of benefits of approximately 0.5 percent of the entire Phase 1 rule. That is the equivalent of over 100 million gallons of oil and 1 million metric tons of greenhouse gas emissions just for the model years in question. It is critical therefore that this be remedied. [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

If for some reason the agencies are unable to correct this factor through a technical amendment, the stringency of the Phase 2 rule should reflect the undue credits that manufacturers would be banking entering the 2021 model year, in order to ensure that the regulations be set based on real world performance and result in the appropriate real world fuel consumption and emissions reductions. [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

#### COMPLIANCE MARGIN FOR AERODYNAMIC TESTING

The agencies are eliminating the ability for manufacturers to “pass” a real-world compliance audit of aerodynamics as long as the confirmatory test results in measurement within the bin greater than certified (example, Bin II if certified as Bin III; see 40 CFR 1037.150(k)). This was a significant margin of error for manufacturers that could have encouraged gaming, and we agree with the agencies that this was unjustified based on the reproducibility of coastdown testing—as Table 3-8 in the Draft RIA illustrates, the typical reproducibility for coastdown testing is around 2 percent, much less than the 15- to 25-percent error for which the real world audit allowed. With the agencies' additional changes to the testing procedure to account for environmental conditions, this is a much-needed adjustment that will make the program stronger and hold manufacturers more accountable for real world reductions in fuel use and emissions due to improvements in tractor aerodynamics. Constant speed testing, which the agencies are also considering, appears to offer an even narrower band of reproducibility (Draft RIA Table 3-9), providing further argument against a large “compliance margin.” [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

#### THE STANDARD TRAILER AND INCENTIVIZING TRACTOR-TRAILER INTEGRATION

Tractor aerodynamics are measured while pulling a standard trailer. In Phase 1, this trailer contained no aerodynamic devices; however, the uptake of aerodynamic devices on trailers has led to the agencies



determination that tractors should be measured against a trailer with an aerodynamic skirt in Phase 2. [EPA-HQ-OAR-2014-0827-1329-A2 p.14]

Because tractors and trailers are completely interchangeable, there is no guarantee that a new tractor will be pulling the newest trailer. Therefore, we do not recommend further revising the standard trailer over the course of the rule to reflect improvements to new trailers, which some parties have called for, since tractors will generally be on-call to haul a variety of different trailers. However, we do believe it is important to recognize opportunity for innovation in cases where tractors and trailers may be more closely coupled because it can lead to significant fuel consumption reductions. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

Results of the SuperTruck program and countless aerodynamic designers over the years have shown that designing the tractor-trailer system together as an integrated system would lead to significantly more aerodynamic vehicles. While we do not anticipate the ability for this type of integration to become mainstream in the timeframe of this rule, we recommend that the agencies develop a procedure to incentivize tractor manufacturers to work with trailer manufacturers to develop vehicle systems that better optimize the aerodynamics of the tractor-trailer in order to spur the market in this direction. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

One possible way to do this is through A-to-B testing. Tractor manufacturers and trailer manufacturers already must obtain aerodynamic information relative to a standard tractor and trailer. If the system is truly integrated, there will be further reductions in CdA that are not captured when attached to a standard tractor or trailer. Consider two tractors, TRAC0 (baseline) and TRAC1 (advanced), and two trailers, TRLR0 (baseline) and TRLR1(advanced). The manufacturer of TRAC1 already must complete a test of TRAC1 and TRLR0 ([CdA]<sub>x0</sub>-[CdA]<sub>x1</sub>). Likewise, the trailer manufacturer must already prove the effectiveness of its trailer with an A-to-B comparison using a Bin III tractor or better (therefore, TRAC0 or TRAC1)—this could be measured as [CdA]<sub>x0</sub>-[CdA]<sub>x1</sub>. Finally, [CdA]<sub>00</sub> is simply a baseline configuration that could be used repeatedly by the two manufacturers. This leaves just a single test unaccounted for in estimating the additional efficacy of the integrated tractor-trailer system. If the tractor and trailer are truly integrated, then the difference in aerodynamic drag between the baseline tractor pulling a baseline trailer and the advanced, integrated tractor trailer would be greater than the sum of the differences between the baseline and advanced tractor and baseline and advanced trailer ( $[CdA]_{00}-[CdA]_{11} \sim \{[CdA]_{00}-[CdA]_{10}\} + \{[CdA]_{x0}-[CdA]_{x1}\}$ ). The difference between the two sides could be considered as a credit to the tractor manufacturer, applicable to the certified CdA for TRAC1. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

There are two additional considerations to address here. The first is that under the trailer regulation, trailer manufacturers can choose the tractor pulling the trailer, as long as it is Bin III or better—this means that credit for tractor-trailer integration is currently evaluated under the trailer regulation. A credit on the tractor side could therefore be seen as double-counting. However, given the relative research budgets and in light of the SuperTruck program itself, it seems much more likely that any additional investment in this opportunity would be made by tractor manufacturers, so therefore this does not provide sufficient incentive. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

The second consideration is that there is no guarantee that the tractor and trailer would always be used as an integrated system. It seems likely that the purchaser would be incentivized to use the two together due to the increased upfront investment, but that can't be validated. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

To address both of these concerns, we recommend that the credit only be given to the tractor manufacturer upon submitted data on how these vehicles are being operated together over the lifetime of the tractor. While it is likely that fleet operators purchasing these tractors would purchase an appropriate number of integrable trailers, we believe that the burden of proof should be on the manufacturer to prove the use of these vehicles in order to avoid undercutting the environmental benefits of the regulation. This arrangement could avoid the most significant negative environmental impacts of over crediting while promoting advanced aerodynamic design. Given the impact that aerodynamics can have on the overall efficacy of the rule (see section above on the Calculation of Wind-Averaged Drag), it is important that the incentive be balanced against real world performance. [EPA-HQ-OAR-2014-0827-1329-A2 p.15]

#### SUPPLEMENTAL DYNAMOMETER AND OVER-THE-ROAD TESTING

The agencies have proposed a chassis dynamometer testing program designed to complement full vehicle standards. Due to the agencies' reliance on GEM modeling for certification, we find this proposal entirely necessary and consistent with the goal of producing real-world benefits. Not only should this program be required of manufacturers, but the results of these tests should be shared publicly as part of an annual compliance report. It is in the public interest to ensure that any regulation is yielding the anticipated reductions in harmful emissions— therefore, it is a necessary component of that program that the public be made aware of the actual emissions of these vehicles. In order to maintain the greatest usefulness to the public, the agencies should give additional guidance to the OEMs on vehicles to select for production testing, prioritizing the testing of high-volume vehicles to inform the assessment of clear industry trends. [EPA-HQ-OAR-2014-0827-1329-A2 p.15-16]

In addition to the proposed tractor dynamometer testing, the agencies should implement a program to perform over-the-road testing of select vehicles to monitor the advancement of emissions reductions and fuel economy under real world conditions. This data could further inform any updates to dynamometer or GEM test cycles in the future along with future rulemakings on fuel economy, greenhouse gas emissions, and criteria pollution. The recent admittance by Volkswagen to circumventing laboratory testing with defeat devices harkens back to activities in the nineties by the heavy-duty truck industry and again highlighted the critical importance of not only ensuring test cycles and dynamometer testing accurately reflects real world driving as closely as possible but also the necessity of actually performing on-road testing of vehicles. [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

#### **Response:**

##### *Model Year Alignment*

Phase 2 is requiring a significant number of changes that apply to both the engine and the vehicle so it is necessary for alignment of model years between the two categories. The final Phase 2 rule includes a greater impact of engine technologies than were considered in the NPRM to determine the tractor standards. By aligning the model years of the tractors with the engines, this essentially provides some additional lead time for the tractor manufacturers. This additional lead time was considered by the agencies in setting the tractor stringency levels. For example, the technology package developed by the agencies for setting the 2027 MY tractor standards included both a high adoption rate of waste heat recovery and new engine platforms that will require some modifications to the vehicle, therefore, the vehicle standard cannot take effect before the engine standards.

##### *Phase 1 Wind Averaged Drag Equation*

EPA proposed a different equation with a ratio of 0.8330 in 40 CFR 1037.525(d) for the case of full yaw sweep measurements to determine wind-averaged drag correction as an amendment to the Phase 1 program. Some commenters argued that this change would impact stringency of the Phase 1 standard, but we disagree because manufacturers are already subject to EPA compliance using both methods (full yaw sweep and  $\pm 6$  degree measurements), and this Phase 1 flexibility was not used in setting the level of the Phase 1 standards. Nevertheless, we are adopting the final rule without amending this part of the Phase 1 rules. Commenters persuasively indicated that any such amendment to the Phase 1 rules at this date could upset compliance plans predicated on the rules remaining un-amended. These expectations and reliance are legitimate, and the agencies accordingly are not amending this aspect of the Phase 1 rules. However, the agencies evaluated the status of Phase 1 credit balances in 2015 by sector.<sup>143</sup> For tractors, we found that manufacturers are generating significant credits, and that it appears that many of the credits result from their use of an optional provision for calculating aerodynamic drag. However, we also believe that manufacturers will generate fewer credits in MY 2017 and later when the final Phase 1 standards begin. Still, the agencies believe that manufacturers will have significant credits balances available to them for MYs 2021-2023, and that much of these balances would be the result of the test procedure provisions rather than pull ahead of any technology. Therefore, we are increasing the stringency of the CO<sub>2</sub> and fuel consumption tractor standards for MYs 2021-2023 by 1 percent to reflect these credits (see Preamble Section III.D.1b.xiii).

#### *Aerodynamic Compliance Margin*

Although EPA sometimes provides interim compliance margins to facilitate the initial implementation of new programs, we generally do not consider such an approach to be an appropriate long-term policy. Consistent with the commenter's suggestion, we are not adopting a fixed compliance margin for Phase 2. Nevertheless, EPA recognizes that compliance testing relying on coastdowns to evaluate aerodynamic parameters differs fundamentally from traditional compliance testing, in which test-to-test variability is normally expected to be small relative to production variability. With coastdown testing, however, test-to-test variability is expected to be larger relative to production variability. In response to comments addressing this difference, EPA developed a different structure for conducting SEAs to evaluate tractor C<sub>d</sub>A s and solicited supplemental comments on it. We believe the structure being finalized appropriately balances EPA's need to provide strong incentives for manufacturers to act in good faith with manufacturers' need to avoid compliance actions based on inaccurate testing. Our current assessment is that, where a manufacturer acts in good faith when certifying and uses good engineering judgment throughout the process, false failures for individual vehicles would be rare and false failures for a family would not occur. As shown in Figure 3-9 of the RIA, the standard error of test decreases as the number of runs in a test increases. At 24 runs, the standard error is on average, approximately 0.84 percent (not the +/- 5 percent noted by the commenter). For a given distribution, increasing the number of runs to 100 would roughly halve the standard error to 0.42 percent, as the standard error decreases with the square root of the number of runs. Additional discussion is included in Section III.E.2.a of the Preamble to the final rule.

#### *Standard Trailer*

The agencies re-evaluated the proposal to include trailer skirts on the Phase 2 reference trailer with consideration of the comments. We still project that the bulk of trailers that will be in operation during the life of tractors produced early in Phase 2 will be represented by the aerodynamic performance of a trailer with skirts. Therefore, we are adopting the reference trailer as proposed. However, we also want

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<sup>143</sup> U.S. EPA. Memo to Docket. "Phase 1 Credit Balance Analysis." Docket # EPA-HQ-OAR-2014-0827.

to recognize that the trailer fleet will continue to evolve over the lifetime of tractors built and certified to Phase 2, especially from MY 2027 and later. Based on testing conducted to support the trailer portion of Phase 2, we found that on average a boat tail added to a dry van trailer with skirts reduces wind averaged  $C_dA$  by  $0.6 \text{ m}^2$ . We recognize that if we do not account for reduced aerodynamic loads in the real world, then we may not be appropriately evaluating the tractor powertrain. We considered changing the standard trailer in MY 2027; however, this would lead to significant testing burden for the manufacturers because they would have to determine new  $C_dA$  values for their entire fleet of tractors. Instead, we are adopting Phase 2 GEM that beginning in MY 2027 will take the  $C_dA$  input for each vehicle and reduce it by  $0.3 \text{ m}^2$  to reflect the lower aerodynamic loads that are a mix of trailers with skirts and trailers with skirts and boat tails. This change has been accounted for in both the baseline and standard setting of the  $\text{CO}_2$  emissions and fuel consumption values.

With respect to UCS's recommendation for the agencies to facilitate the transition to more integrated tractor-trailers, such as those demonstrated with SuperTruck, the agencies believe this would require a significant change in tractor-trailer logistics to encourage more matching of specific tractors to specific trailers in operation. We believe that this would be most appropriately handled through the Off-Cycle Credit program.

#### *In-Use Chassis Testing*

The agencies are finalizing the tractor chassis test requirement largely as proposed. Past experience has shown us that including a broad range of testing discourages manufacturers from focusing their development efforts on a single narrow test procedure. Even though there will be no direct compliance liability for the GHG testing, the agencies would still be able to identify differences in performance that resulted (on purpose or inadvertently) from how the powertrain is installed in the chassis.

EPA agrees that in-use (or over-the-road) testing of engines provides a number of benefits for ensuring useful life compliance. The heavy-duty on-highway engine manufacturers are already required to conduct in-use testing under the criteria pollutant regulations. In addition, the GHG Reporting Rule required manufacturers to submit  $\text{CO}_2$  data from all engine testing beginning in the 2011 MY, which we believe is equally applicable to in-use measurements. Furthermore, EPA conducts periodic in-use testing of heavy-duty engines.

**Organization:** United Parcel Service (UPS)

#### Drive Cycle Weightings Need to be Re-evaluated

UPS notes that our class 8 tractor and trailers average 54 miles per hour in part because we also deploy speed governors on all our heavy trucks. This disparity between our actual average speed and what is assumed in the proposed rule will significantly reduce the fuel efficiency potential of speed-dependent technologies such as aerodynamic devices and low rolling resistance tires. We agree in principle with the following ATA comments on this point. [EPA-HQ-OAR-2014-0827-1262-A1 p.11]

"The proposed rule indicates drive cycle weightings of 5% of the transient cycle, 9% of the constant speed 55 mph cycle, and 86% of the constant speed 65 mph cycle for sleeper cabs. For day cabs, the weightings are 19% of the transient cycle, 17% of the constant speed 55 mph cycle, and 64% of the constant speed 65 mph cycle. ATA believes these weightings are not reflective of real world operations and tend to overestimate the benefits of certain technologies, such as aerodynamics and rolling resistance, and potentially discount others. [EPA-HQ-OAR-2014-0827-1262-A1 p.11]

'As discussed in Appendix 2, using 3.6 million spot speed records collected from throughout the U. S. during the month of May 2015, trucks operated at speeds of 55 mph or greater 57% of the time. This is significantly lower than the weightings being used by EPA (95% of the time for sleeper cabs and 81% of the time for day cabs). ..' [EPA-HQ-OAR-2014-0827-1262-A1 p.11]

#### Limited Flexibility Must be Built In to the Use of Speed Limiters

UPS deploys speed limiters on all its class 8 trucks, and we support ATA's efforts to advocate for lower average speed of all vehicles, including the mandatory, electronic speed governing of large trucks. Such changes would yield substantial benefits in fuel efficiency, as well as in safety. We think that greater flexibility is needed in how speed limits are set in these devices and that this is easily achieved given today's ECMs. The concept of 'tamper-proof' devices is unnecessary and incompatible with modern trucks because any changes, and in fact the mere entry into the ECM software settings is trackable by authorities. Instead of 'tamperproof devices,' UPS would support a regulatory approach in which the fleet owner can adjust speed settings, but only if certified personnel make these changes and their activities within the ECIVIs are trackable and fully accountable to proper authorities. [EPA-HQ-OAR-2014-0827-1262-A1 p.12]

UPS notes that the proposed rule does not provide any incentive for speed limiters because, as we understand it, the test cycles are conducted at legal speed limits and therefore unless EPA and NHTSA provide some specific credit to the speed limiter, it gains nothing for the OEM. And the fleet owner gains nothing via this in the eventual rule. Traffic of course does not always honor the posted speed limit. As vehicle air drag increases as the square of velocity, the potential fuel savings with speed limiters are substantial. UPS urges EPA/NI-ITSA to consider providing some credit for inclusion of speed limiters. [EPA-HQ-OAR-2014-0827-1262-A1 p.12]

#### **Response:**

##### *Drive Cycle Weightings*

The agencies considered these comments along with the information that was used to derive the drive cycle weightings in Phase 1. The agencies believe that the study cited by ATA includes weightings of speed records, which represent the fraction of *time* spent at a given speed. However, our drive cycle weightings represent the fraction of *vehicle miles traveled* (VMT). The agencies used the vehicle speed information provided in the ATA comments and translated the weightings to VMT. Based on our assessment, their findings produce weightings that are approximately 74 percent of the vehicle miles traveled are at speeds greater than 55 mph and 26 percent less than 55 mph. In addition, the study cited by ATA represents "Class 8 trucks" which would include day cab tractors, sleeper cab tractors, and heavy heavy-duty vocational trucks. Based on this assessment, the agencies do not believe this new information is significantly different than the drive cycle weightings that were proposed. Therefore, we are adopting the drive cycle weightings for tractors that we adopted for Phase 1 and proposed for Phase 2.

##### *Vehicle Speed Limiters*

The commenter is mistaken in their assessment that the rule does not provide any incentive for speed limiters. Phase 1 and Phase 2 provide CO<sub>2</sub> emissions and fuel consumption reductions in GEM for vehicles with tamper-proof vehicle speed limiters (VSL) set below 65 mph. The existing Phase 1 VSL flexibilities provide opportunities for manufacturers to receive credit for VSL while still allowing the settings to change after an "expiration" time determined by the manufacturer and the agencies adopted provisions to allow for VSLs with "soft top" speeds. At this time, we believe that the Phase 1 flexibilities

sufficiently balance the desire to encourage technologies that reduce GHG emissions and fuel consumption while minimizing the compliance burden of trying to accommodate changes throughout the useful life of the vehicle. Therefore, the agencies are not adopting any new VSL provisions for Phase 2.

**Organization:** Volvo Group

### **Aerodynamic Drag Determination**

While we are open to continued evaluation of alternative aerodynamic test methods, Volvo Group opposes the agencies' proposal to shift the primary test method from coast-down to constant speed at this time, simply because there is inadequate time to fully evaluate any new test method prior to promulgation of the final rule. The agencies should not mandate Constant Speed Aerodynamic testing as the default method for CdA determination in the final rule. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

Volvo Group supports all comments from EMA on necessary changes to the processes for coast-down measurements and alternative aero certification. This issue has been extensively discussed with the agencies and the major heavy-duty tractor manufacturers have agreed on the proposal. Measurement of tractor-trailer aerodynamic drag is extremely complex and subject to many variables. Even if there are advantages to constant speed testing, there is inadequate time to evaluate and resolve the many critical details needed to ensure accurate results, maintain a level playing field, and to establish new aero bins and targets based on test results. We also believe that the expected advantages from constant speed testing could be largely gained through further refinement of the coast-down procedure. We are open to continued evaluation of constant speed testing that could be introduced as a technical amendment or in a subsequent rulemaking when and if it is found to be an improvement over coast-down and all issues are resolved. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

### **EPA coast down test data**

The EPA plans to use coast down test data from a handful of tractors to set the standards for Phase II. These "standard-setting" tractors were tested under varying wind conditions, from yaw angles below 2° for some to ~4° for others. Since Phase I procedure assumes coast down to represent 0° condition, the associated errors were larger on the trucks tested under higher crosswind condition. EPA needs to account for this in establishing the baseline. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

Although the Phase II procedure accounts for wind condition, the analysis procedure leads to a somewhat flatter yaw curve than expected (or obtained from alternate aero methods). The same truck tested under higher crosswind (yaw>2°) may produce a lower certification CdA (@4.5°) than when tested under calmer conditions. Ironically, this is the exact opposite of the problem encountered in Phase I. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

The EMA (industry consensus) proposal requested the EPA to limit crosswind during coast down tests to <2mph, which was not accepted by the compliance division. This constraint had been proposed initially to address the artificial asymmetry in the CdA vs. yaw curve, but this needs to be re-visited in the context of the flatter yaw curve generated by the Phase II coast down procedure. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

Since the initial proposal of the Phase 1 rule, the industry has been working with coastdown to understand the issues and to improve measurement and analysis methods. In Phase 1 comments, Volvo Group and the rest of the industry noted shortcomings in the coastdown procedure and provided the agencies with many suggestions on sources of errors and variability and how to correct or account for them. Few of the comments were implemented in Phase 1. Since that time the industry has gained significantly more

experience in coastdown testing and provided feedback and a full proposal to the agencies on limiting variability and improving accuracy in the Coastdown process. [EPA-HQ-OAR-2014-0827-1290-A1 p.38]

Based on the industry's gained knowledge of the Coastdown procedure, our comments and our inputs already provided to the agencies, as well as industry's complete lack of experience with Constant Speed testing, Volvo Group requests that the agencies incorporate the industry recommendations and maintain coastdown in the Phase 2 final rule as the default procedure. We support a longer term process to continue to improve the aerodynamic procedures, which may at some point incorporate constant speed testing via subsequent rulemaking or via technical amendments to the final rule. [EPA-HQ-OAR-2014-0827-1290-A1 p.39]

### **EPA constant speed test data**

At this time Volvo does not have sufficient information or experience with constant speed testing to comment on the test data collected by the EPA. Based on our experiences to date with the proposed coast down testing and analysis procedure, we should expect to unearth several issues as we look into constant speed testing in earnest. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

### **Multiple Aerodynamic Adjustment Factors**

The aerodynamic adjustment factor ( $F_{\text{alt-aero}}$ ) is a ratio between the test result of the full vehicle coast-down test and the alternative method (computational fluid dynamics or reduced scale model wind tunnel testing) used by a manufacturer to evaluate the multitude of truck models and aero options. The proposed rule section 1037.525(b) (3) would require determining separate adjustment factors for "a high-roof day cab and a high-roof sleeper cab corresponding to each major tractor model." The agencies came to the conclusion that this would be required based on limited and faulty test data using the test procedure with all the flaws we have reported to the agencies and reviewed in the EMA comments. In fact, the whole aerodynamic adjustment factor concept is based on the premise that  $F_{\text{alt-aero}}$  is not vehicle dependent but only method dependent. We have shared data with EPA showing that, when the testing is done under the conditions and methods industry has recommended,  $F_{\text{alt-aero}}$  is highly consistent for widely varying truck models. As such, there is no need to repeat the full vehicle aerodynamic testing for many different vehicles as proposed. This testing is extremely time-consuming and expensive and must not be expanded without adequate quantifiable benefit. [EPA-HQ-OAR-2014-0827-1290-A1 p.39]

### **EPA wind tunnel test data**

Volvo does not intend to use reduced scale wind tunnel (RSWT) as an alternate aero method for Phase II certification since it is cost prohibitive, given the diversity and complexity of its highway tractor portfolio. Nevertheless, EPA has raised concerns about variability between alternate methods (different CFD tools, various wind tunnels, etc.) especially regarding potential facility dependence of yaw curves. EPA's own data shows a variation of ~2% (1.078 to 1.101) in terms of  $CdA(4.5^\circ)/CdA(0^\circ)$  comparing constant speed, two different CFD methods and one RSWT facility. EPA considers this level of variability acceptable, while Volvo does not. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

### **EPA CFD simulation data**

The CFD data from two different sources (vendors) show significant discrepancy on the order of 10-15%. While this may be alarming, it is within the expected level of variation between RANS-based steady-state calculations and Lattice-Boltzmann method based transient simulations. Although such discrepancies are supposed to be absorbed into  $F_{\text{alt-aero}}$ , differences in the two yaw curves could affect the certification  $CdA$ . EPA's data shows this difference to be ~0.5% on the particular truck in the NoDA. [EPA-HQ-OAR-2014-0827-1928-A1 p.16]

## **Aerodynamic Audits**

Volvo Group fully supports EMA's comments on reducing audit measurement variability by auditing for conformance or selective enforcement by using only the same vehicles (tractor and trailer), test facilities, and methods used by manufacturers to certify vehicle aerodynamics. In addition, we support the need to add audit margins that consider all the variables inherent in these measurements. [EPA-HQ-OAR-2014-0827-1290-A1 p.39]

## **Chassis Dyno Testing**

Volvo Group does not support the requirement to annually test five tractors on a chassis dynamometer as proposed in NPRM section 1037.665. Chassis dyno testing requires simulated or separately measured inputs to determine road loads associated with aero drag, rolling resistance, climbing grades, and acceleration; loads that comprise around 90% of the vehicle load in the tractor cycles. Rolling resistance of the drive tires on the dynamometer rollers does not duplicate on-road rolling resistance, so applied dynamometer loading must be corrected for this as well as for dynamometer inertia. Accessory loads will not duplicate on-road utilization unless the use of power steering, compressed air, vehicle cooling, ram air, air conditioning, and electrical systems are all precisely managed. Differences in driver shifting, throttle control, and braking have large impacts. In addition, there are many other variables in the test set up and measurements. In short, chassis dyno testing introduces errors that are much worse than simply simulating vehicle efficiency. The only system actually tested in a chassis dyno test is the powertrain, which is tested much more precisely in a powertrain test. [EPA-HQ-OAR-2014-0827-1290-A1 p.41]

There are few facilities capable of running a Class 8 chassis dyno test, particularly when adding the proposed requirement to include emissions of NOX, PM, CO, NMHC, CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O. Building such a facility is estimated to cost as much as \$2M. Manufacturers could end up competing to contract testing to the few capable test sites, driving up costs. In addition, the cost to pull a vehicle out of service and provide a substitute vehicle, or to build and run-in a new vehicle add enormous cost, especially when the resulting data has little value. [EPA-HQ-OAR-2014-0827-1290-A1 p.42]

Furthermore, we do not believe EPA has the authority to compel emissions testing of non-new vehicles simply for collecting information to compare to the regulatory approach. The proposed testing has no bearing on vehicle or engine certification and is an unnecessary burden without justification. EMA has proposed alternative methods to collect data to help the agencies refine the simulation and certification protocol. We support this effort but cannot support the current NPRM proposal. [EPA-HQ-OAR-2014-0827-1290-A1 p.42]

## **4x2 Tractors with Class 8 Powertrains**

Under the Phase 1 rule, the agencies allowed OEMs to certify vehicles into a higher service class and they propose to continue this with the Phase 2 rulemaking. No credits can be generated from vehicles certified to the higher service class, but any deficit produced must be offset by credits generated from other vehicles within the higher service class. Volvo used this flexibility to accommodate very limited volumes of Class 7 4x2 Tractors. These tractors are HHD models that only differ in axle configurations and gross vehicle weight ratings (GVWR) from other vehicles of the same model and still utilize the same HHD engines and drivelines as the Class 8 versions of the same model (>10L). [EPA-HQ-OAR-2014-0827-1290-A1 p.48]

In Volvo's case, the Class 7 tractors have GVWRs of no less than 32,000 lbs. by utilizing a 12,000 lb. front gross axle weight rating (GAWR) with a 20,000 lbs. rear. At times the rear GAWR is 21,000 lbs.,



but this still results in a Class 7 vehicle with a GVWR of 33,000 lbs. (just 1 lb. short of being a Class 8 vehicle). Even though these 4x2 tractors have a GVWR from 32,000-33,000 lbs. and are considered by definition to be class 7, they are rated to 80,000 lbs. gross combination weight rating (GCWR) and are routinely employed to pull double trailers with the added benefit of maneuverability and improved efficiency from eliminating one axle. [EPA-HQ-OAR-2014-0827-1290-A1 p.48]

Since these Class 7 4x2 tractors are in the same (or even heavier) duty cycles as their Class 8 counterparts, are rated to 80,000 lbs. GCWR, and utilize a HHD powertrain, Volvo proposes that the agencies allow these vehicles to be certified as Class 8 with any generated credits banked in the HHD service class. [EPA-HQ-OAR-2014-0827-1290-A1 p.48-49]

**Response:**

*Constant Speed Testing*

The agencies investigated the use of constant speed testing as the reference method to achieve a wind-averaged  $C_dA$  result, which would have eliminated the need to rely on alternate methods for yaw curves. We received comments from manufacturers, including Volvo, that they did not have enough experience in constant speed testing and recommended that the agencies not use it as a reference method. Though the agencies believe that the potential for a wind-averaged  $C_dA$  from constant-speed testing exists, we did not pursue this as the reference method based on these comments. Similarly, we do not expect manufacturers to use constant speed testing as an alternate method (even though it is an option) because it requires full-scale on-road tests for all certification configurations, which is extremely burdensome and the entire reason for not requiring coastdown tests for certification of all tractor configurations in the first place.

*Coastdown Testing*

Please see the agencies' response to EMA's comments regarding aerodynamic test procedures, located in this section of the RTC.

The agencies are requiring calculation of a mean yaw angle to characterize a coastdown result in Phase 2. Thus, there will no longer be an assumption of zero yaw for a coastdown result. At least 24 runs within a certain  $\pm 1^\circ$  yaw angle range and statistical criteria, as determined by the test conditions, are required to determine a mean  $C_dA$  and yaw angle. This helps to reduce the precision error from the proposed coastdown procedure. The coastdown  $C_dA$  and yaw angle must then be used in conjunction with data from an alternate aerodynamic method to produce a wind-averaged drag result, using surrogate angles of  $\pm 4.5^\circ$ .

The agencies coasted down the Phase 1 tractor configurations using the Phase 1 test procedures. Any data that exceeded the Phase 1 maximum, average, or cross-wind limits were considered invalid and not included in the analysis shown in RIA Chapter 3.2.1.1.1. The remaining valid data is appropriate for use to determine the Phase 1 bins.

The agencies adopted a lower low speed range (20 to 10 mph instead of 25 to 15 mph proposed) to address the issue raised by the commenter related to the fact that coastdown testing using the proposed approach produced a flatter yaw curve. Additional detail and analysis is included in RIA Chapter 3.2.1.1.2.6.

*Aerodynamic Adjustment Factors*

The agencies determined the  $F_{alt-aero}$  values for all of the tractors tested using different aerodynamic methods for Phase 2 using the aerodynamic test procedures and data analysis finalized for Phase 2. As shown in further detail in RIA Chapter 3.2.1, the  $F_{alt-aero}$  values ranged between 1.13 to 1.20 for multiple sleeper and day cab tractors tested with the same CFD software. Therefore, the agencies concluded that a single  $F_{alt-aero}$  value is not sufficient for determining the correlation of test methods for all tractors. Furthermore, based on the comments and further refinement of our selective enforcement audit (SEA) provisions in the Phase 2 final rule, we are adopting provisions that require manufacturers to determine  $F_{alt-aero}$  for a minimum of one day cab and one sleeper cab in MYs 2021, 2024, and 2027.<sup>144</sup> While this significantly reduces the test burden from the levels proposed, it also only represents a minimum requirement.

#### *Wind Tunnel and CFD*

The agencies expect some differences between CFD simulations of the same vehicle between multiple acceptable CFD software, which is why the  $F_{alt-aero}$  calculation is required.

To account for differences between yaw curves, a multiplicative, not additive, approach was finalized to adjust between the effective yaw angle and the surrogate yaw angle.

RIA Chapter 3.2.1 shows that the two CFD software in the EPA dataset in conjunction with the tractor's coastdown result produce good agreement in the final surrogate-angle  $C_dA$  values for Sleeper Cab 1 (5.96 and 5.98 m<sup>2</sup>).

A spread of 2% in the yaw increase between alternate methods is not a large amount given that  $C_dA$  bin widths are set around 8%. Not including constant speed results in the alternate method evaluation further reduces the spread of the results from Sleeper Cab 1 down to about 1%. We should note that the agencies incorporated the use of alternate aerodynamic methods into the test procedures mainly to allow manufacturers to use tools they were already using in product development for GHG certification. Because of variability in these tools, precision error of coastdown testing, and the large number of configurations to certify, the agencies set up a bin structure for certifying aerodynamic performance instead of requiring precise test results as input into GEM.

Please see the agencies' response to EMA's comments regarding aerodynamic audit procedures, located in this section of the RTC.

#### *In-Use and Chassis Dynamometer Testing*

After consideration of the comments, the agencies are requiring tractor manufacturers to annually chassis test five production vehicles over the GEM cycles to verify that relative reductions simulated in GEM are being achieved in actual production. See 40 CFR 1037.665. We have revised 40 CFR 137.665 for the final rule to allow testing of new or used tractors. We do not expect absolute correlation between GEM results and chassis testing. GEM makes many simplifying assumptions that do not compromise its usefulness for certification, but do cause it to produce emission rates different from what would be measured during a chassis dynamometer test. Given the limits of correlation possible between GEM and chassis testing, we would not expect such testing to accurately reflect whether a vehicle was compliant with the GEM standards. Therefore, we are not applying compliance liability to such testing. The testing is ultimately related to compliance with the standards since it is used as a cross-check on GEM-based results from certification. However, we do expect there to be correlation in a relative sense. Vehicle to

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<sup>144</sup> See Section III.E.2.a.ix for details on the SEA requirements.

vehicle differences showing a 10 percent improvement in GEM based only on the technologies that can be simulated in the chassis dynamometer (aerodynamic loads, rolling resistance loads, axle efficiency, transmission type and efficiency, engine fuel maps, axle ratio, etc.) should show a similar percent improvement with chassis dynamometer testing. Nevertheless, manufacturers will not be subject to recall or other compliance actions if chassis testing did not agree with the GEM results on a relative basis. Rather, the agencies will continue to evaluate in-use compliance by verifying GEM inputs and testing in-use engines. Note that NTE standards for criteria pollutants may apply for some portion of the test cycles.

EPA believes this chassis test program is necessary because of our experience implementing regulations for heavy-duty engines. In the past, manufacturers have designed engines that have much lower emissions on the duty cycles than occur during actual use. The recent experience with Volkswagen is an unfortunate instance. By using this simple test program, we hope to be able to identify such issues earlier and to dissuade any attempts to design solely to the certification test. We also expect the results of this testing to help inform the need for any further changes to GEM.

As also noted in Section II. B. (1) of the Preamble, it can be expensive to build chassis test cells for certification. However, EPA has structured this pilot-scale program to minimize the costs. First, this chassis testing will not need to comply with the same requirements as will apply for official certification testing. This will allow testing to be performed in developmental test cells with simple portable analyzers. Second, since the program will require only five tests per year, manufacturers without their own chassis testing facility will be able to contract with a third party to perform the testing. Finally, 40 CFR 1037.665(c) states that we may approve a request to perform alternative testing that will provide equivalent or better information compared to the specified testing, therefore the agencies may consider testing such as suggested by the commenter. We may also direct the manufacturers to do less testing than we specify in this section.

EPA estimates that the cost to conduct chassis testing at a third party facility would be approximately \$30,000 per tractor, for a total of \$150,000 per year per manufacturer. RIA Chapter 7.2.1.2 includes the compliance costs of the program, including the increased level of reporting in the tractor program.

In its comments, Volvo slightly expanded on EMA's argument, stating that "we do not believe EPA has the authority to compel emissions testing of non-new vehicles simply for collecting information to compare to the regulatory approach." But EPA seeks the information as an assurance that in-use performance is being adequately evaluated through the certification process. So this information is directly related to assuring that in use performance is consistent with certification, and thus is directly related to compliance with the section 202 (a) standards. (EPA, must, of course, develop standards that apply in use, see section 202 (a), and therefore can require testing designed ultimately to assure that standards are met in use).

#### *4x2 Tractors*

EPA adopted language in 40 CFR 1037.106 that allows manufacturers to optionally certify 4x2 tractors with heavy heavy-duty engines to the standards and useful life for Class 8 tractors, with no restriction on generating or using emission credits within the Class 8 averaging set.

## **4.6 PM Emissions from APUs**

**Organization:** American Lung Association

The American Lung Association offers the following recommendations to strengthen the stringency and timing of the proposal and address several key elements of California's commitment to protecting public health and air quality. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.143-144.]]

**The American Lung Association urges strengthening changes to require that particle pollution from the increased use of Auxiliary Power Units be reduced through filter technologies.** The projected increase in Auxiliary Power Units (APUs) to achieve fuel and emissions savings, and APUs' associated particle pollution increases, must be mitigated nationwide with the use of particle filter systems as are required in California. We simply cannot afford trade-offs in this rule that would allow for increased carcinogenic, lethal diesel exhaust or climate-forcing black carbon emissions. Californians enjoy protections that should be extended to all Americans. [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.146.]]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** American Trucking Associations (ATA)

**New Standards for Auxiliary Power Units will Increase Cost and Discourage Use**

ATA is concerned that efforts to place additional emissions controls on diesel-fired auxiliary power units (APUs) will discourage the use of this fuel efficient technology. Currently, APUs are one of several alternatives to operating the main engine for ancillary power and cab comfort. And while APUs provide year-round comfort and fuel savings, as opposed to heat- or air conditioning-only systems, they tend to be at the higher end of the cost spectrum. Requiring additional emissions control technology will further increase the cost of this technology and likely discourage its use. [EPA-HQ-OAR-2014-0827-1243-A1 p.15]

California currently requires diesel-powered APUs to be equipped with particulate filters when used on trucks with 2007 and newer engines. And while these filters are available, use has been limited primarily due to the additional cost and maintenance. Carriers who rely on APUs for fuel savings throughout the United States tend to forego their use in California in order to comply with the state's unique filter requirements. This practice reduces the overall fuel savings benefit from an APU. ATA believes a further expansion of this type of requirement will have a negative impact on the use of idle reduction technologies and fuel efficiency. [EPA-HQ-OAR-2014-0827-1243-A1 p.15]

For example, currently battery-powered APUs are another option. However, depending on a number of factors, including period of operation, ambient temperature, power demand, etc., this option may or may not meet a carrier's ancillary power and cab comfort requirements during federally-mandated rest periods. By increasing the cost of one of the most common idle reduction technologies, diesel-powered APUs, solutions to reduce idling will become more limited. ATA recommends that EPA fully consider the potential impacts of increasing the cost of APUs on consumer acceptance, how such a cost increase will impact the cost-benefit assumptions used in the proposed rule, and what operational limitations may exist with other idle reduction technology option. [EPA-HQ-OAR-2014-0827-1243-A1 p.15]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. We project that the annual impact of the final program to further control PM will lead to a reduction of PM<sub>2.5</sub> emissions nationwide by 927 tons in 2040 and by 1,114 tons in 2050. Our review of the costs and cost effectiveness of these standards indicate that they will be reasonable. We have also concluded that given the timing of the PM emission standards for APUs installed in new tractors and the availability of the technologies, engines for use in APUs can be designed to meet the new standards in the lead time provided. In terms of safety, EPA considered the facts that diesel particulate filters are a known technology. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Bendix Commercial Vehicle Systems, LLC

**III. Class 7 and 8 Combination Tractors, C. Proposed Phase 2 Tractor Standards, (3) PM Emissions From APUs [EPA-HQ-OAR-2014-0827-1241-A1 p.5]**

EPA is also seeking comment on new standards to further control emissions of particulate matter (PM) from auxiliary power units (APU) installed in tractors that would prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Bendix believes that the full vehicle emissions and fuel consumption should be considered. This means that APUs should not be excluded from the counting of CO<sub>2</sub> emissions or the fuel consumed for their operation. Inclusion of the emissions and fuel consumption of APUs will create a more accurate comparison when considering alternatives to diesel powered APUs or APU alternatives altogether. [EPA-HQ-OAR-2014-0827-1241-A1 p.5-6]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** California Air Resources Board (CARB)

**4. Address projected diesel PM increases due to the increase use of auxiliary power units**

The proposal encourages manufacturers to increase the use of auxiliary power units (APUs) to reduce idling. While CARB supports reducing such unnecessary idling, U.S. EPA estimates that this action could increase diesel particulate matter emissions throughout the rest of the country by nearly 10 percent, thus exacerbating public health issues associated with exposure to toxic diesel particulate matter. This is one of the largest public health problems tackled by GARB in recent decades, and even after an extensive control program in California, diesel particulate matter remains responsible for about 60 percent of the known risk from toxic air contaminants. As such, CARB supports the development of a federal rule that requires diesel particulate filters on APUs, concurrent with the Phase 2 program, similar to requirements already in place in California. [EPA-HQ-OAR-2014-0827-1265-A1 p.4]

In the Phase 2 NPRM, U.S. EPA and NHTSA rightly note that CARB, recognizing the excess PM emissions from APUs, requires APUs that operate in California to control PM emissions by either installing a DPF that is Level 3 (85 percent filtration efficiency) verified or must have the APU exhaust routed to the truck's exhaust system upstream of the truck's DPF. To comply with California's

requirements, several APU and DPF manufacturers have verified Level 3 DPFs for use with APUs. Commercially available today, verified DPFs for use with APUs include Thermo King's Electric Regenerative DPF for use with their TriPac APU, Impco Ecotrans Technologies' ClearSky DPF for use with their Comfort Pro APU, and Proventia's Electronically Heated DPF for use with the Thermo King TriPac APU. APUs are typically equipped with diesel-fueled off-road engines with power ratings less than 25 hp. The verified DPFs are available as factory installed on APUs or as APU retrofits. As of December 31, 2014, approximately 7,000 APUs equipped with CARB verified DPFs have been sold nationwide. These technologies have been in use now for the last 5 to 7 years and during this period, CARB has not received any complaints from end users related to DPF performance, safety, reliability, or noise issues that would make these devices impractical to use on APUs. Thus, there are no technical feasibility issues that would hinder U.S. EPA and NHTSA from requiring additional PM controls on APUs. [EPA-HQ-OAR-2014-0827-1265-A1 p.179-180]

The health risk posed by diesel PM is one of the largest public health problems tackled by CARB in recent decades, and even after an extensive control program including a series of air toxic control measures in California (see for example the mobile source measures listed at <http://www.arb.ca.gov/toxics/atcm/atcm.htm>), diesel PM remains responsible for 60 percent of the known risk for air contaminants. Hence, controlling diesel PM remains a huge priority for CARB. Diesel PM also contains black carbon, which is a powerful short-lived climate pollutant, so even beyond the toxicity reasons for controlling diesel PM, there are climate reasons as well. The PM 2.5 increases projected for the Phase 2 regulation are very significant – an increase of 1,631 tons and 2,257 tons of nationwide PM 2.5 in 2035 and 2050,<sup>77</sup> respectively. To put those emission increases in perspective, they are greater than the entire projected reductions of 1,058 tons statewide diesel PM in 2023 from CARB's Truck and Bus Regulation.<sup>78</sup> While this issue does not significantly affect California because CARB already requires DPFs on APUs, CARB staff supports adopting similar requirements at the federal level concurrent with the Phase 2 program. [EPA-HQ-OAR-2014-0827-1265-A1 p.180-181]

Based on price quotes provided by the three manufacturers, the average incremental cost of a verified DPF for an APU is approximately \$2,500. This cost estimate for an APU engine rated at less than 25 hp is relatively high compared to the \$580 DPF incremental cost estimate for a 150 hp off-road engine that U.S. EPA cites in the NPRM. The higher cost quoted by the three manufacturers for these DPFs is due to the low sales volume of APUs with verified DPFs since the requirements only apply to California as opposed to being a nationwide requirement. Also, since DPFs are not required on APUs installed on trucks equipped with 2006 or older MY engines, California does not prohibit the purchase and installation of non-DPF equipped APUs. It only restricts their operation within the state if installed on trucks equipped with 2007 or subsequent MY engines. Thus, many trucking companies that purchase APUs do not purchase the DPF. CARB staff expects if the requirements are applied nationally, the sales volume will increase and consequently the incremental cost will drop significantly, most likely to levels even below the \$580 DPF cost estimate for a 150 hp engine that U.S. EPA and NHTSA cite in the NPRM. [EPA-HQ-OAR-2014-0827-1265-A1 p.180]

Overall, CARB staff strongly urges U.S. EPA and NHTSA to regulate PM emissions from APUs in this rulemaking since the technology is commercially available, trucking businesses are currently using it, and it is cost-effective. It does not make sense to pursue CO<sub>2</sub> emissions reductions at the expense of increased toxic diesel PM emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.181]

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<sup>77</sup> Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Notice of Proposed Rulemaking; 40 CFR 1036; 40 CFR 1037; 40 CFR 86; <http://www.regulations.gov#!documentDetail;D=EPA-HQ-OAR-2014-0827-0002>.

<sup>78</sup> (CARB, 2014d) California Air Resources Board, “Staff Report: Initial Statement of Reasons for Proposed Rulemaking – Proposed Amendments to the Truck and Bus Regulation,” page 33, March 2014, <<http://www.arb.ca.gov/regact/2014/truckbus14/tb14isor.pdf>>.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

As indicated in our response to Thermo King and Proventia comments below (EPA-HQ-OAR-2014-0827-1196-A1; EPA-HQ-OAR-2014-0827-0811-A1), in the NPRM, EPA discussed several sources for DPF cost estimates. The three sources included the Nonroad Diesel Tier 4 rule, ARB, and Proventia. EPA developed long-term cost projections for catalyzed diesel particulate filters (DPF) as part of the Nonroad Diesel Tier 4 rulemaking. In that rulemaking, EPA estimated the DPF costs would add \$580 to the cost of 150 horsepower engines (69 FR 39126, June 29, 2004). On the other hand, ARB estimated the cost of retrofitting a diesel powered APU with a PM trap to be \$2,000 in 2005. Proventia is charging customers \$2,240 for electronically heated DPF for retrofitting existing APUs. EPA considered all of the comments on DPF costs and more closely evaluated NHTSA’s contracted TetraTech cost report which found the total retail price of a diesel-powered APU that includes a DPF to be \$10,000. Based on all of this information, EPA is projecting the retail price increment of an actively regenerating DPF installed in an APU to be \$2,000. This cost is incremental to the diesel-powered APU technology costs beginning in 2024 MY.

**Organization:** Center for Biological Diversity

**THE EPA MUST ADOPT A PARTICULATE MATTER (“PM”) CAP THAT PROTECTS AGAINST INCREASED BLACK CARBON EMISSIONS FROM AUXILIARY POWER UNITS**

As proposed, the Phase 2 standards would result in an increase in national black carbon and associated fine particulate matter (“PM”) emissions from auxiliary power units (“APUs”): this is untenable. APUs allow a tractor to maintain power during non-road hours, but the tradeoff is increased black carbon and particulate matter emissions. Black carbon is a significant short-lived climate pollutant that must be controlled to avoid undermining the climate benefits of the proposed standards. In addition, PM poses significant public health risks. [EPA-HQ-OAR-2014-0827-1460-A1 p.20]

Black carbon is a potent short-lived pollutant with climate impacts that may be second only to carbon dioxide over the next 20 years.<sup>98</sup> As such, it has received international attention as an important part of short-term actions to stave off immediate climate catastrophe and avoid imminent tipping points. Black carbon, or soot, is a product of incomplete combustion. It is typically co-emitted with organic carbon; the ratio of black carbon to organic carbon is highest for fossil fuels. Both black carbon and organic carbon are components of particulate matter. [EPA-HQ-OAR-2014-0827-1460-A1 p.20]

One of the fundamental characteristics of a climate pollutant is the amount that it contributes to global warming. This is often characterized as radiative forcing. The most recent Assessment Report (“AR5”) from the Intergovernmental Panel on Climate Change estimates that the radiative forcing for black carbon is approximately 0.40 W/m<sup>2</sup>.<sup>99</sup> For comparison, Chung and Seinfeld recently reported observational estimates of direct radiative forcing for both black carbon and organic matter from biomass burning. They estimate direct radiative forcing for black carbon to be 0.65 W/m<sup>2</sup> and the contribution of organic carbon to be 0.0 W/m<sup>2</sup> due to the offsetting balance of absorption by brown carbon and light scattering.<sup>100</sup> Thus,

the radiative forcing of black carbon is at least similar to that of methane, and potentially higher. [EPA-HQ-OAR-2014-0827-1460-A1 p.20]

Public health impacts from black carbon include both cardiovascular and respiratory effects.<sup>101</sup> Much of the negative health effect can be attributed to ultrafine black carbon particles emitted from diesel engines and likely reflects increased inflammatory responses.<sup>102</sup> Black carbon has also been associated with decreased memory and learning in children.<sup>103</sup> Moreover, cancer risk is increased with exposure to diesel particulate emissions.<sup>104</sup> Notably, these public health impacts can be avoided easily through the use of diesel particulate filters. [EPA-HQ-OAR-2014-0827-1460-A1 p.20]

The United States has reduced black carbon emissions, primarily from diesel engines, through a number of recent regulatory actions. However, allowing an increase in PM – and associated black carbon – from APUs will undermine both recent efforts to reduce US black carbon emissions and the climate benefits of the proposed standards for medium- and heavy-duty trucks. An increase in diesel PM will also result in harm to public health. Consequently, it is imperative that the agencies adopt measures to ensure that PM emissions from APUs are fully controlled. [EPA-HQ-OAR-2014-0827-1460-A1 p.21]

The EPA should take into account that California already requires PM emissions to be controlled from APUs. Thus, manufacturers of vehicles for use in that state will already be complying with such a requirement. In California, a diesel-fueled APU operated on a truck equipped with a 2007 or newer engine must either be fitted with a verified Level 3 particulate control device (85% particulate reduction efficiency), or have its exhaust plumbed into the vehicle's exhaust system upstream of the particulate matter after-treatment device.<sup>105</sup> We urge the EPA to adopt a similar, nation-wide control requirement for PM emissions from APUs, which would level the playing field and enhance air quality in all states. [EPA-HQ-OAR-2014-0827-1460-A1 p.21]

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98 See, e.g., V. Ramanathan and G. Carmichael, *Global and regional climate changes due to black carbon*, 1 NATURE GEOSCIENCE 221, 221 (2008).

<sup>99</sup> IPCC, AR5 *supra* note 69 at 683, Table 8.4.

100 C. E. Chung et al., *Observationally constrained estimates of carbonaceous aerosol radiative forcing*, 109 PROC. NATL. ACAD. SCI. 11624, 11627 (2012), available at <http://www.pnas.org/content/109/29/11624.full.pdf>.

101 See Joel Schwartz, *Testimony for the Hearing on Black Carbon and Climate Change House Committee on Oversight and Government Reform United States House of Representatives The Honorable Henry A. Waxman, Chair* (Oct. 17, 2007); Nicole A.H. Janssen et al., *Chapter 3: Effects of BC exposure observed in epidemiological studies*, in HEALTH EFFECTS OF BLACK CARBON 23, World Health Organization (2012).

102 Schwartz Testimony, *supra* note 101; Peter S. Gilmour et al., *Pulmonary and systemic effects of short-term inhalation exposure to ultrafine carbon black particles*, 195 TOXICOLOGY AND APPLIED PHARMACOLOGY 35 (2004).

103 S. Franco Suglia et al., *Association of Black Carbon with Cognition among Children in a Prospective Birth Cohort Study*, 167 AM. J. EPIDEMIOLOG. 280 (2008).



104 See H.-E. Wichmann, *Diesel Exhaust Particles*, 19 INHALATION TOXICOLOGY 241 (2007).

105 13 California Code of Regulations Chapter 10 § 2485.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Coalition for Clean Air/California Cleaner Freight Coalition

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 217-218.]

I agree with MECA, who talks about the APUs having a filter requirement nationwide, as they do here in California. EPA should adopt this regulation expeditiously.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Daimler Trucks North America LLC

18. PM Emissions from APUs

**Requirement to Control PM Emissions from APUs** – The agencies propose new standards to further control emissions of particulate matter (PM) from auxiliary power units (APU) installed in tractors that would prevent unintended consequence of increasing PM emissions from tractors during long duration idling. 80 FR 40211. The agencies request comment on the technical feasibility of diesel particulate filters ability to reduce PM emissions by 85 percent from non-road engines used to power APUs. We understand the direction the agencies are taking in regulating APUs to reduce the amount of PM, and we currently supply APUs that meet California ARB emission requirements. The technology is available and has been used in California for years (CARB 13 CCR § 2485(c)(3)(A)(1) as stated on page 176 of the RIA). If the EPA plans to adopt regulations on PM emissions from APUs, we recommend that the EPA adopts the CARB requirements word-for-word to reduce future complexity on APU emissions and idling requirements. This will allow for a nationwide standard which in turn will satisfy the agencies requirements. That said, we think it makes more sense to simply require that APUs meet Tier 4-final regulations. [EPA-HQ-OAR-2014-0827-1164-A1 p.134-135]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Though EPA did not adopt CARB's APU requirements directly, manufacturers should be able to meet both EPA and ARB requirements using the same engines and emission control technologies. EPA used the existing engines and effectiveness of DPFs that were developed for the ARB

program as the basis for setting the PM standards. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Environmental Defense Fund (EDF)

**EPA should promulgate more stringent PM emission standards for APUs to protect public health**

Auxiliary power units (APUs) are among the technologies available today to reduce fuel use from sleeper cab tractors due to idling. We request the agencies adopt more protective health-based diesel particulate matter (PM) emissions standards for these units to bring them in line with the truck engines they are relieving. [EPA-HQ-OAR-2014-0827-1312-A1 p.50]

Reducing idling is an important step in reducing fuel consumption, GHG emissions and other airborne contaminants from diesel engines in sleeper cabs because they are estimated to idle 6-8 hours a day, as many as 250-300 days a year.<sup>213</sup> EPA estimates that every year long-duration idling of truck and locomotive engines consumes over one billion gallons of diesel fuel and emits 11 million tons of carbon dioxide, 200,000 tons of oxides of nitrogen, and 5,000 tons of particulate matter.<sup>214</sup> A truck owner can end up paying an extra \$6000 or more per year in fuel costs.<sup>215</sup> Also, idling can increase engine maintenance costs, shorten engine life, harm driver well-being, and elevate noise levels. [EPA-HQ-OAR-2014-0827-1312-A1 p.50]

EPA has verified dozens of cost-effective technologies that can be applied to APUs to reduce fuel consumption and CO2 emissions from these engines. EDF supports the inclusion of APUs as a technology option manufacturers can use to meet the proposed standards for sleeper cab trucks. [EPA-HQ-OAR-2014-0827-1312-A1 p.50]

However, the PM standards for diesel APUs, established under the nonroad rule, are not as protective as the truck engine standards for MY 2007 and later trucks, which require the use of diesel particulate filters (DPFs) or comparable alternative. This disparity allows diesel APUs to emit more than 5 times as much harmful diesel PM as a MY 2007 or later diesel sleeper cab engine.<sup>216</sup> Indeed, EPA estimates in the proposal that without further controls on APUs, harmful particulate emissions will increase by 1,600 tons annually by 2035 and more than 2,200 tons annually in 2050. This increase in PM emissions will be particularly significant at idling “hotspots” like truck stops, travel centers, rest areas, distribution centers and port areas, creating high concentrations of harmful diesel PM, and threatening the health of drivers, area workers and neighboring communities, many of which are often low-income. In addition to the health impacts, diesel PM is made primarily of black carbon, which is a potent GHG. We therefore request that the agencies promulgate more protective PM emissions standards for these units to protect public health and the environment from the harmful impacts of diesel PM. [EPA-HQ-OAR-2014-0827-1312-A1 p.51]

To address these public health concerns, in 2008, California Air Resources Board established more protective standards for diesel APUs that require the use of diesel particulate filters or a comparable alternative, which reduce PM by as much as 85 percent and make APUs as clean as the truck engines they are attached to. CARB concluded that the technology to make these reductions is available and cost-effective.<sup>217</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.51]

It is imperative that EPA follow California’s leadership and protect the health of all Americans by adopting protective particulate matter standards for APUs. Such an action will allow cost-effective APU technology to be used to reduce unnecessary fuel consumption by idling trucks without increasing harmful particulate pollution. [EPA-HQ-OAR-2014-0827-1312-A1 p.51]

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213 EPA, “Idle reduction” tab, available at <http://epa.gov/smartway/forpartners/technology.htm> (last accessed August 14, 2015).

214 Id.

215 Id.

216 CARB, Staff Report: Initial Statement of Reasons Notice of Public Hearing to Consider Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008 (2005). Table 3 and Table 5, page 44, available at <http://www.arb.ca.gov/regact/hdvidle/isor.pdf>.

217 CARB, Heavy-Duty Idling Emissions Reduction Program, available at <http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm>.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Environmental Law and Policy Center

The proposed regulation should do more to protect children's health. Asthma hospitalization rates in Chicago are nearly double those of the national average, and that's why we're so concerned that the proposed rule would actually increase particulate pollution by encouraging the use of auxiliary power units on trucks. We urge you to amend this rule by requiring that these units be equipped with particulate filters. This would eliminate the long-term increase in particulate pollution which may occur as a result of these regulations.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Idle Smart

**3. As proposed, implementation of Extended Idle technologies in Phase 2 rulemaking would lead to higher PM<sub>2.5</sub> emissions, which is directly counter to the stated goals of Phase 2 to reduce GHG emissions.** This fact is acknowledged and quantified in the Phase 2 draft. The Phase 2 draft explicitly states that the use of APUs results in “an increase in PM emissions” and goes on to quantify the impact using data presented in MOVES2014<sup>12</sup>. Specifically, the adverse PM<sub>2.5</sub> emissions impact of utilizing of diesel APUs is 1,631 tons and 2,257 tons of PM<sub>2.5</sub> emissions in 2035 and 2050, respectively. As noted in the rulemaking, this is because diesel APUs emit 1.8 grams PM per hour vs. 0.35 grams PM per hour for 2010 or newer model engines. Putting this in simpler terms and comparing it to Idle Smart yields the following: [EPA-HQ-OAR-2014-0827-1128-A1 p.3]

[Table of diesel APU and Idle Smart comparison can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1128-A1]<sup>13</sup>

Said another way, utilizing a diesel APU to offload 2000 Extended Idle hours a year generates 3600 PM grams/year, which is nearly 20 times that which is produced when utilizing Idle Smart's automatic start/stop solution. [EPA-HQ-OAR-2014-0827-1128-A1 p.4]

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12 Exhaust Emission Rates for Heavy-Duty On-road Vehicles in MOVES 2014, September, 2015

13 Idle Smart performance metrics (2014)

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Manufacturers of Emission Controls Association (MECA)

**Control of Black Carbon with Particulate Filters**

Black carbon is a major component of particulate matter emissions from mobile sources and is believed to have a significant net atmospheric warming effect by enhancing the absorption of sunlight. Black carbon is a mix of elemental and organic carbon, in the form of soot, emitted by fossil fuel combustion, bio-mass burning, and bio-fuel cooking. Black carbon is a dominant absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon are transported over long distances and are most concentrated in the tropics where solar irradiance is highest. Because of the combination of high absorption, a regional distribution roughly aligned with solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are thought to be the second strongest contribution to current climate change, after CO<sub>2</sub> emissions. The glacier retreat has accelerated since the 1970s and several scientists have speculated that solar heating by soot in atmospheric brown clouds and deposition of dark soot over bright snow surfaces may be an important contributing factor for the acceleration of glacier retreat. A study published in a 2009 issue of Nature Geoscience (vol. 2, 2009) by researchers from the NASA Goddard Institute and Columbia University found that black carbon is responsible for 50% of the total Arctic warming observed from 1890 to 2007 (most of the observed Arctic warming over this timeframe occurred from 1976 to 2007). [EPA-HQ-OAR-2014-0827-1210-A3 p.10]

It is estimated that 70% of the black carbon emissions from mobile sources are from diesel-fueled vehicles, with the assumption that 40% of gasoline PM is black carbon and 60% of diesel PM is black carbon. The black carbon concentration and its global heating will decrease almost immediately after reduction of its emission. Black carbon from diesel vehicles can be significantly reduced through emission control technology that has been required on every U.S. heavy-duty diesel truck manufactured since 2007. The basis for the design of wall-flow particulate filters is a ceramic honeycomb structure with alternate channels plugged at opposite ends. As the gases pass into the open end of a channel, the plug at the opposite end forces the gases through the porous wall of the honeycomb channel and out through the neighboring channel. The porous wall and the filter cake of particulate matter that forms within and on the surface of the wall serve as the filter media for particulates. Since the filter can fill up over time by developing a layer of retained particles on the inside surface of the porous wall, the accumulated particles

must be burned off or removed to regenerate the filter. This regeneration process can be accomplished with a variety of methods including both active strategies that rely on generating external sources of heat (e.g., fuel burners, fuel dosing strategies that utilize fuel combustion over a catalyst, electrical elements, intake air throttling) and passive strategies that utilize catalysts that are displayed directly on the filter element or upstream of the filter. During the regeneration of DPFs, captured carbon is oxidized to CO<sub>2</sub> but this filter regeneration still results in a net climate change benefit since the global warming potential of black carbon has been estimated to be as high as 2,200 times higher than that of CO<sub>2</sub> on a per gram of emission basis. It is estimated that the installation of DPFs has reduced PM emissions from U.S. heavy-duty diesel vehicles by 110,000 tons per year. The ACES Phase 2 study that evaluated the PM emissions from 2010 technology heavy-duty engines showed that DPF equipped engines emit PM at one to two orders of magnitude below the current standard of 0.01 g/bhp-hr and deliver over 99% PM capture efficiency over their lifetime. MECA encourages EPA to develop policies and/or incentives that reward vehicle and engine manufacturers for employing technologies such as particulate filters that provide significant reductions in mobile source black carbon emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.10-11]

### **Control of PM from Auxiliary Power Units**

Auxiliary power units or APUs are used on heavy-duty trucks during “hoteling” at truck stops or other suitable rest areas. During long periods of idling, the APU provides power to auxiliary systems such as cabin electricity and air conditioning so that the main truck engine can be turned off. Because APUs have diesel engines less than 10 horsepower, they burn less fuel than the main engine and thus reduce CO<sub>2</sub> emissions. Under Tier 4 standards, the small displacement of these engines allows them to operate without exhaust emission controls such as diesel particulate filters and as a result they emit 5-10 times more PM emissions than the much larger displacement but filter-equipped main truck engine idling for the same amount of time. The California Air Resources Board recognized this fact and in 2008, included as part of their anti-idling regulations for heavy-duty trucks, a requirement that APUs must be retrofit with a particulate filter capable of achieving at least an 85% reduction in PM or have the APU exhaust diverted through the main DPF in the exhaust system of the truck. To achieve an 85% PM reduction, the particulate filter must be a wall flow device, or similar. ARB has verified four of these retrofit devices, made by third-party manufactures, for installation on existing APU engines. Due to the relatively cold exhaust temperatures of these small engines, the DPF filters installed on APUs must use either all active or a combination of passive and active regeneration to periodically clean the soot from the filter. Active regeneration can be accomplished through the use of a fuel burner or electrical heater upstream of the filter element that can be activated if the back pressure is too high. [EPA-HQ-OAR-2014-0827-1210-A3 p.11]

California’s APU Air Toxics Control Measure (ATCM) regulation demonstrates that it is feasible to control PM from small APU engines and several companies are supporting this market. The technology is commercially available and has been implemented on APUs since 2008 as part of the state’s Diesel Risk Reduction Plan (DRRP). In the Phase 2 proposal, EPA estimates the potential PM reduction impacts from installing DPFs on APUs as approximately 3,000 tons in 2035. Because these engines operate for many hours in a single location, the health impact from PM exposure to people that work, stop or live near rest areas and truck stops may be of greater concern than might be indicated by a simple mass-based inventory. Groups of trucks operating their APUs at a truck stop are similar to a stationary point source. California based their requirements for using PM controls on stationary sources on the health-based cancer risk of PM exposure around a point source exceeding one in a million. To better quantify the emissions impacts of installing emission controls on small diesel engines, such as APUs, TRUs and other small off-road engines, CARB is funding a demonstration program at UC-Riverside. MECA is supporting this effort with technology and expertise and we encourage EPA to seriously consider requiring DPF

technology on APU engines as part of this regulation. We agree with EPA's cost estimates for a DPF retrofit on an existing APU, that cost includes the expense of verifying the device and the need for a separate control unit to monitor and regenerate the filter. We believe that the cost would be significantly lower if the filter could be integrated onto the APU engine at the time of manufacture or the APU exhaust is routed into the truck exhaust, upstream of the DPF, at the time of vehicle manufacture and incorporates economies of scale that an OEM can achieve with larger numbers of engines. [EPA-HQ-OAR-2014-0827-1210-A3 p.11-12] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.212-213.]]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Moving Forward Network

*Eliminate loophole for Auxiliary Power Units (APUs), which will increase harmful Particulate Matter Emissions* – As the California Air Resources Board has pointed out, a regulation that will increase the use of APUs more extensively throughout the nation will result in increased PM<sub>2.5</sub> emissions unless these APUs are equipped with diesel particulate filters. We cannot sacrifice public health protections as we seek to battle climate pollution. We represent groups on the front lines battling deadly pollution from the freight industry. This approach that increase PM<sub>2.5</sub> emissions is even more problematic given at least one state, California, has shown that diesel particulate filters can be required on APUs. The final rule should require the use of diesel particulate filters on APUs. [EPA-HQ-OAR-2014-0827-1130-A2 p.2]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** National Association of Clean Air Agencies (NACAA)

Next, EPA projects an increase in the use of auxiliary power units (APUs) under the Phase 2 proposal and an associated 10-percent increase in PM emissions. The agency seeks comment on this, but proposes nothing to address the unacceptable and unnecessary expected rise in PM pollution. Exposure to diesel PM is one of the greatest public health challenges of our time. In California, for example, diesel PM was identified as a toxic air contaminant in 1998. However, even after implementation by the state of extensive control programs, diesel PM remains responsible for 60 percent of the known risk from toxic air contaminants. Therefore, NACAA recommends that, concurrent with the final Phase 2 rule, EPA adopt national requirements to equip APUs with diesel particulate filters, similar to CARB's requirements. [EPA-HQ-OAR-2014-0827-1157-A1 p.4-5]

Additionally, while MOVES modeling points to other air quality benefits of APU usage, there remains a significant difference between the emission standards for Tier 4 smaller nonroad diesel engines typically used in APUs when compared to the emission rates of a modern long-haul truck at idle. To prevent any potential backsliding from air quality benefits appreciated from the newest onroad engine standards, we recommend adding provisions to ensure that there are no increases in emissions of NO<sub>x</sub> or PM as a result

of increased use of APUs on all affected vehicles. We also encourage EPA to ensure against overestimation of the potential NOx benefits associated with APU use. [EPA-HQ-OAR-2014-0827-1157-A1 p.5]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

Furthermore, the MOVES emission rates for extended idle were lowered significantly for criteria pollutants based on the analyses of the latest test programs that reflect the current prevalence of clean idle certified engines. The extended idle rate for NOx was changed from 203 g/hr to 42.6 g/hr for model year 2013 and later. This change resulted in smaller differences between emission rates for extended idle and APUs for all criteria pollutants. Therefore, the emissions benefits of using APUs during extended idle, instead of the main engine, are lower for non-GHGs in the final rulemaking than at proposal.

**Organization:** Natural Resources Defense Council (NRDC)

Prevent increases in diesel particulate matter (PM) pollution from greater use of diesel-powered auxiliary power units (APU) by establishing appropriate APU PM emission requirements. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

**Prevent Increases in Diesel Particulate Matter from Diesel APUs**

Auxiliary power units (APUs) offer significant fuel savings and CO2 emissions benefits compared to main engine idling. However, the agencies note that the proposed rule results in a net increase in PM emissions from the increased use of diesel APUs (Table III-2 of Proposed Rule). Non-road diesel engines used to power APUs do not meet the same criteria pollutant emission standards as the main engine. [EPA-HQ-OAR-2014-0827-1220-A1 p.9]

Short- and long-term exposure to particulate matter pollution can have severe negative health impacts. Communities close to diesel vehicle and equipment operation suffer from high health risks due to PM exposure. To address this issue, the California Air Resources Board (CARB) requires diesel powered APUs to obtain equivalent or better particulate matter emissions than the main engine through the use of a diesel particulate filter or alternative means. There are three manufacturers offering particulate matter filters for diesel fuel APUs.<sup>21</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.9]

Given the availability of technology to control PM emission from diesel powered APUs, the potential health impact to communities from elevated levels of PM emission from truck idling, and the existence of preventative measures already in place in California, the EPA should require diesel powered APUs to achieve the maximum technically feasible and cost-effective reductions in PM emissions. [EPA-HQ-OAR-2014-0827-1220-A1 p.9]

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21 See CARB verified devices listed at <http://www.arb.ca.gov/msprog/cabcomf/cabcomf.htm>.

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from new tractors during long duration idling. The 2018 provision is a compliance constraint, simply not allowing credit for APUs installed in MY 2018 tractors unless the APU engine meets specified PM standards. Additional details are discussed in Section III.C.3 of the FRM Preamble.

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

**There should be no backsliding on fine particulate matter (PM<sub>2.5</sub>) and NO<sub>x</sub> from increased use of auxiliary power units (APUs).**

We also urge the agencies to ensure that there are no increases in emissions of either PM<sub>2.5</sub> or NO<sub>x</sub> as a result of the proposed rule. We note that the agencies project an increase in PM<sub>2.5</sub> as a result of increased APU use. While idle reduction represents an important opportunity for fuel savings, any increase in this harmful pollutant is unacceptable, particularly given that appropriate PM control technology for APUs is already in the marketplace and currently required by CARB. EPA should adopt similar requirements to CARB's for PM control on APUs, and should do so concurrently with this proposed Phase 2 rulemaking. Similarly the agencies should ensure there is no backsliding on NO<sub>x</sub> emissions as a result of increased use of APUs. [EPA-HQ-OAR-2014-0827-1221-A1 p.3 [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.139.]]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

The agencies do not expect backsliding of NO<sub>x</sub> emissions due to the use of APUs. EPA conducted a new analysis of the emission rates for extended idle for the final rule. The NO<sub>x</sub> extended idle rate for main engine idling was lowered in the MOVES analysis from 203 g/hr to 42.6 g/hr for model year 2013 and later to reflect new analysis of test results, but the extended idling NO<sub>x</sub> emission rate of APUs is 15.6 g/hr which is still significantly lower than main engine idling.<sup>145</sup>

**Organization:** Ozone Transport Commission (OTC)

Auxiliary Power Units

In the Regulatory Impact Analysis (RIA) for the Heavy-Duty Greenhouse Gas proposal USEPA cites a reduction in NO<sub>x</sub> emissions of around 7% in 2025 due to the implementation of the rule, primarily from an expansion of the use of Auxiliary Power Units (APUs). Although this reduction is commendable, it is not nearly enough to achieve the NO<sub>x</sub> reductions necessary for the states in the OTR to meet their clean ozone obligations, and leaves a great amount of potential for emission reductions unrealized. There are

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<sup>145</sup> U.S. EPA. Updates to MOVES for Emissions Analysis of Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 FRM. Docket No. EPA-HQ-OAR-2016 July, 2016.



also concerns as to whether the 7% reductions will be achieved given that USEPA has reduced its estimate of the emission benefits from the use of APUs cited in the first Heavy-Duty Greenhouse Gas Rule. [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Lastly, while MOVES modeling points to the air quality benefits derived from APU usage, there remains a significant difference between the emission standards for the Tier 4 smaller nonroad diesel engines typically used in APUs as compared to the emission rates of a modern long haul truck at idle. To prevent any potential backsliding from air quality benefits appreciated from the newest on-road engine standards, we recommend adding language to ensure that there are no increases in emissions from either NO<sub>x</sub> or fine particulate matter as a result of increased use of APUs on all affected vehicles. [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

**Response:**

EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of increasing PM emissions from tractors during long duration idling. Additional details are discussed in Section III.C.3 of the FRM Preamble.

The agencies do not expect backsliding of NO<sub>x</sub> emissions due to the use of APUs. EPA conducted a new analysis of MOVES emission rates for extended idle for the final rule. The NO<sub>x</sub> extended idle rate for main engine idling was changed from 203 g/hr to 42.6 g/hr for model year 2013 and later, but the extended idling NO<sub>x</sub> emission rate of APUs at 15.6 g/hr is still significantly lower than main engine idling.

**Organization:** Proventia Emission Control

Proventia received ARB approval (Executive Order DE-13-003) for their level 3 (85 percent PM reduction) actively regenerating DPF to fit the Thermo King Tripac APU and has been manufacturing and selling it since 2012. Due to the very low exhaust temperatures of the APU (110 to 260C), the DPF systems need to be actively regenerating. This technology is proven, reliable, and commercially available. [EPA-HQ-OAR-2014-0827-0811-A1 p.1]

The EPA technology cost estimate of \$580 added to the cost of 150 hp engines is accurate, if it is defined as the OEM cost of materials and manufacturing cost in production quantity exceeding 10,000+ annually. [EPA-HQ-OAR-2014-0827-0811-A1 p.1]

The \$2,240 cost estimate cited for Proventia for the electrically heated DPF is an end-user price for an aftermarket retrofit device, not an OEM cost for an OEM device. Proventia estimates that a comparable OEM cost of materials and manufacturing cost for production quantity exceeding 10,000+ annually would be \$975 for the actively regenerating DPF for APU. The basis for this estimate is that current Proventia production cost in quantity of 50 units is \$1069. [EPA-HQ-OAR-2014-0827-0811-A1 p.1]

It should be noted that the \$580 added cost for 150 hp engines is likely to be for a catalyzed passively regenerating DPF due to the higher exhaust temperatures for this class of engine. In comparison, the APU's, due to their low exhaust operating temperatures, always need an actively regenerating DPF and the cost of actively regenerating devices is significantly higher than passively regenerating devices. [EPA-HQ-OAR-2014-0827-0811-A1 p.1]

**Response:**

In the NPRM, EPA discussed several sources for DPF cost estimates. The three sources included the Nonroad Diesel Tier 4 rule, ARB, and Proventia. EPA developed long-term cost projections for catalyzed diesel particulate filters (DPF) as part of the Nonroad Diesel Tier 4 rulemaking. In that rulemaking, EPA estimated the DPF costs would add \$580 to the cost of 150 horsepower engines (69 FR 39126, June 29, 2004). On the other hand, ARB estimated the cost of retrofitting a diesel powered APU with a PM trap to be \$2,000 in 2005. Proventia is charging customers \$2,240 for electronically heated DPF for retrofitting existing APUs. EPA considered all of the comments on DPF costs and more closely evaluated NHTSA's contracted TetraTech cost report which found the total retail price of a diesel-powered APU that includes a DPF to be \$10,000. Based on all of this information, EPA is projecting the retail price increment of an actively regenerating DPF installed in an APU to be \$2,000. This cost is incremental to the diesel-powered APU technology costs beginning in 2024 MY.

**Organization:** Thermo King

**Technical Feasibility of Diesel Particulate Filter (DPF) Requirements in Auxiliary Power Unit (APU) Applications [§III.C(3)]**

Section III.C(3) of the Proposed rule requests comment on the technical feasibility of requiring the use of DPFs for diesel-powered APUs, as is required by the California Air Resources Board (CARB), and on the assumptions made by EPA in its preliminary analysis. Ingersoll Rand has significant concerns with regards to a nationwide requirement for use of DPFs in diesel-powered APUs, and strongly urges EPA not to impose such a burden on the trucking industry. [EPA-HQ-OAR-2014-0827-1196-A1 p.1]

Thermo King currently offers a DPF option on its line of diesel-powered APUs in order to help the trucking industry comply with CARB requirements. However, the incremental cost of the DPF option can be as high as \$3,500 – considerably higher than the cost estimated by EPA in this section of the proposed rule – and often the deciding factor in removing the cost-effectiveness justification for the installation of an APU at all. [EPA-HQ-OAR-2014-0827-1196-A1 p.1-2]

If diesel-powered APUs were to no longer be cost-effective on a nationwide basis, Ingersoll Rand believes the consequences on the trucking industry would be significant. Currently, the only alternatives available to diesel-powered APUs are battery-powered options. While battery-powered APUs may be commercially available, the technology is not yet mature enough to adequately serve as a replacement for diesel. A typical battery-powered APU provides half the air conditioning cooling capacity of a diesel-powered model, and often is unable sustain a charge for the entire driver rest period. Drivers are already under constant pressure to meet mandated rest times regardless of factors such as traffic or weather; having to sacrifice comfort during these periods by relying on battery-powered APUs would be an added detriment to their ability to get quality rest, which could ultimately decrease highway safety. According to the Federal Motor Carrier Safety Administration<sup>1</sup>, 33.6% of large truck accidents in 2013 cited at least one driver-related factor, and of those accidents 11.4% were determined to be the result of driver impairment, which includes fatigue. [EPA-HQ-OAR-2014-0827-1196-A1 p.2]

Ingersoll Rand believes that high-capacity battery-powered APUs will eventually become a commercially available and cost-effective alternative to diesel-powered APUs, and Thermo King has been dedicating resources to research and development in this area for some time. However, mandating this technology today would significantly decrease consumer choice, competitiveness in the APU marketplace, and driver comfort and safety. Ingersoll Rand would welcome additional research, development, and deployment of

high-capacity battery technologies available to APUs supported by or in collaboration with EPA. [EPA-HQ-OAR-2014-0827-1196-A1 p.2]

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1 “Large Truck and Bus Crash Facts 2013,” U.S. Department of Transportation Federal Motor Carrier Safety Administration, Analysis Division, Rep. FMCSA-RRA-15-004, Apr. 2015.

**Response:**

The agencies have adopted CO<sub>2</sub> emissions and fuel consumption standards based on our analysis of *one* technology pathway for each level of stringency, but manufacturers will be free to use any combination of technology to meet the standards, as well as the flexibility of averaging, banking and trading, to meet the standards on average. In addition to diesel powered APUs, tractor manufacturers have several other idle reduction technology options in addition to other vehicle technologies such as aerodynamic designs, lower rolling resistance tires, and powertrain improvements. In addition, the idle reduction technology package in the final rule actually has an overall lower cost (even after increasing the diesel APU technology cost for the final rule) than would have been developed for the final rule due to the reduced penetration rate of diesel APUs. The stringency of the tractor standards are not affected because of the higher penetration rate of other idle reduction technologies. The increased use of these other idle reduction technologies offsets the difference in APU use, even though these other technologies are not quite as effective as APUs from a GHG standpoint.

In the NPRM, EPA discussed several sources for DPF cost estimates. The three sources included the Nonroad Diesel Tier 4 rule, ARB, and Proventia. EPA developed long-term cost projections for catalyzed diesel particulate filters (DPF) as part of the Nonroad Diesel Tier 4 rulemaking. In that rulemaking, EPA estimated the DPF costs would add \$580 to the cost of 150 horsepower engines (69 FR 39126, June 29, 2004). On the other hand, ARB estimated the cost of retrofitting a diesel powered APU with a PM trap to be \$2,000 in 2005. Proventia is charging customers \$2,240 for electronically heated DPF for retrofitting existing APUs. EPA considered all of the comments on DPF costs and more closely evaluated NHTSA’s contracted TetraTech cost report which found the total retail price of a diesel-powered APU that includes a DPF to be \$10,000. Based on all of this information, EPA is projecting the retail price increment of an actively regenerating DPF installed in an APU to be \$2,000. This cost is incremental to the diesel-powered APU technology costs beginning in 2024 MY.

**Organization:** Truck & Engine Manufacturers Association (EMA)

APU Requirements

The agencies should not impose any new emission requirements on APUs as a part of the Phase 2 program. APUs already meet the Tier 4 nonroad standards, and so are in compliance with technology-forcing emission limits. This rulemaking is not the proper forum for amending the Tier 4 nonroad engine standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

**Response:**

As explained in Preamble section III.C.3, EPA is adopting new PM standards that apply exclusively to APUs installed in MY 2018 and later new tractors that will prevent an unintended consequence of

increasing PM emissions from tractors during long duration idling.<sup>146</sup> We project that the annual impact of the final program to further control PM will lead to a reduction of PM<sub>2.5</sub> emissions nationwide (i.e. prevent emissions that would otherwise occur) by 927 tons in 2040 and by 1,114 tons in 2050. As explained at the conclusion of this response, EPA considers the costs of achieving these emission reductions (more precisely, preventing their occurrence) to be reasonable.

EPA has carefully considered the adequacy of lead time. With respect to the constraint that takes effect in 2018, EPA acknowledges that it is acting relatively aggressively to forestall potential increases in APU-related diesel exhaust PM emissions. However, this 2018 provision is a compliance constraint which prevents tractors from obtaining any credit for use of an APU unless the APU is certified to a given standard which is already being achieved within the industry. APUs not meeting that standard can be used for other purposes. This provision thus can be implemented expeditiously, and it is appropriate to do so given that diesel exhaust PM is a likely human carcinogen. See Preamble Section VIII.A.6. The MY 2021 standard, which is essentially the same type of provision as the 2018 provision except that any APU installed in a MY 2021 tractor would have to meet the given PM standard, has adequate leadtime for the same reason as the 2018 provision. The MY 2024 and 2027 standards are predicated on use of diesel particulate filters, a known technology which can be designed into these engines within that amount of lead time.<sup>147</sup> In addition, APUs and their engines do not have to meet these standards; they only must do so if the APUs are to be used in new MY 2024 and later tractors.

In terms of safety, EPA considered the fact that diesel particulate filters are a known technology with no known adverse safety implications.

EPA regards any costs associated with these provisions to be reasonable. First, none of these costs need be incurred, and so the standard can be viewed as cost free to both tractor manufacturers and manufacturers of APUs and APU engines. Tractor manufacturers can use other types of idle reducing technologies, or choose a Phase 2 compliance path not involving idle control. The agencies have developed technology packages for determining the final Phase 2 tractor GHG and fuel consumption standards that are predicated on lower penetration rates of diesel APUs than in the NPRM and have included several additional idle reducing technologies, making it more likely that alternative compliance paths are readily available. See RIA 2.8.3.5 indicating that APUs are not projected to be a critical part of the compliance pathway for achieving either the MY 2024 and MY 2027 standards. APU manufacturers (and manufacturers of APU engines) also can market their product to any entities other than MY 2024 and later new tractors without meeting the DPF-based PM standard.

In addition, the PM standard is necessary to avoid an unintended consequence of GHG idle control. The standard adopted is also appropriate for APUs used in on-highway applications, since it is comparable to the heavy-duty on-highway standard after considering rounding conventions (the PM standard for a tractor's main engine is 0.01 g/hp-hr as specified in 40 CFR 86.007-11(a)(1)(iv)); cf. CAA section 213

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<sup>146</sup> As noted in the final Preamble, this standard can be expressed and justified as either a tractor vehicle standard or as a standard for the non-road engine powering the APU. The standard can be a vehicle standard because engines of any age can be placed in motor vehicles and the vehicle remains a new motor vehicle. See CAA section 216(3) (definition of new motor vehicle engine, which includes "an engine in a new motor vehicle" and so is not limited to engines of the same model year as the vehicle).

<sup>147</sup> Cf. CAA section 213 (a)(3) which directs the Administrator to consider standards equivalent in stringency to the comparable on-highway standard. Here, the MY 2024 and 2027 PM standards for APU engines used in new tractors will be identical to the on-highway engine standard for comparably sized engines. Although CAA section 213(a)(3) is not applicable here (it does not apply to PM), the provision is nonetheless suggestive of Congressional intent to provide parity between on-road and non-road engine standards where feasible and otherwise reasonable to do so.

(a)(3) (in considering what standards for non-road engines are “available,” EPA “shall first consider” emission standards equivalent in stringency to on-highway standard for comparable engines). The emissions in question also are of diesel exhaust PM, which is a likely human carcinogen. See Preamble Section VIII.A.6.b. In the agency’s view, the toxicity of the pollutant in question further supports that the costs of this standard, which costs need not be incurred, are reasonable.

A final reason we regard the costs as reasonable is that the costs of APUs equipped with a diesel particulate filter are included as part of the agencies’ cost assessment of the tractor vehicle standard. See RIA Chapter 2.11.6.3. The agencies have explained why the costs of that vehicle standard are reasonable. EPA further noted in Section III.C.3 of the Preamble that the quantified benefits of the filter-based PM standard are greater than potential costs, but EPA’s determination that the costs of the APU provisions are reasonable is not based on that information.

## 5 Trailers

### 5.1 General Comments

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

**Inclusion of trailers.** The addition of trailers to the program is crucial, because known, affordable trailer aerodynamic and tire technologies can deliver almost 10% fuel savings for tractor-trailers. [EPA-HQ-OAR-2014-0827-1280-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.55.]]

**Response:**

The agencies agree and are adopting a trailer program as part of the final Phase 2 rulemaking.

**Organization:** American Trucking Associations (ATA)

NHTSA Should be Aware of Potential Weight Implications of Regulating Under-Ride and Over-Ride Guards

In July 2015, NHTSA issued an Advanced Notice of Proposed Rulemaking pertaining to rear impact (under-ride) guards and other safety strategies for single unit trucks. NHTSA also indicated that it will issue a Notice of Proposed Rulemaking focusing on rear under-ride guards on trailers. Further, NHTSA noted that it is still evaluating a petition request to improve side under-ride and front override guards for all trucks and will issue a separate decision on those issues at a later date. [EPA-HQ-OAR-2014-0827-1243-A1 p.22]

A measure included under Phase 2 to advance trailer fuel efficiency promotes the use of lighter weight materials in their construction (i.e., decreasing trailer weight will allow for the substitution of additional freight weight). NHTSA must remain aware that if the pending petition on side under-ride and front over-ride guards is granted, such new standards will increase tractor, trailer, and straight truck weights. While NHTSA and EPA give OEMs credit for selling new, light-weight equipment under Phase 2, light-weighting gains could be quickly overcome by the added weight attributed to the addition of new side under-ride and front over-ride guards. Likewise, new requirements for rear under-ride guards will likely result in increased weights attributed to the use of stronger materials used in their construction. [EPA-HQ-OAR-2014-0827-1243-A1 p.22]

**Response:**

The agencies recognize the interrelatedness of this regulation to other federal regulations. The subject of a possible side guard requirement is in a research stage. As discussed in a July 2015 document, NHTSA is in the process of evaluating issues relating to side guards and will issue a decision on them at a later date. In December 2015, NHTSA issued a notice of proposed rulemaking proposing to adopt requirements of Transport Canada's standard for underride guards. NHTSA is currently assessing next steps on that proposal, and includes as part of its analysis consideration of impacts of any decisions on the fuel efficiency of the vehicles.

We cannot predict how the performance of future aerodynamic devices may be impacted if such requirements were in place, though we do expect both trailer and device manufacturers will be mindful

of the performance of both features in their future designs. The additional weight of the any future safety-related components would have the potential to increase vehicle weight, but EPA and NHTSA will not adjust their CO<sub>2</sub>- or fuel consumption standards to account for the weight increase. Customers that expect their trailers to “weigh-out” can request that the trailer manufacturer adopt some of the agencies’ lightweight components or other weight reduction measures, which could keep their trailers within the weight limits, improve their CO<sub>2</sub> emissions and fuel consumption, and assist in the trailer manufacturer’s Phase 2 compliance.

**Organization:** American Trucking Associations (ATA)

### **Trailer Concerns**

While ATA recognizes the potential for fuel-efficiency gains from improved trailer design, ATA commends the agencies in affording trailer OEMs flexibility in achieving new trailer efficiency targets. The trailer manufacturing industry is far different from the engine and truck manufacturing sectors. Whereas there are only a handful of truck and engine manufacturers, there are well over 100 trailer manufacturers in the U.S. with the vast majority being designated as small businesses. The top 10 trailer manufacturers account for over 75% of total sales. Unlike the business relationships between engine and truck manufacturers, trailer manufacturers remain separate and unique entities. [EPA-HQ-OAR-2014-0827-1243-A1 p.23]

Trailers come in a variety of different styles including dry vans, refrigerated, tank, flat bed, and specialized to name a few. The ratio of trailers to tractors is 3:1 or more and tractors are often paired with a variety of different trailer types depending on a company’s operations. Adding another level of complexity to the equation, the useful life of a trailer can exceed 20 years with proper maintenance and even be remanufactured to provide many more years of useful life. [EPA-HQ-OAR-2014-0827-1243-A1 p.23-24]

Having just surpassed the 100-year anniversary of the semi-trailer, ATA agrees that it is time to reassess trailer design elements including use of LRRTs, aerodynamic devices, tire pressure technologies, and light-weighting. Trailer regulation should be nationally harmonized and not done in a piecemeal manner such as CARB has done. As a key stakeholder, ATA desires to work with the agencies in developing a logical and cost-effective approach in developing a national trailer efficiency improvement program. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

### **Response:**

The agencies designed this program to be a national program. The agencies recognize the unique characteristics of the trailer industry and we developed the Phase 2 trailer standards and compliance regime with this in mind. We are confident these standards can be achieved and that compliance with the standards can be successfully demonstrated, including by manufacturers that lack prior experience implementing such standards. We are adopting many of the proposed flexibilities that are meant to reduce the compliance burden for this newly regulated industry. Compared to the proposal, the final program also reduces the number of regulated trailer types by limiting the non-box trailer program to tanks, flatbeds and container chassis only, which removes more than 70 small business trailer manufacturers from the program.

**Organization:** Corwin, Michael

I currently work for a small trucking company that has 26 trucks running the US & Canada. ... I have no problem with mandating fuel efficient tires but they should be for everyone regardless of the type of trailer. The easier way to accomplish this would be to put the regulations on the tire manufacturers which would get rid of the inefficient ones altogether making the cost better for the end user. I purchased a used trailer a number of years ago in California that had brand new tires on it but as it turned out they weren't on any rolling resistance list that I could find. I was unable to get the dealer to switch them and couldn't afford to do it myself at the time. If the rules said that to be sold in the US they had to meet minimum rolling resistance standards this would help both the manufacturer and the end user. It would also have off road heavy equipment using them as well which should improve their efficiency as well. [EPA-HQ-OAR-2014-0827-0730-A1 p.1]

**Response:**

EPA's regulatory authority is limited to vehicle manufacturers; we cannot set emissions-related standards for suppliers, including tire manufacturers. However, under the trailer program, trailer manufacturers will be equipping new trailers covered by the program with tires that meet the LRR specifications needed for each of those trailers to comply with the performance standards or design standards of this rule. We expect this increased market demand from trailer manufacturers will encourage tire manufacturers to make appropriate LRR tires available.

Also, although tires are not specifically regulated as part of FMVSS No. 121, tires (including the LRR tires that trailer manufacturers will be installing for compliance with the Phase 2 trailer program) are part of the braking system that must meet the performance requirements outlined in FMVSS No. 121.

**Organization:** Corwin, Michael

On the issue of aerodynamics, the truck can be made aerodynamic, regardless of the trailer it is pulling, so the regulations should be separate for the tractor and for the trailer. This would allow regulators to take into account the different types of trailers regardless of the truck that is pulling it and no matter what truck pulled it the aerodynamics would be good. The vast majority of companies pull one type of trailer vs multiple types but one truck lease operator may switch companies several times and pull a different type of trailer each time. By having the requirements separate the long term effects would be better. [EPA-HQ-OAR-2014-0827-0730-A1 p.1]

**Response:**

The agencies are setting GHG emissions and fuel consumption standards separately for the tractor and trailer. We designed our trailer program such that box vans are tested and evaluated with relatively aerodynamic high roof tractors (Bin III or better) that are likely to be in widespread use in the timeframe of the program. In the tractor program, high roof tractors are paired with box vans that include aerodynamic skirts. By evaluating tractors and trailers that are likely to be paired in-use, including the expected aerodynamic improvements, OEMs will be better equipped to design their tractor and trailer aerodynamic improvements to work synergistically with the other half of the vehicle.

**Organization:** Great Dane

We at Great Dane support reductions in Greenhouse Gas emissions and improved energy efficiencies in transportation. The issue of Greenhouse Gas (GHG) regulations affecting semi-truck trailers is a complex matter. Trailer designs and specifications vary widely from customer to customer and even



within a given customer's fleet based on their operational needs. [EPA-HQ-OAR-2014-0827-1219-A1 p.1]

In conversations with the EPA we have shared our concerns with staff as to the potential consequences of deployment of certain types of devices that we believe will significantly increase the likelihood of adverse effects on trailers such as water leaks due to mechanical damage, corrosion due to accumulation of road chemicals (one of the most extensive problems the transportation industry faces) or unplanned device damage as a result of operation of the trailer. We believe that the trailer OEM and fleet together are best qualified to determine the practicality of the use of a particular device and hope that the agencies agree with our viewpoint. [EPA-HQ-OAR-2014-0827-1219-A1 p.3]

We appreciate the agencies study of multiple alternatives as detailed in the NPRM and believe that for many reasons a regulatory approach with a more aggressive adoption of stringencies than the proposed approach (Alternative 3) increases the probability of negative effects on stakeholders considerably. Thus we suggest that the agencies consider devising an incentive based approach that could benefit all stakeholders to augment the proposed approach and assist in the deployment and adoption of advanced technologies as opposed to adoption of the more stringent Alternative 4 being considered. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

Great Dane looks forward to continuing to work with both EPA and NHTSA to further shape and refine the proposed rule and help develop the most appropriate regulations for the industry. We appreciate your consideration of these matters. [EPA-HQ-OAR-2014-0827-1219-A1 p.5]

**Response:**

The agencies are adopting standards based on the proposed Alternative 3 and essentially agree with the commenter that the three-year pull ahead reflected in Alternative 4 raises issues of adequacy of lead time, including reliability of the technology. We designed our program such that manufacturers can gradually introduce technologies that are generally familiar to their customers.

**Organization:** Institute for Policy Integrity at NYU School of Law

The agencies have made several changes to the Phase 2 rule that are consistent with our previous comments. Notably, the Phase 2 proposal includes standards for trailers. For more on Policy Integrity's views on heavy-duty vehicle regulation, see our comments on the Phase 1 rulemaking.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.3]

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<sup>6</sup> [http://policyintegrity.org/files/publications/2211\\_Regulatory\\_Report\\_2011\\_Heavy\\_Trucks\\_Rule.pdf](http://policyintegrity.org/files/publications/2211_Regulatory_Report_2011_Heavy_Trucks_Rule.pdf)

**Organization:** Sierra Club

**Finalize proposed trailer standards**

We applaud the agencies for proposing to include trailers in the standards. This is a critical part of the proposed standards, as we know that existing trailer aerodynamic and tire technologies can deliver more than 10 percent fuel savings for tractor-trailers. [EPA-HQ-OAR-2014-0827-1277-A1 p.3]

**Response:**

In response to The Institute for Policy Integrity at NYU School of Law, National Association of Clean Air Agencies, and Sierra Club, we appreciate your support of our proposed trailer program. The agencies are including standards for trailers in the final Phase 2 program.

**Organization:** STEMCO

We support the EPA and NHTSA's effort to reduce greenhouse gas emissions in the transportation industry while at the same time recognizing the complexity of implementing this nationwide regulation, especially when trailers are included for the first time. Because our products related to this regulation are primarily installed on trailers, our comments will apply only to that portion (section IV) of the EPA and NHTSA's proposal. In general, we believe that this proposal combines an appropriate standard for achieving the goal of significant environmental improvements with an implementation strategy that aims to minimize negative impacts on industry stakeholders. We specifically support: [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

-Alternative 4 standards for trailers [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

-Aerodynamic Device Testing Alternative [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

**Response:**

We appreciate the commenter's support for our proposed trailer program. The trailer manufacturers unanimously opposed the accelerated timeline of the proposed Alternative 4 in their public comments, citing lead time concerns. The agencies agree that the accelerated timeline of that alternative raises serious concerns regarding adequacy of lead time, including reliability concerns. To afford adequate lead time, the agencies are adopting standards based on the four-stage implementation schedule of Alternative 3, with some changes to our projected technology adoption rates, including strengthened standards for the full-aero van program that includes greater adoption of advanced aerodynamics in the final (MY 2027) stage.

We are finalizing an aerodynamic device testing compliance path that provides for trailer aerodynamic device manufacturers to seek preliminary approval of the performance of their devices (or combinations of devices). Trailer manufacturers could then choose to use these devices and apply the approved performance levels in the certification application for their trailer families.

**Organization:** Stoughton Trailers

Continue voluntary implementation of technological advances:

The trucking transportation industry has and is very interested in all aspects of fuel saving technology and has through programs such as SmartWay made advances in fuel conservation. The driving force behind such implementations has been the financial bottom line. Some of the innovations employed include increases to interior volume while maintaining exterior size, reduction in weight, decking systems for multi-layer cargo transportation; along with some of the technologies the EPA regulation is basing its reductions on, such as aerodynamic devices, low rolling resistant tires, and automatic tire inflation systems. These advances have been employed as the industry has seen and realized value supported by evidence. The current proposal for a regulation will indeed claim a difference which would likely have been accomplished through the voluntary adoption of systems proven as functional. An

unintended side-effect will be the increased creation of CO<sub>2</sub> due to the additional fuel expended on those “regulated units” that do not operate in a manner which causes the added options to provide for a realized and effective performance (i.e. the added weight will cause additional fuel usage and additional trips due to the inability to maximize the cargo potential: not to mention the increase to potential safety issues and the cost of maintaining the components and the fact that shipping the components will result in added miles traveled due to additional loads being generated). [EPA-HQ-OAR-2014-0827-1212-A2 p.1-2]

When push comes to shove the industry is very resourceful and may take action which actually detracts from the overall purpose of reducing CO<sub>2</sub> creation: one such scenario has been experienced in the CARB regulating of the state of California; some shipments have found their way to a container/chassis combination as an over-the-road mode of transportation. The combined weight effect of 5,000lb increase to the empty weigh of the unit of transference. [EPA-HQ-OAR-2014-0827-1212-A1 p.2]

Request 3: Maintain voluntary program without mandated regulations. [EPA-HQ-OAR-2014-0827-1212-A2 p.2]

Request 4: do not regulate non-CO<sub>2</sub> producing transportation equipment. [EPA-HQ-OAR-2014-0827-1212-A2 p.2]

**Response:**

The agencies believe the majority of box vans will experience CO<sub>2</sub> and fuel consumption reductions with use of the technologies that we expect trailer manufacturers to utilize to achieve the standards. The agencies have tailored the standards in part to avoid the problem raised by this commenter; adding technologies under circumstances where they do not provide CO<sub>2</sub> or fuel savings benefit. Thus, the final rule has separate standards for partial- and non-aero trailers. We believe that many of the box vans that operate at lower speeds will have work-performing equipment (e.g., side platforms, rear lift gates) that will allow manufacturers to designate these trailers as partial-aero or non-aero vans. Partial-aero standards are based on adoption of a single aerodynamic device, and non-aero vans have design standards that require installation of tire technologies only with no aerodynamic requirements. A small fraction of the box van industry may not qualify for a partial- or non-aero designation, yet still operate at lower speeds. These vans may not achieve the real-world benefits that their compliance results would suggest or that similar vans experience because they frequently travel at higher speeds. However, in RIA Chapter 2.10.2.1.1, we show that even trailers operating under 100% transient conditions will experience a small benefit from use of trailer skirts, and trailers that spend any time at speeds of 55-mph or greater will achieve benefits of at least 1% during that time, compared to operating without skirts.

The agencies are establishing GHG emissions and fuel consumption standards that provide appropriate and maximum feasible reductions under their respective statutory authorities. We do not believe a voluntary trailer program will produce sufficient emissions and fuel consumption reductions to meet our regulatory obligations. The agencies’ baseline accounts for improvements already present in the trailer fleet due to participation in the voluntary SmartWay program or other factors. The agencies project that very significant and cost-effective reductions over that baseline are available, largely through further utilization of already-available tire and aerodynamic technologies that are not presently deployed on significant portions of the trailer fleet. Thus, reliance on further voluntary efforts will not achieve reductions which are readily feasible in the lead time provided, cost-effective, and which indeed, will

pay for themselves in fuel savings. See RIA Chapter 7 and our memo to the docket for more information on our cost calculations.<sup>148</sup>

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## 9 - Ways to simplify/streamline

When and if legal authority is given to regulate trailers, there are certain ways that the program could be streamlined. One example would be to require trailer tires to be low rolling resistance and/or trailers to have ATIS as part of NHTSA only, so that compliance can be within the manufacturer's certification label to remove unneeded compliance burden. That way, the regulated classes of trailers goes down and the EPA can focus its priorities where they will do the most good, while manufacturers of non-aero- and non-box-trailers will have a minimum of compliance burden while maximizing the available CO2 reductions/fuel savings. [EPA-HQ-OAR-2014-0827-1172-A1 p.14-15]

Moreover, there are far more effective methods to reduce fuel consumption and improve the freight sector's carbon footprint. Recent proposals to lengthen combination trailers to 33' would have a tremendous impact. This can be seen in the agencies' own data and proposed CO2 standards for trailers, where longer trailers have substantially lower CO2 emissions per ton-mile<sup>22</sup>. Similarly, an increase in permissible weights would be met with improvements in fuel economy and carbon footprint. Also, a slight reduction in speed limits for HD vehicles would be most effective<sup>23</sup>. Any and all of these would have to be done carefully so as to give due consideration to all aspects including safety concerns, but they would work better than the proposal as written. [EPA-HQ-OAR-2014-0827-1172-A1 p.15]

Regardless of exemption levels and classification schemes, requiring reporting on every individual trailer produced and each device fitted as the proposal envisions is overly capricious, unreasonably burdensome and is not supportive of the goal of reducing greenhouse gas emissions or saving fuel. Individual trailer manufacturers can certify that they have complied with the regulations and that should be sufficient. If the agencies elect to regulate end users as we suggested in our authority objections sections, we could see adding a panel/label that clearly spells out the characteristics of the trailer in terms that work with that regulation. [EPA-HQ-OAR-2014-0827-1172-A1 p.15]

### Response:

Each agency has an independent obligation here to develop standards. See *State of Massachusetts v. EPA*, 549 U.S. at 532 ("But that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's "health" and "welfare," 42 U.S.C. § 7521(a)(1), a statutory obligation wholly independent of DOT's mandate to promote energy efficiency. See Energy Policy and Conservation Act, § 2(5), 89 Stat. 874, 42 U.S.C. § 6201(5). The two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency"). The agencies have worked diligently to develop a single national program so that compliance with the standards of either agency assures compliance with the other agency's standards, and with standards of the State of California as well. The agencies have also developed a compliance regime for trailer manufacturers designed to minimize regulatory burden and complexity. Examples are design standards for non-aero trailers, and (for the other regulated trailers) certification via use of an equation rather than needing to run the full GEM model.

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<sup>148</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Tractor-Trailer Cost per Ton Values", August 2016.

We expect trailer manufacturers to produce their range of trailer models with a relatively small number of certified configurations. The regulation also generally allows manufacturers to group their trailer models into one or two emission families. The application for certification requires data submission for at most three different configurations. The annual production report would require configuration information for each trailer produced, but trailers with like configurations could be grouped together.

Size and weight restrictions for tractor-trailers are under the jurisdiction of the Federal Highway Administration (FHWA), and are largely controlled by the weight limits established by Congress in 1956 and 1974, the size limits established in the Surface Transportation Assistance Act (STAA) of 1982, and the size and weight limits established in the Intermodal Surface Transportation Efficiency Act of 1991. Changes to these restrictions would require a broader process involving Congress and Federal and State agencies, and is beyond the scope of the Phase 2 trailer program.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

### **Costing**

Anti-Trust issues prevent us from gathering cost of goods data. Our members have commented that the costs of certain components in the RIA seem quite low. We will encourage members to submit specific examples directly to the agencies as confidential business information. [EPA-HQ-OAR-2014-0827-1172-A1 p.18]

### **Response:**

We did not receive comments specifically indicating technology costs that differ from those in the proposal. General comments that imply costs are too high or too low are not sufficient to direct the agencies to make appropriate changes, particularly when the agencies have presented a documented component-by-component cost assessment. As a result, the cost of our projected technology packages remain unchanged from the proposal.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## **12 - Conclusion**

If rules must be crafted, they should be done so reasonably, and not arbitrarily, so as to avoid these sorts of deleterious effects. We have pointed out certain areas that the agencies have overlooked for both exclusion from the rule and for changing the ways that box trailers are counted to account for the ways that they are used. We also encourage regulators to refrain from unnecessarily harming the trailer manufacturing industry by being sensitive to its small-business, produce-to-order nature and to craft any such regulation with the realization that there is no “average” trailer manufacturer. Putting a manufacturer out of business by forcing it to make what it cannot sell or exclusively absorb costs that it cannot pass on will save no fuel and reduces no emissions. There are methods in use today that accomplish regulation of the industry without such an arbitrarily heavy hand as the agencies are proposing here. We have detailed a few such ways that the agencies should consider that would reduce the unreasonable burden while still accomplishing the agencies goals. [EPA-HQ-OAR-2014-0827-1172-A1 p.19]

Once again, we appreciate the agencies’ outreach to us and pledge to continue dialog to help the agencies craft the best regulations possible. We will continue to gather data and may submit further

information as it becomes available, and welcome inquiries from the agencies. [EPA-HQ-OAR-2014-0827-1172-A1 p.20]

**Response:**

The agencies recognize that the trailer industry is differently situated when compared to many other light- and heavy-duty vehicle sectors. The final standards acknowledge and account for those differences, where it is legitimately possible to do so. We have significantly reduced the number of regulated trailers in the final program. The non-box trailer subcategory is now limited to tanks, flatbeds, and container chassis. All other non-box trailers -- about half of the non-box trailers produced -- are excluded from the Phase 2 trailer program, with no regulatory requirements. We offer reduced standards for trailers with work-performing equipment that would impede installation of aerodynamic technologies. We are adopting the same list of work-performing equipment that can be used to qualify box vans for partial- or non-aero designations, and are including roll-up doors as work-performing equipment through MY 2023. Additionally, in response to many comments from entities representing both small and large trailer companies, we are limiting averaging as a compliance mechanism to MY 2027 and later, and offering a set allowance of trailers from each manufacturer that do not have to meet the standards in the years without averaging (i.e., prior to MY 2027). These are a few of the provisions the agencies are adopting to ensure these standards are reasonable for this newly regulated industry.

We appreciate TTMA's participation in pre-proposal meetings, including our small business discussions, and its comments on the proposed rulemaking.

**Organization:** Utility Trailer Manufacturing Company

**Market Forces Will Achieve Most of the Benefits of the Proposed Rules with Few of the Costs**

The semi-trailer industry is a mature, extremely competitive, cyclical, low-margin industry. Utility Trailer and the other large manufacturers do not dictate specifications to their customers. Rather, their customers are often large trucking fleets who design their trailers to meet specific needs and then seek to have the manufacturers produce them on a semi-custom basis. The customers are overwhelmingly interested in a trailer that meets their respective specific needs in the most cost-effective way, as the transportation industry too is a mature, low-margin industry. [EPA-HQ-OAR-2014-0827-1183-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.219.]]

What this means is that if technological advances exist that will permit the transporters to move their goods more efficiently at lower costs, they will require the manufacturers to supply those advances. The Agencies justify the Proposed Rules by touting its cost-benefit payback to the trailer owner, claiming that there is a two-year payback on the mandated technologies.<sup>1</sup> As mentioned later, Utility Trailer believes the Agencies have understated substantially the cost of the mandated technologies. But accepting as accurate for now the Agencies' estimates on which it based its Proposed Rules, the owners have every incentive to require that their trailers have these technologies in place and to buy them. [EPA-HQ-OAR-2014-0827-1183-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.219.]]

What possible justification is there for the Agencies to substitute their judgment and mandate for free-market forces, which operate very efficiently in the trailer industry? The Proposed Rule does not provide any; it does not explain why the operators, left to their own devices and the free-market, would not adopt these technologies. [EPA-HQ-OAR-2014-0827-1183-A1 p.2]

One justification, of course, is that the technologies simply don't provide the savings touted by the Agencies in all applications. As discussed later, all real efficiencies from the aerodynamic devices (trailer skirts, trailer tails, and similar devices) mandated by the Agencies come at higher speeds – not a surprising conclusion since elementary physics tells us that aerodynamic drag is proportional to velocity squared, and power (and thus fuel) required to overcome this drag force is proportional to velocity cubed. Those transportation applications that operate at the lower speeds – such as urban delivery, food service, and many short-haul operations – will not achieve significant fuel savings (which, of course, correlates directly to reduced CO2 emissions) from the aerodynamic devices. Those users have no need for the devices, and requiring installation for those applications accomplishes little if anything. [EPA-HQ-OAR-2014-0827-1183-A1 p.2-3]

In other words, the free market efficiently self-selects which applications should install the aerodynamic devices on trailers – the Agencies themselves note that operators have every incentive to do just this. As discussed later, the Proposed Rule imposes substantial regulatory and administrative burden on the trailer-manufacturing industry. There is neither a need nor justification for adding layers of mandates and regulations where the market has every incentive to achieve the same results through voluntary compliance. The Proposed Rule is silent on this topic. [EPA-HQ-OAR-2014-0827-1183-A1 p.3]

**Response:**

As noted in our response to Stoughton in this Section 5.1 on page 965, we do not believe a voluntary trailer program will produce sufficient emissions and fuel consumption reductions to meet our statutory mandates. Additionally, most box vans that exclusively travel at low speeds will qualify for designation as partial- or non-aero vans. For those without work performing equipment, our results from RIA Chapter 2.10.2.1.1 indicate that the technologies will provide some savings to those trailers, even if they spend a large portion of their time at lower speeds.

**Organization:** Utility Trailer Manufacturing Company

The Proposed Rule fails to account for the increases in greenhouse gases that will result from the Rules; they do not measure net greenhouse gas effects of the devices.

A proper analysis of the greenhouse-gas reduction resulting from implementing the Proposed Rule would speak of the net effect on greenhouse gases by accounting from increases in emissions resulting from the Proposed Rule. The Proposed Rule largely fails to do this, even though the Rule will result in activities that will increase greenhouse gases. [EPA-HQ-OAR-2014-0827-1183-A1 p.12]

First, manufacturing the devices results in unwanted greenhouse gas emissions. The aerodynamic devices typically are constructed from lightweight metal, plastic, and – particularly for the skirts – polymers and glass fiber. Many of these materials require extreme heat and significant quantities of petrochemicals to produce, as well as the energy expended in the mining or manufacturing process. The materials also must be transported to the factory and repair shops, and additional fuel is required, of course, to move a trailer with the additional weight of the devices attached. [EPA-HQ-OAR-2014-0827-1183-A1 p.12-13]

It is not easy to determine the amount of greenhouse gases or CO2 emitted from these trailer devices; it certainly is not negligible, and the Agencies should not ignore it or assume it is negligible. But as written, the Proposed Rule neglects the fuel costs and greenhouse-gas emissions associated outside of operations on the trailer. The Proposed Rule needs to account for the greenhouse gases and energy consumption of various devices during the entire lifetime of the component's construction, delivery, use

and disposal, rather than just highway use as it does now. It would be pointless to require the use of devices whose greenhouse-gas savings in use are small compared to the greenhouse-gas emissions resulting from production, delivery, maintenance, retreading, disposal, and the like. [EPA-HQ-OAR-2014-0827-1183-A1 p.13]

Additionally, any computation of the additional greenhouse-gas emissions associated with manufacturing and repairing the aerodynamic devices must account for the fact that there is not a 1-to-1 ratio of tractors to trailers. The GHG-2 Impact Analysis acknowledges that there are typically two long-refrigerated box trailers per tractor and three (and sometimes up to six) long-dry-van box trailers per tractor. The fuel savings analysis ignores this reality. When these multipliers are included, the number of trailer aerodynamic devices required to achieve the savings is basically doubled or tripled, and by extension, the amount of GHG (CO<sub>2</sub>) emissions reductions required to make up for the total the GHG emissions caused by their fabrication, installation, and maintenance. [EPA-HQ-OAR-2014-0827-1183-A1 p.13]

**Response:**

The agencies cannot precisely calculate the upstream emissions/fuel consumption associated with producing and delivering the devices, a simple back-of-the-envelope, worst-case analysis can show that they would be much less than the projected fuel savings. For example, assuming that energy consumption represents 25 percent of the cost of a \$1,500 aerodynamic package, it would be equivalent to about 100 to 150 gallons of diesel fuel.<sup>149</sup> Even this worst case cost estimate would be offset by a mere one percent savings after the 100,000 miles of operation.

Regarding the comment about accounting for the ratio of tractors to trailers, the agencies calculate overall GHG emissions based on our MOVES model. In MOVES, tractors and trailers are modeled together, such that we are only considering active tractors and trailers, not trailers that are parked and waiting to be used. If we assume an average tractor-trailer ratio of 1:3, the GHG reductions projected by MOVES as a result of trailer improvements would not account for 2/3 of the trailers produced. Consequently, our published GHG reductions are lower than what could be expected if we accounted for all trailers produced.

**Organization:** Utility Trailer Manufacturing Company

Second, the Proposed Rule ignores that the aerodynamic devices are not one-time purchases; rather, they are unlikely to survive more than a fraction of the trailer's expected life and therefore must be replaced multiple times. Our freight trailers are expected to last 15 years on average. There is no data to suggest that the aerodynamic devices will last nearly that long. The aerodynamic trailer devices have only been available since 2010. Early-adopter fleets (having approximately 5,300 trailers with skirts) have reported spending \$1.2 million over 5 years repairing or replacing damaged skirts and trailer tails on their long-box trailers. [EPA-HQ-OAR-2014-0827-1183-A1 p.13]

Skirts, for example, dwell in space beneath the trailer where objects regularly intrude. Whether it is railroad tracks, inclines on loading docks, or road debris, the skirts will be abused. Utility Trailer and the other manufacturers know this from real-world use, as shown by the following two photographs that reflect a frequent result when the skirts encounter real-world intrusions into their space. [EPA-HQ-OAR-2014-0827-1183-A1 p.13]

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<sup>149</sup> Assuming \$2.50 to \$3.50 per gallon of fuel.



[Pictures of damaged skirts and tails can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

Tails encounter similar problems. As noted, the driver cannot see the tail when it is deployed, and drivers often forget to retract the tail and then back into a fence or dock, damaging the trailer. Additionally, because the tail causes the door when fully opened to rest further away from the side of the trailer, drivers catch the door on another trailer when backing in or pulling out, as shown by the following photograph. Such damage requires repairing or replacing the doors, as well as the devices themselves. [EPA-HQ-OAR-2014-0827-1183-A1 p.14]

**Response:**

Aerodynamic device and tire pressure system suppliers indicated that their products could be expected to last the life of the trailer with proper maintenance. The agencies recognize that some fraction of the CO<sub>2</sub>- and fuel consumption reducing technologies installed on trailers for compliance with this program will experience damage in their lifetime. Our analysis of these technologies indicates that even trailers traveling in mostly urban conditions will experience benefits from these technologies. See RIA chapter 2.10.2.1.1. Because of this, we expect customers will have sufficient incentive to make any necessary repairs. And because of their relatively simple designs, we can assume that the repaired technologies will usually perform as well as the original and our trailer program benefits will be maintained. With proper maintenance, which can include replacement of worn subcomponents, we are aware of no reason that these systems would be unable to meet the durability requirements of the trailer program to last the full 10 year useful life of the trailer.

We note the durability requirements included in the regulations. Utility cites marginal impacts for “early-adopters”, but these do not accurately represent the devices that we expect will be used to comply with the trailer program. The regulations require that devices be durable for 10 years, and thus, we expect them to be more durable than the devices used by early adopters. We acknowledge that improved durability may not cover all damage due to accidents or misuse, but we expect manufacturers and customers will increasingly select devices that remain effective in common trailer operations.

**Organization:** Utility Trailer Manufacturing Company

Third, the aerodynamic devices add weight to the trailers. A typical combination of skirt and tail adds between 300 and 350 pounds to a trailer. This is a problem for all trailers, since added weight means added fuel usage. But it also presents additional problems for that high percentage of trailers (often but certainly not exclusively refrigerated trailers) that weigh out rather than cube out. Adding the weight of trailer aerodynamics will typically displace hundreds of pounds of payload per trip and thus cause additional trips to be made to deliver the same amount of product. This not only negates the fuel savings of the trailer aerodynamic device, but also adds to traffic congestion and increases carbon emissions for all vehicles on the road. [EPA-HQ-OAR-2014-0827-1183-A1 p.14]

**Response:**

The agencies evaluated the effect of additional aerodynamic device weight on CO<sub>2</sub> emissions using our GEM vehicle simulation tool. For both short and long box vans in the model, the additional weight of

aerodynamic devices was found to increase the gCO<sub>2</sub>/ton-mile results by less than 1 percent. See our memo to the docket for more information on these calculations.<sup>150</sup>

Additionally, the potential positive implications of weight reduction efforts could partially or fully offset concerns from added weight of aerodynamic devices, including fuel use, GHG emissions, and safety. We discuss this issue, including NHTSA's associated safety analysis in our response to the Utility comment regarding the "cost-benefit calculation" below.

**Organization:** Utility Trailer Manufacturing Company

Requiring the trailer industry to affix trailer skirts and tails to all trailers in the hopes of achieving questionable aerodynamic efficiencies is not a wise policy choice. The Agencies have not done a satisfactory job of determining the savings that will result from the aerodynamic-device requirements. What is known is that the projected efficiencies depend on assumptions that are demonstrably unrealistic, and that when real-world data is used to perform the efficiency calculations, the projected efficiencies – even in an ideal environment – drop dramatically. Additionally, the savings even then are overstated because they do not account for the net decrease in emissions, ignoring emissions caused in manufacturing and transporting the devices, in replacing the devices, and in the added weight affixed to the trailers. The better option is to allow the industry to continue its practice of voluntarily adopting these technologies in those uses where it makes sense to do so. This is a proven approach. Accordingly, Utility Trailer requests that the aerodynamic device requirement be removed from the proposed EPA Phase 2 Rule. In other words, the term "C3•(ΔCDA)" should be removed from the equation, and the maximum "eCO<sub>2</sub>" grams per ton-mile should be adjusted downward to compensate equivalently. [EPA-HQ-OAR-2014-0827-1183-A1 p.14-15]

**Response:**

The agencies are not requiring trailer manufacturers to install any particular device to their trailers (with the exception of the design standards for non-box and non-aero trailers). The standards for box vans are performance standards, and manufacturers can choose to install any combination of aerodynamic, tire, and weight-reduction technologies, or make changes to the trailer design to achieve the desired performance. Trailer manufacturers can evaluate and choose which devices to offer to their customers and install on their trailers. Our primary box van standards are based on adoption of aerodynamic technologies, and we are finalizing a program that includes these technologies as a compliance option for box van manufacturers. However, a manufacturer can offset reduced aerodynamic performance by incorporating a significant weight reduction. Manufacturers can also fine-tune their trailer designs to improve their aerodynamic properties without the addition of bolt-on technologies. Additionally, manufacturers have the option to use our off-cycle provisions that can account for innovative technologies or strategies that cannot be captured adequately by our GEM-based compliance equation.

The per-vehicle reductions based on the performance standards (ranging from 3% to 9% for the different trailer subcategories) are representative of performance under specific conditions that we established to reasonably compare different trailers and technologies from multiple manufacturers. The individual performance of each trailer in a given subcategory will differ based on their use, and we do not claim that every trailer in the real world will achieve the reductions suggested by their performance in testing.

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<sup>150</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Impact of Additional Weight Due to Trailer Aerodynamic Devices". July 2016.

Our own testing demonstrated the potential improvements with use of these technologies for both long and short trailers. While the testing was performed at high-speed conditions, our analysis in Chapter 2.10.2.1.1 of the RIA indicates that some improvements are seen at much lower speeds. Since most trailers spend at least some of their time at speeds of 55-mph or greater, they can experience even greater emission and fuel consumption reductions during that time.

The agency responded to Utility's comment about "manufacturing and transporting" emissions the agencies' analytical assumptions with a sample upstream emissions calculation on page 970.

**Organization:** Utility Trailer Manufacturing Company

**The cost-benefit calculation is flawed because it fails to give safety adequate consideration and weight.**

The aerodynamic devices specified by the EPA are relative newcomers to the market. Manufactured of plastic, fiberglass, and light metal, they are easily damaged as the trailers travel over the road and railroad crossings, or – in the case of trailer tails – as drivers routinely back into docks, fences, and other trailers. Some number of these devices will become detached in over-the-road operations, resulting in some number of increased accidents. [EPA-HQ-OAR-2014-0827-1183-A1 p.17]

The additional technologies are also likely to increase accidents and the injuries and fatalities associated with them. As noted previously, adding the aerodynamic technologies to trailers that otherwise would run at full permitted weight will mean that cargo equal to the weight of the devices will have to be transported on additional trips. There is a correlation – some would say direct – between miles driven and accidents/injuries/fatalities. The Agencies have not accounted for this important societal cost in performing their cost-benefit analysis. [EPA-HQ-OAR-2014-0827-1183-A1 p.17]

Finally, the effect of implementing a combination of technologies on a large scale is not yet sufficiently evaluated to be certain that there will not be unintended consequences. Other than its own side skirt, Utility Trailer does not know of any other aerodynamic device that has been certified to meet or exceed relevant DOT regulations. For example, some vendors market devices to cover the ends of axles, claiming they will reduce drag. But covering the wheel end may reduce airflow, causing the components to run hotter. Before installing such devices, a prudent manufacturer would require approval from the axle supplier, the bearing supplier, the hub supplier, the oil-seal and hubcap supplier, the lubricant supplier, the brake supplier, the wheel supplier, and the tire supplier. [EPA-HQ-OAR-2014-0827-1183-A1 p.17-18]

**Response:**

We emphasize that the agencies do not require trailer manufacturers to install any specific technologies to meet the standards (with the exception of design standards for non-aero box vans and non-box trailers, for which specific tire technologies are required). The performance standards for most box vans are designed to be met with a variety of technologies. Trailer manufacturers can evaluate and choose which devices to offer to their customers and install on their trailers.

Regarding the comment about potential accidents from debris from damaged aerodynamic devices, we refer to this excerpt from a recent DOT study:

*Damage from road debris, or detachment of aerodynamic skirts and tails in normal vehicle operation are a potential safety issue for aerodynamic features, particularly for underbody devices. However, no*

*reported incidents of aerodynamic component detachment or structural failure while en route could be found in the literature. Trailer skirt developers have prioritized the design of components that are resilient against road damage. Various aerodynamic skirts have been in continuous use on MD/HDVs in European and certain Asian countries for over two decades, where regulatory and economic factors promote both fuel efficiency and the provision of vulnerable road user (VRU) override protection. Newer skirts are typically constructed of fiber-reinforced plastic and appear to resist damage when repeatedly impacted by curbs, loading dock ramps, railroad crossings, and snow. Some designs have full-flex struts that allow them to bend up to 90 degrees rather than snap, as in older monolithic designs, and they weight as little as 190 pounds.. (Excerpt from “Review and Analysis of Potential Safety Impacts of and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles,” U.S. DOT, June 2015. DOT HS 812 159).*

This study’s conclusions are reinforced by anecdotal experience with these technologies. The primary technologies that the agencies expect manufacturers to use for compliance, especially in the early years of the program, are trailer skirts, LRR tires, and tire pressure systems. All of these technologies, although far from universal, have significant in-use experience, often in combination with each other. As with the DOT investigators, the agencies are aware of no large-scale concern in the industry about unintended consequences of the use of these technologies. We expect that with the implementation of the trailer program and its durability requirements, such concerns will generally be addressed as manufacturers and suppliers respond to the new program in their new technologies and designs.

Regarding Utility’s comments about unintended consequences, we leave it to manufacturers to determine what appropriate approvals need to be obtained before accepting a technology to install on its trailers. EPA is adopting durability requirements for all CO<sub>2</sub>- and fuel consumption-reducing technologies applied to meet the rules, and technologies that fail to remain durable are subject to our recall provisions in 40 CFR 1068 Subpart F. We also note that to the extent that manufacturers install devices using pre-approved data submitted by device manufacturers, these device manufacturers are subject to the same recall provisions as vehicle manufacturers. NHTSA evaluated the potential safety impact suggested by TTMA and noted by Utility. NHTSA recognizes that regulatory and market factors that result in changes in trailer weight can potentially have safety ramifications, both positive and negative, as discussed in response to the similar TTMA comment on page 1019.

**Organization:** Wabash National Corporation

### **The Final Rule Should Be Consistent with Overlapping Government Policies to Promote Technological Advancements and Innovation in the Trailer Manufacturing Industry**

EPA should work with other agencies to ensure that its trailer regulations harmonize with other requirements being applied to trailers and trailer manufacturers. At least five such opportunities for complementary policies and regulations currently exist, with respect to: (1) NHTSA RIG, (2) twin 33s, (3) the federal excise tax (“FET”), (4) weight exemptions for aerodynamic devices, and (5) harmonized rules with CARB. [EPA-HQ-OAR-2014-0827-1242-A2 p.20]

- NHTSA continues studies to analyze the cost-benefit and feasibility of new RIG standards and installation of side crash override guards. The ability to integrate these side guards with aerodynamic skirt devices is unknown, but at a minimum, both types of devices would add significant weight to trailers and potentially could interfere with the performance of the other.
- Allowing twin 33-foot trailers would improve freight efficiency, and freight efficiency is a prime way to improve fuel efficiency. With fewer trucks on the road, GHG emissions are reduced.

- Installation of aerodynamic devices adds to the overall cost of a new trailer, which is subject to the FET. Exemption of aerodynamic devices from the FET, similar to the exemption provided for auxiliary power units, would incentivize their installation.
- Similarly, providing a weight exemption for aerodynamic devices would incentivize their installation by removing the inherent conflict between payload capacity and trailer devices imposed by regulatory weight constraints.
- To reduce compliance complexity, the agencies should ensure that there is a nationally harmonized 50-state program for trailers. Any federal requirements should be aligned and harmonized with existing and potential future CARB regulations. In Phase 1 of this rule, the agencies recognized the importance of cooperating with CARB and stakeholders to craft a consistent set of rules in the HD National Program. Wabash has significant concerns that the Phase 2 Proposal contains little, if any, discussion of the importance of national standards for trailer manufacturers. As EPA acknowledges, this is the first rule regulating trailer manufacturers under Title II of the Clean Air Act. Harmonized and consistent national standards are even more important to Wabash and other trailer manufacturers. [EPA-HQ-OAR-2014-0827-1242-A2 p.20]

Whenever possible, EPA should proactively engage with other agencies imposing requirements on trailers to align those requirements and ensure a cost-effective and smooth glide path to regulation under Title II of the Clean Air Act. [EPA-HQ-OAR-2014-0827-1242-A2 p.20]

**Response:**

The agencies recognize the interrelatedness of this regulation to other federal regulations. As noted in our response to ATA previously on page 960, the subject of a possible side guard requirement from NHTSA is in a research stage. We cannot predict how the performance of future aerodynamic devices may be impacted if such requirements were in place, though we do expect both trailer and device manufacturers will be mindful of the performance of both features in their future designs.

Size and weight restrictions for tractor-trailers are under the jurisdiction of the Federal Highway Administration (FHWA), and are largely controlled by the weight limits established by congress in 1956 and 1974, the size limits established in the Surface Transportation Assistance Act (STAA) of 1982, and the size and weight limits established in the Intermodal Surface Transportation Efficiency Act of 1991. Changes to these restrictions would require a broader process involving Congress and federal and state agencies, and is beyond the scope of the Phase 2 trailer program. Similarly, Federal Excise Taxes are managed by the Internal Revenue Service (IRS) and beyond the scope this program. The comment does not suggest that our regulations conflict with current size, weight or safety requirements in other agencies; simply that these suggestions would complement our Phase 2 rulemaking.

The agencies designed the Phase 2 GHG and fuel efficiency rules to be a national program: identical standards and compliance mechanisms at the federal level. The agencies consulted with CARB prior to the NPRM and we are adopting the set of standards that we believe are the maximum feasible and appropriate under the EPA's and NHTSA's respective authorities, considering lead time, cost, and other factors, such as small business considerations. California has adopted the Phase 1 program, and the agencies hope that the same will be true for these maximum feasible and appropriate Phase 2 standards.

**Organization:** XL Specialized Trailers

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 205-206.]

The truck/trailer industry is a very innovative industry that embraces new technologies and standards that enhances the efficient operation of our equipment as well as leading to a safer product. Mandating the implementations of this type of regulation across the board creates a counter-productive environment that leads to subpar products that end up costing consumers more and not achieving the goals set out by the regulatory agencies.

**Response:**

The trailer program was designed with standards tailored to specific trailer types. The agencies proposed and are adopting performance standards for box vans and do not require the use of specific technologies. Instead, manufacturers can decide which combinations of aerodynamic, tire, and weight reduction technologies to apply. To limit the compliance burden for non-box trailers, we proposed design standards requiring use of lower resistance (LRR) tires and automatic tire inflation systems (ATIS). The final trailer program further reduces that burden by limiting the regulated non-box trailers to tanks, flatbeds and container chassis only, and basing the design standards on use of LRR tires and less expensive tire pressure monitoring systems (TPMS). We believe a majority of the trailers that would find limited benefits from these technologies are among the excluded trailer types.

## **5.2 Trailer Designs Covered By This Proposed Rule**

**Organization:** STEMCO

STEMCO recommends equal treatment under the regulation for long van roll-door trailers. We believe the fuel savings and emissions reductions can be significant given the number of medium and long haul trailers in this category, and including them creates an incentive for innovation. [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

**Response:**

The agencies recognize there may currently be limited availability of rear aerodynamic technologies for roll-up door trailers, yet, as the commenter suggests, we also understand that innovations and improvements continue for all trailer aerodynamic technologies. For this reason, the final trailer program includes an interim provision – through MY 2023 – for box vans with roll-up doors to qualify for non-aero and partial-aero standards (as defined immediately below), by treating such doors as work-performing devices equivalent to rear lift gates. For MY 2024 and later, roll-up doors will not qualify as a work-performing device in this way; however, we expect that manufacturers of trailers with roll-up doors will comply with the 2024 and later MY standards using combinations of new rear aerodynamic technologies, in conjunction with improved trailer side and gap-reducing technologies as appropriate.

**Organization:** Union of Concerned Scientists (UCS)

### **SHORT VAN TRAILERS**

Short, “pup” van trailers are utilized in a significantly different manner than long van trailer, often in tandem. This means that for 28’ trailers, they may fall either fall in lead directly behind the tractor or at the end. Thus, reducing aerodynamic drag for short van trailers is more complex and devices must therefore not only be effective in either position but deployable. [EPA-HQ-OAR-2014-0827-1329-A2 p.17]

The agencies' definition of "short" trailers extends beyond pups to include trailers up to 48' in length. While California's trailer regulations are applicable to 53' and longer van trailers, the aerodynamic technology being moved to market today for long van trailers is applicable to trailers of shorter length, and we recommend that the agencies' definition of a "short" trailer be restricted to only those most likely to be utilized in a tandem configuration. Therefore, we recommend that the agencies shift the cut-off length between a long and short van trailer from 52' down to at least 47'. [EPA-HQ-OAR-2014-0827-1329-A2 p.17]

**Response:**

The agencies agree that 48-foot vans are aerodynamically similar to longer vans and that 28-foot trailers are often used in tandem, reducing the opportunity for rear aerodynamic features. However, the agencies believe that the *use* of 48-foot vans is more similar to that of shorter trailers than to that of the long-haul vans that make up most the long box subcategory. Trailer manufacturers have indicated that 48-foot vans are mostly used in short-haul operations (e.g., local food service delivery) and consequently they travel less frequently at speeds at which aerodynamic technologies can be most beneficial. Also, 48-foot vans make up a relatively small fraction of box vans. The agencies thus do not believe that standards predicated on the use of more effective aerodynamic technologies on 48-foot vans will provide a substantial enough additional reduction in CO<sub>2</sub> emissions and fuel consumption to justify more stringent standards for those trailers. For these reasons, the agencies are maintaining the proposed 50-foot demarcation between long and short box vans and are basing the standards for each van size category accordingly. Please see our memo to the docket with our complete analysis of the 50-foot demarcation.<sup>151</sup>

### 5.3 Proposed Trailer Standards for CO<sub>2</sub> and Fuel Consumption

**Organization:** American Trucking Associations (ATA)

**In-Use Trailers Should be Used in Establishing Compliance Baseline** The trailer efficiency improvements use a baseline 2017 SmartWay trailer. In-use trailers at the time would be a more representative baseline figure. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

**Response:**

The agencies used the available data to project a baseline trailer for evaluating trailer improvements. We did not use a "baseline 2017 SmartWay trailer", but did refer to our baseline by the bin in which we expected SmartWay-verified technologies to fall. In a letter from TTMA, the association stated that, as of 2014, 35% of their members' 53-foot van sales included skirts.<sup>152</sup> We assume these skirts performed similarly and would fall into our final trailer aerodynamic Bin III. Our long box van baselines for the final standards assume skirt adoption will rise to 40% by 2018, with an additional 5% in Bin IV. TTMA also noted that under 2% of their members' short trailers included skirts and we project that there will be a modest increase by 2018 so that the value adopted in our (2018) baseline is 5% for trailers less than 50-feet in length. See also RIA chapter 2.10.3.2.

Because the agencies cannot be certain about future trends, we also considered a second baseline. This "dynamic baseline" reflects the possibility that, absent a Phase 2 regulation, there would be continuing

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<sup>151</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827: "Evaluation of 50-Foot Trailer Length Demarcation to Distinguish between Long and Short Box Vans." July 2016.

<sup>152</sup> Letter, Truck Trailer Manufacturers Association to EPA, October 16, 2014, Docket EPA-HQ-OAR-2014-0827-0146.

adoption of aerodynamic technologies in the long box trailer market after 2018 that reduce fuel consumption and CO<sub>2</sub> emissions. This case assumes the research funded and conducted by the federal government, industry, academia and other organizations would, after 2018, result in the adoption of additional aerodynamic technologies beyond the levels required to comply with existing regulatory and voluntary programs. In this second baseline, adoption of trailer side skirts on long box vans increases beyond 2018 at a rate of 5% every three years, until the adoption rates of the technologies reach 75% of long box vans in MY 2040. See Section IV.D.2.b of the Preamble for a description of our baselines. As noted in that section, the dynamic baseline mainly impacts long-term, overall Phase 2 program projections of benefits beyond MY 2027. When calculating the relative CO<sub>2</sub> reduction due to our trailer standards in this program, we use the flat baseline. However, the reduction values are relatively insensitive to the choice of trailer baseline throughout the timeframe of the rules. The 35% difference in skirt adoption between flat and dynamic baselines in MY 2040 results in just a 1 gCO<sub>2</sub>/ton-mile difference in emissions for long dry vans and long refrigerated vans.

**Organization:** Bay Area Air Quality Management District (BAAQMD)

The proposed EPA/DOT Phase 2 rule-making can help us pursue both our air quality and GHG emission reduction goals. To ensure the maximum benefits are achieved from this joint-rule-making effort, we would like to offer the following suggestions.

Collaborate with the ARB to set uniform truck/trailer standards that would apply throughout the nation's truck fleet. [EPA-HQ-OAR-2014-0827-1136-A1 p. 2]

**Response:**

The agencies consulted with ARB prior to the NPRM and considered ARB comment on the NPRM. We are adopting the set of standards that we believe are the maximum feasible and appropriate under the agencies' respective authorities, considering lead time, cost, and other factors, such as small business impact considerations.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Stringency of trailer standard, alternative 4 recommended**

The NPRM also requests comments on whether Alternative 3 or Alternative 4 should be the preferred alternative. Both alternatives provide a gradual increase in the adoption rates of aerodynamic technologies, leading to the same final stringency, except that Alternative 4 arrives at the final stringency three years earlier. The main difference in the implementation of the two alternatives is the second phase of standards, which occurs during the 2021 MY. Under Alternative 4, the adoption rates specified in Alternative 3's second phase is skipped so that Alternative 3's 2024 standards take effect in 2021, and Alternative 3's 2027 standards take effect in 2024. [EPA-HQ-OAR-2014-0827-1265-A1 p.72]

Since most of the requirements for trailer aerodynamic equipment can be met with technology that is already available, the difference in cost from accelerating the adoption of these technologies by three years would be low. Table I-11 in the NPRM provides the costs of the technology needed on a baseline trailer to comply with the Phase 2 regulation, under Alternatives 3 and 4 and is provided here for reference. [EPA-HQ-OAR-2014-0827-1265-A1 p.72]



[Table I-11 can be found on p.72 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

As indicated in the table, the added cost per trailer to meet Alternative 3 MY 2024 standards is \$1010 (2012 dollars); whereas the cost to meet the Alternative 4 MY 2021 standards (the equivalent of the MY 2024 Alternative 3 standards) is \$1080 (2012 dollars), a difference of \$70, or 6.9 percent. Similarly, the difference in cost to meet the final stringency requirements of the two alternatives is \$60, or 5.1 percent. [EPA-HQ-OAR-2014-0827-1265-A1 p.72]

The differences in compliance cost should then be viewed in terms of their effect on the payback period, since the adoption of Alternative 4 requires more aerodynamic trailers sooner, leading to greater fuel savings earlier. The NPRM provides the results of analyzing the payback periods of the two alternatives, and have determined that choosing Alternative 4 over Alternative 3 results in negligible impacts on the payback periods, with both alternatives having payback periods of 2 years, as shown below in the NPRM's Table I-12. [EPA-HQ-OAR-2014-0827-1265-A1 p.73]

[Table I-12 can be found on p.73 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

While Tables I-11 and I-12 show that there is a negligible impact on the economics of fleets that operate trailers, it is also important to compare the impacts of the two alternatives in terms of the overall costs and benefits of the regulation as well. Table X1 and X-3 in the NPRM provide a comparison of the net costs and benefits of the two alternatives for the tractor-trailer vehicle as a whole, in which trailer benefits play a major part. Under both the 3 percent discount rate and the 7 percent discount rate assumptions, Alternative 4 provides a greater net benefit, after subtracting out the costs, over the 2018 to 2029 timeframe. [EPA-HQ-OAR-2014-0827-1265-A1 p.73]

[Table 14 can be found on p.73 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

Upon examining the cost-benefit analysis provided in the NPRM and differences in stringency between the two alternatives, and drawing upon CARB's experience in implementing its Tractor Trailer GHG Regulation, CARB staff recommends Alternative 4. Under Alternative 4, by 2021, 65 percent of long box van trailers (defined in the NPRM as those over 50 feet) would employ Bin V aerodynamic technology, which is equivalent to SmartWay Elite levels, which became effective in 2014. CARB staff believes it is reasonable to assume 65 percent penetration of such technology by 2021, which will be five years after the adoption of the proposed Phase 2 regulation and seven years after SmartWay Elite levels became effective. In addition to recommending Alternative 4, CARB staff also recommends two modifications to the stringency levels. First, given that Bins I through VII can all be attained using existing technology, CARB staff believes that the final phase of standards should incorporate some adoption of Bin VIII, which represents as yet undeveloped technology. Having seen how quickly aerodynamic technology has evolved since the SmartWay's launch in 2004, CARB staff believes that these technologies will continue to evolve at a rapid pace for the next nine years, when the final phase of standards in Alternative 4 takes effect. As such, CARB staff recommends that the stringencies of Alternative 4 for long box dry van trailers should be modified to include some adoption of Bin VIII technology trailers, such as 10 percent Bin V, 45 percent Bin VI, 40 percent Bin VII, and 5 percent Bin VIII, by 2024. Using the compliance equation given in the proposed 40 CFR 1037.515 in the redline version of the regulation, this modification reduces the final standard by a further 0.24 grams of CO<sub>2</sub> per ton-mile. CARB staff believes that it is important to include at least a nominal adoption rate of Bin VIII technologies in order to move beyond off-the-shelf technology and push for further development of aerodynamic technologies. In the event that such technology is still unavailable by the 2024 MY, the 5 percent adoption rate is low enough such that manufacturers would still be able to meet the stringency

by slightly adjusting the percent adoption rates between Bins V and VII. [EPA-HQ-OAR-2014-0827-1265-A1 p.73-74]

Another recommended modification relates to the final stringencies of long box refrigerated van trailers. From the RIA, the trailer-to-tractor ratio of refrigerated vans (2:1) is lower than that of dry vans (3:1), which means that a refrigerated van trailer is typically used on the road more than dry van trailers. Because of the higher use experienced by refrigerated van trailers, investments in aerodynamic equipment for refrigerated trailers can generate faster, and larger, returns on investment. In addition, because of the higher base cost of a refrigerated trailer (roughly twice as much as a dry van trailer<sup>34</sup>), the incremental cost of the required aerodynamic equipment would be a much smaller percentage of the base cost of a refrigerated van trailer than it would be for a dry van trailer. For these reasons, CARB staff believes that the final stringency level (applicable to MY 2024 under Alternative 4) of long box refrigerated van trailers should be adjusted so that the combined adoption of Bins VI and VII should match or exceed that of long box dry van trailers. For example, the Alternative 4 MY 2024 long box refrigerated van trailer adoption rates should be as follows: 10 percent Bin V, 60 percent Bin VI, and 30 percent Bin VII. Using the compliance equation from the proposed 40 CFR 1037.515 in the redline version of the regulation, this modification reduces the final standard by a further 0.41 grams of CO<sub>2</sub> per ton-mile. [EPA-HQ-OAR-2014-0827-1265-A1 p.74-75]

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34 (ICCT, 2013) The International Council on Clean Transportation, "Trailer technologies for increased heavy-duty vehicle efficiency - Technical, market, and policy considerations," June 2013, [http://www.theicct.org/sites/default/files/publications/ICCT\\_HDV\\_trailertechs\\_20130702.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_HDV_trailertechs_20130702.pdf).

#### **Response:**

In determining "maximum feasible" and "appropriate" under the agencies' respective authorities, we must consider more than just the cost and availability of technologies that could be used to meet the standards. We must also consider lead time, cost of compliance, and may consider factors such as disproportionate impacts on small businesses. We do not believe the accelerated timeline of Alternative 4 provides sufficient lead time for *all* manufacturers to test, evaluate, market and adopt today's most advanced technologies by MY 2024. While Alternative 5 does provide an additional three years to adopt more advanced technologies, the proposed stringency of that alternative would require nearly 100% adoption of technologies with performance the agencies did not observe in testing. These factors alone justify not adopting this alternative. Additionally, Alternative 5 would include aerodynamic improvements for some non-box trailers, but we expect these relatively new and untried technologies would result in relatively little emission and fuel consumption benefit at relatively high cost. Furthermore, non-box trailers are predominately manufactured by small businesses. We believe these small businesses would be unable to compete with the few large manufacturers to meet those standards, which could result in significant economic impacts for these companies. See our response to UCS on page 1026 for a more complete explanation of our decision to adopt design standards for non-box trailers.

We are adopting a set of trailer standards based on the implementation schedule of Alternative 3. The agencies adjusted their baseline adoption rates, and made several changes to our projected adoption rates that made the standards more stringent than those proposed for certain of the trailer subcategories, and thus address some of the issues raised in this comment. The standards for all box vans are now based on nearly 100% adoption of SW-level tires in MY 2018, and CRR of 4.7 kg/ton in MY 2021 (at proposal, the MY 2024 standard was predicated on these penetration rates). Additionally, the full-aero van program is predicated on greater adoption than at proposal of advanced aerodynamics in the MY 2027 standard.

The proposed aerodynamic bins were adjusted to account for wind-averaging and additional test data obtained since the NPRM. A majority of the combinations of skirts and tail or skirts, tails and gap reducer, including several technologies that are designated “SmartWay-Elite,” were found to fall within the new Bin V. The agencies observed one device combination that presently meets Bin VI, suggesting that this bin can be met with combinations of existing aerodynamic technologies. However, no technology combinations tested met our new Bin VII. Our MY 2027 standards for full-aero long vans are based on significant but not universal adoption of technologies in our new performance Bin VI; full-aero short van standards for MY 2027 are based on some adoption of Bin IV-type technologies. These two bins represent future, optimized combinations of aerodynamic technologies for these lengths. Trailer and device manufacturers continue to develop more effective individual aerodynamic technologies, and combinations of technologies, which is a trend that we expect to continue as the requirements of the trailer program are implemented. By the 2027 time frame, we expect that there is ample lead time for existing commercial long van and short van technologies and technology combinations to be optimized such that they can meet Bin VI and Bin IV performance levels respectively, and that these technologies will be broadly, but probably not universally, used. See Chapter 2.10.2.1.3 of the RIA.

Thus, in response to the commenter’s suggestion that the agencies adopt the proposed Alternative 4 standards, the agencies note that features of the proposal that we think are possible are in fact reflected in the final standards. While we believe the standards can largely be met by optimizing use of existing aerodynamic technologies, the optimization process will require greater lead time. As trailer and device designers approach the higher technologically feasible levels of aerodynamic performance, the engineering challenges of developing devices that individually and synergistically perform at these levels becomes greater. Technology costs may not be extreme, but we do not see cost as the key concern during this process. While we are optimistic that these performance levels will in time be achieved on a broad commercial basis, we are not prepared to assume that this can happen before MY 2027. Further, the advent of commercial technologies capable of exceeding these performance levels similar to the more stringent standards of the proposed Alternative 5 is even more uncertain and would require advances that may well not be technologically achievable, even with fundamental changes to the industry. On the basis of what we know today, the agencies are unable to show a pathway for the industry to achieve such additional improvements in the time frame of this program, at least without the potential for major disruptions to the industry due to requiring, for example, fundamental changes to trailer design and construction, or impractical levels of tractor-trailer integration.

Based on our analyses and as informed by the comments, we believe that the final standards in the program, slightly revised from the proposed Alternative 3 standards, are appropriate and represent the maximum feasible standards.

In response to the comment about refrigerated long box vans, we have reassessed the relative stringencies of the dry and refrigerated van categories. Our test results show that gap reducers have a relatively small impact on aerodynamic performance, and several technology combinations that did not include a gap reducer were able to achieve our higher aerodynamic bins. The proposed MY 2027 standards for dry vans were predicated on the use of gap reducers, but refrigerated vans are unable to use gap reducers due to the TRU. We are confident that sufficient technology combinations exist that could meet our dry van stringencies without the use of a gap reducer. Consequently, our final refrigerated van standards in MY 2027 are predicated on stringencies that match the dry van stringencies. Note that the numerical standards for dry and refrigerated vans only differ due to the difference in default vehicle weight within GEM, which is reflected in the GEM-based compliance equation for trailers.

**Organization:** Environmental Defense Fund (EDF)

### **EDF supports the inclusion of standards for trailers**

EDF fully supports the agencies proposal to establish standards for trailers. Trailers are the primary vehicles for moving freight in the U.S.<sup>70</sup> In 2010, there were nearly 5.8 million commercial trailers registered in the U.S.,<sup>71</sup> and production of trailers by the top 25 manufacturers was up 9.4 percent in 2012, over the year before.<sup>72</sup> Trailers impact the fuel efficiency of trucks through aerodynamic drag, tire rolling resistance and additional weight. Trailer efficiency measures would garner much-needed additional GHG and fuel consumption reductions in the tractor-trailer fleet by promoting the development and deployment of new trailer technologies. Such measures would also address market barriers like split incentives and consumers' lack of confidence in technology performance. The technologies needed to make significant efficiency improvements are incredibly cost-effective, well-tested and on trailers today. We request that the agencies finalize robust standards for all trailers that reflect the leading efficiency technology for each trailer type. See Section VI below for specific recommendations on strengthening the trailer program. [EPA-HQ-OAR-2014-0827-1312-A1 p.15-16]

### **Trailer standards can be strengthened and achieved earlier**

Trailers used with Class 7 and 8 tractors contribute significantly to the heavy-duty vehicle sector's total CO<sub>2</sub> emissions and fuel consumption. We commend the Agencies for following through on their commitment in the Phase 1 rule to address trailers and proposing the first ever trailer standards. We support the Agencies' proposed framework, which will provide important GHG reductions. [EPA-HQ-OAR-2014-0827-1312-A1 p.35]

We also encourage the Agencies to strengthen the standards by accelerating the compliance timelines and encouraging technology innovation. The proposed standards are based on off-the-shelf technologies that are in use on trailers today. In fact, there is already a significant market demand for these technologies in part because of California's existing trailer regulations, the SmartWay voluntary program and because of the very short payback periods for all of the trailer technologies being considered.<sup>155</sup> Consequently, we believe the trailer program could be improved by accelerating the implementation schedule and requiring the broader deployment of more advanced aerodynamics and tire technologies. The Agencies themselves indicated in the Preamble that Alternative 4, which accelerates the program to 2024, "has the potential to be the maximum feasible alternative within the meaning of section 32902(k) of EISA, and appropriate under EPA's CAA authority." Additionally, Alternative 5 indicates that there are other efficiency technologies the Agencies could include and additional types of trailers the program could be applied to. We encourage the Agencies to consider the stringency levels in Alternative 5 applied to the timeline suggested in Alternative 4. [EPA-HQ-OAR-2014-0827-1312-A1 p.35-36]

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70 76 Fed. Reg. 57,106, Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rule at 57,362 (September 15, 2011) [hereinafter "Medium- and Heavy Duty I; Final Rule"].

71 US Department of Transportation (USDOT), Federal Highway Administration, Highway Statistics Series: Trailer and Semi-trailer registrations – 2010, (December 2011), available at <http://www.fhwa.dot.gov/policyinformation/statistics/2010/mv11.cfm>.

72 “Trailer output up 9.4% in 2012”, Trailer-Body Builders, (February 1, 2013), available at <http://trailer-bodybuilders.com/trailer-output/output/trailer-output-up-2012/>.

155 Sharpe, B., Recommendations for regulatory design, testing, and certification for integrating trailers into the Phase 2 U.S. heavy-duty vehicle fuel efficiency and greenhouse gas regulation, (2014), available at <http://www.theicct.org/integrating-trailers-us-phase-2-hdv-efficiency-rule>.

**Response:**

See our previous response to CARB on page 980, which includes our justification for adopting standards based on Alternative 3. Also, in response to the comment about the effect of the existing California program, the SmartWay program, and favorable payback, we have accounted for all of these factors in our estimates of technology adoption and effectiveness in our reassessment for the final program, based on information we have developed and drawn from the comments. (Chapter 2.10 of the RIA). The commenter correctly points to important drivers of future technological improvement in the early stages of the program. However, consistent with our latest aerodynamic test results, reaching the higher performance levels for the later years will be very challenging for the industry and will require time. This is the key factor limiting the time frame and the degree of aerodynamic performance that is appropriate and feasible in the later years of the program’s phase-in.

**Organization:** Great Dane

We appreciate the agencies’ study of multiple alternatives as detailed in the NPRM and believe that for many reasons a regulatory approach with a more aggressive adoption of stringencies than the proposed approach (Alternative 3) increases the probability of negative effects on stakeholders considerably. Thus we suggest that the agencies consider devising an incentive based approach that could benefit all stakeholders to augment the proposed approach and assist in the deployment and adoption of advanced technologies as opposed to adoption of the more stringent Alternative 4 being considered. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

**Response:**

The agencies are adopting a set of trailer standards based on the implementation schedule of Alternative 3, and have concluded that the significant emission and fuel consumption reduction of the final trailer program based on Alternative 3 are appropriate. We do offer an off-cycle testing option for manufacturers to evaluate innovative strategies for meeting the standards. Trailer configurations that exceed the standards will not receive credit in the early years of the program, but these trailers can be used to off-set lower performing trailers if manufacturers opt to participate in averaging in the MY 2027 or later.

**Organization:** International Council on Clean Transportation (ICCT)

*Trailers* – The trailer technologies upon which the stringency is determined embrace the already commercialized technologies that have been spurred by EPA’s SmartWay program and California’s in-use regulation. These technologies are already being adopted in increasing numbers by leading SmartWay Elite fleets and as part of the California regulation (Sharpe and Roeth, 2014). Asking trailer manufacturers and tractor fleets to move toward 2015’s leading technologies by 2024 provides sufficient lead time. [EPA-HQ-OAR-2014-0827-1180-A4 p.5] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.39.]]

**Response:**

See response to CARB earlier in this section on page 980. As we discuss in that response, we acknowledge that technology development is proceeding, but also recognize that the significant additional engineering and development and the widespread commercial adoption of technologies and technology combinations capable of meeting or exceeding the performance of the best available technologies today requires the degree of lead time that the final program provides.

**Organization:** Natural Resources Defense Council (NRDC)

NRDC strongly supports the inclusion of trailer standards in the rule and urges the agencies to adjust the standards so that the proposed 2027 stringency is achieved by 2024. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

**Set Standards for Trailers**

NRDC strongly supports the agencies' proposal to adopt CO<sub>2</sub> emission and fuel consumption standards for new trailers designed for use in combination tractor-trailer configurations. The agencies note that they "expect that the MY 2027 standards would be met with high-performing aerodynamic and tire technologies largely available in the marketplace today." NRDC believes that the current availability of technology supports the proposal to start standards no later than 2018 (as proposed by EPA) and that the 2027 standards can be achieved by 2024. [EPA-HQ-OAR-2014-0827-1220-A1 p.6-7]

NRDC recognizes that the trailer industry is being regulated for the first time. However, the prospect of regulatory requirements on the industry is not new. In 2011, NRDC urged the agencies to adopt trailer requirements in Phase 1. Although the agencies declined to include trailer standards in the Phase 1 rule, the agencies amassed information and signaled a likely future standard stating that "[t]he agencies broadly solicited comments on controlling fuel efficiency and GHG emissions through eventual trailer regulations as we described in the notice of proposed rulemaking which could set the foundation of a future rulemaking for trailers."<sup>17</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.7]

While trailer manufacturers have not previously been under federal regulation for CO<sub>2</sub> and fuel consumption, the agencies note that the manufacturers are familiar with applying and proving the effectiveness of technologies. As justification for the program starting in 2018, the agencies note that "box trailer manufacturers have been gaining experience with CO<sub>2</sub>- and fuel consumption-reducing technologies over the past several years, and the agencies expect that trend to continue, due in part to EPA's SmartWay program and California's Tractor-Trailer Greenhouse Gas Regulation." The agencies appropriately expect that trailer manufacturers will be familiar with necessary technology and the regulatory process in time for 2018 compliance. The agencies also expect the standard levels proposed for 2027 could be met with existing technology. For these reasons, combined with the fact that standards will establish new certainty for investment in the trailer marketplace, NRDC believes that trailer manufacturers could cost-effectively meet the proposed 2027 stringency levels by 2024. [EPA-HQ-OAR-2014-0827-1220-A1 p.7]

17 76 FR 57106 at 57362.

**Response:**

See response to CARB and EDF comments earlier in this section, starting on page 980.

**Organization:** Rubber Manufacturers Association (RMA)

### **The Agencies Should Adjust the Tire Limit Values for Non-Aero Vans and Non-Box Trailers**

The NPRM proposes the requirements of LRR tires on “non-box” and “non-aero vans” of  $RRc < 4.7$  kg/t. Such trailers may instead use tires with  $RRc < 5.1$  kg/t through MY 2023. The application of low rolling resistance trailer tires to “non-box” and “non-aero” trailers may present conflicts in the ultimate service and application of these and similar non-box trailers. [EPA-HQ-OAR-2014-0827-1304-A1 p.23]

Variable terrain use of such trailers often demand tread designs, e.g. deeper tread depths, tread rubber, sidewall scuffing resistance, use on different axle configurations, etc., such that typical highway-type low rolling resistance tires may not provide optimal service performance. [EPA-HQ-OAR-2014-0827-1304-A1 p.24]

Typical examples of tread depths for such non-box and non-aero trailer tires would be: [EPA-HQ-OAR-2014-0827-1304-A1 p.24]

- . 14 – 18/32” for 15, 17.5, 19.5 rim diameters
- . 16 – 22/32” for 22.5 and 24.5 rim diameters

Comparing to line haul trailer tire tread depths, typical examples would be: [EPA-HQ-OAR-2014-0827-1304-A1 p.24]

- . 13 – 16/32” for 17.5, 19.5 rim diameter tires
- . 11-13/32” for 22.5, 24.5 rim diameter tires

Mandatory use of the proposed 5.1 kg/t (current SmartWay™ verification threshold) and 4.7 kg/t will challenge the balance of performance in non-aero van and non-box trailer applications. Since tires for non-aero vans and non-box trailers are significantly different in construction and desired performance from trailer tires such as those verified by the SmartWay™ program, it is inappropriate to use the SmartWay™ target values as near-term limit values for these tire applications. [EPA-HQ-OAR-2014-0827-1304-A1 p.24]

#### **i. The Proposed Lead Time is Insufficient to Redesign Tires to Meet the Proposed Tire Rolling Resistance Limit Values for Non-Aero and Non-Box Trailer Applications**

By the time this regulation is final, 2018 trailers will be nearing production, and original equipment contracts may already be in place. There is simply not enough time to design and fully execute a product development program within a tire company with the intent of designing tires for non-aero vans or non-box trailers that would meet the proposed limit values. RMA requests that the Agencies adjust the limit values for tires for these two trailer subcategories to reflect actual tire rolling resistance performance in this tire market segment. [EPA-HQ-OAR-2014-0827-1304-A1 p.24]

Regarding lead time, the NPRM states that because “most manufacturers of long box trailers have some experience installing these [SmartWay] tire technologies for customers,” it is appropriate to truncate lead time for compliance with low rolling resistance requirements. This may be true of line haul-type applications, but it is not true of non-aero vans and non-box trailers. RMA challenges the assertion that

the MY 2018 CO2 emission standards “thus could be met by adopting off-the-shelf aerodynamic and tire technologies available today” in the case of non-aero vans and non-box trailers, since SmartWay verified tires are not appropriate for these trailers. [EPA-HQ-OAR-2014-0827-1304-A1 p.24-25]

RMA also challenges the assertion that “the technologies [manufacturers of trailers other than long boxes] would need are fairly simple and can be incorporated into trailer production lines without significant process changes.” While it is certainly true that for a trailer manufacturer, installing one tire on a trailer is the same as installing another tire type, the technology required to redesign tires for non-aero vans and non-box to meet the proposed targets is not similarly “fairly simple.” EPA should consider not only “the burdens of installing and marketing” low rolling resistance technologies but also the research and development, testing and commercialization costs associated with developing new tires to meet the proposed requirements for non-aero vans and non-box trailers. The lead time analysis is based on the faulty assumption that SmartWay-type tires are appropriate for all other types of trailers. [EPA-HQ-OAR-2014-0827-1304-A1 p.25]

## **ii. RMA Data Collection and Analysis**

RMA collected rolling resistance data from its member companies to assess the typical rolling resistance of tires appropriate for installation on non-aero vans and non-box trailers. As seen in Figure 12 and Figure 13 below, most of the tires studied do not meet the SmartWay™ threshold of 5.1, which is identified as the limit values for 2018 and 2021, since these tire types are not within the scope of the SmartWay™ program, which focuses on tires for line haul applications. This rolling resistance level would be very challenging to meet for tires appropriate for non-aero vans or non-box trailers, particularly since the first trailer model year of applicability is 2018, and would require the development of new tires. [EPA-HQ-OAR-2014-0827-1304-A1 p.25]

[Figure 12, 'Distribution of Rolling Resistance of Tires for Non-Aero Vans and Non-Box Trailers', can be found on p.26 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

[Figure 13, 'Analysis of Rolling Resistance of Tires for Non-Aero Vans and Non-Box Trailers', can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

## **iii. RMA Proposal for Revised Tire RRc Limit Values for Non-Aero Vans and Non-Box Trailers**

RMA has evaluated the data it collected to develop a proposal for a revised baseline and targets for non-aero vans and non-box trailer tires. RMA assessed what percentage of current products are performing at or below the 2017 baseline proposed in the NPRM and what percentage would meet the maximum values for model years 2018, 2021, 2024 and 2027 (Figure 14). As is shown in Figure 14, only 55 percent of the products surveyed would achieve the 2017 baseline, while only 21 percent would achieve the 2018 value. As discussed above, redesigning nearly 80 percent of products for non-aero vans and non-box trailers in time for the 2018 model year simply is unrealistic, particularly given that these products are not within the scope of the SmartWay verification program and in order to achieve satisfactory performance require deeper and more aggressive tread to achieve satisfactory performance compared to their Class 8 line haul counterparts. [EPA-HQ-OAR-2014-0827-1304-A1 p.27-28]

In Figure 14, RMA proposes an alternative 2017 baseline and model year targets for the Agencies' consideration. This proposal balances incremental improvement with required technology changes and considers the percent of products that would have to be redesigned to meet the maximum values for each model year. [EPA-HQ-OAR-2014-0827-1304-A1 p.28]



[Figure 14, 'Percent of Current Tires for Non-Aero Vans and Non-Box Trailers that Would Meet NPRM Limit Values', can be found on p.28 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

For Non-Aero Vans and Non-Box Trailers, the Agencies Should Modify the Limit Values in order to assure that the maximum values reflect current technology and achievable improvements since SmartWay-type data collected by the Agencies may not be sufficient to characterize these tire segments. [EPA-HQ-OAR-2014-0827-1304-A1 p.35]

## **II. The Agencies Should Adjust the Limit Values and GEM Inputs for Non-Aero Vans and Non-Box Trailers**

In its October 1, 2015 comments, RMA stated that mandatory use of the proposed 5.1 kg/t (current SmartWay® verification threshold) and 4.7 kg/t will challenge the balance of performance in non-aero van and non-box trailer applications. After review of the documents made available in the NODA, including the GEM P2v2.1 summary, RMA continues to support this view. Since tires for non-aero vans and non-box trailers are significantly different in construction and desired performance from trailer tires such as those verified by the SmartWay® program, it is inappropriate to use the SmartWay® target values as near-term limit values for these tire applications. [EPA-HQ-OAR-2014-0827-1933-A1 p.3-4]

RMA refers the agencies to its October 1, 2015 comments for a detailed discussion of these issues and data to support RMA's views. [EPA-HQ-OAR-2014-0827-1933-A1 p.4]

### **Response:**

We agree that many non-box trailers are used on “variable terrain” and that the SmartWay-based tire rolling resistance levels on which the proposed design standards for these trailers were based are appropriate for line-haul trailers, but may be ill-suited for off-road applications. The agencies made several revisions to our non-box trailer program based on these and similar comments. First, we are limiting the type of non-box trailers in the program to tank trailers, flatbed trailers, and container chassis. In general, these trailers are more likely to be used in on-road applications compared to many specialty non-box trailers. Limiting the regulated non-box trailers to this narrow range of trailer types reduces number of trailers that would need tires with large tread depths and high rolling resistances.

We appreciate the tire information the commenter shared with the agencies. While we know tread depth can be related to rolling resistance, the comment does not include a correlation or indicate how the agencies should use the provided information to adjust our proposed values. We did, however, revise tire rolling resistance baselines for these three non-box trailers by increasing the rolling resistance by 0.5 kg/ton. Absent regulation, we project that the baseline rolling resistance of the regulated tank trailers, flatbed trailers and container chassis would be 6.5 kg/ton. The revised MY 2018 design standard for these non-box trailers now require use of tire pressure systems and LRR tires meeting a CRR of 6.0 kg/ton. Beginning in MY 2021, the non-box trailer design standards would be based on tire pressure systems and LRR tires with a CRR of 5.1 kg/ton, which is the current SmartWay threshold limit for box vans and met by 55% of the tires in Figure 14 of the comment. Non-box trailers standards no longer would require rolling resistances below 5.1 kg/ton, whereas the NPRM proposed these trailers be equipped with tires meeting a 4.7 kg/ton CRR.

Box vans may be designated “non-aero” vans if they have certain work-performing equipment installed. These work-performing equipment (e.g., lift gates) are expected to indicate urban, low-speed delivery and not “variable terrain.” While customers may not currently be requesting these tires on their local delivery trailers, the comment does not indicate a reasonable technological barrier to non-aero box vans

adopting tires similar to those used on other box vans. Nor did the commenter provide information about why the development of tires for the non-aero subset of box vans would be different than for other box vans. Therefore, the agencies did not adjust the CRR level for non-aero box van design standards.

In response to the comment about tire development lead time, we agree with the commenter that manufacturers of non-box trailer tires intended primarily for off-road use may require longer to develop LRR tires for these applications. However, because our final trailer program excludes such trailers, lead time required to develop LRR tires for these trailers is not an issue for the program. According to the information provided in Figure 14 of the comment, 76% of the surveyed tires would achieve or exceed the MY 2018 non-box trailer rolling resistance, and 21% would achieve the MY 2021 rolling resistance, suggesting that the tires are available today and less lead time would be required to achieve similar levels of performance for the remaining tires.

We note that non-aero box vans and non-box trailers have design standards and do not use GEM. While the agencies did change the baseline tire rolling resistance and tire rolling resistance requirements for non-box trailer standards, there are no changes needed to the GEM vehicle simulation tool.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

Outside of regulating direct use, the agencies should continue voluntary implementation of technological advances. The trucking transportation industry has been and still is very interested in all aspects of fuel-saving technology, and has, through programs such as SmartWay, made great strides in fuel conservation. The driving force behind such implementations has been the financial bottom line of the motor carriers. Some of the innovations employed include increases to interior volume while maintaining exterior size, reduction in weight, decking systems for multi-layer cargo transportation; along with some of the technologies the EPA regulation is basing its reductions on, such as aerodynamic devices, low rolling resistance tires, and automatic tire inflation systems. These advances have been employed as the industry has seen and realized value supported by evidence. The current proposal for a regulation will indeed claim a difference which would likely have been accomplished through the voluntary adoption of systems proven as functional. An unintended side-effect will be the increased creation of CO<sub>2</sub> due to the additional fuel expended on those “regulated units” that do not operate in a manner which causes the added options to provide for a realized and effective performance.

**Response:**

See our response to Stoughton in Section 5.1 on page 965 related to a non-mandatory program. See also our response to Utility’s comments relating to “upstream” or manufacturing emissions on page 970 and our general response in Section 1.

According to ACT Research, only 30% of long dry vans in 2011 were equipped with side skirts and automatic tire inflation. Aerodynamic testing and modeling conducted by the agencies indicates that fuel consumption could be significantly reduced by greater adoption of aerodynamic and tire improving technologies in the dry and refrigerated van population. The same technologies can reduce fuel consumption in trailers that travel shorter distances and at slower average speeds than trailers on long haul cycles, as shown in RIA Chapter 2.10.2.1.1 and discussed in our response to Stoughton on page 965. Lack of information and other factors may be hindering greater adoption of the technologies by fleets. The regulation will address the slow uptake of the technologies by industry by promoting widespread adoption of aerodynamic and other technologies while creating a level playing field for regulated entities.

**Organization:** Union of Concerned Scientists (UCS)

## Trailer Standards

The inclusion of trailers in the Phase 2 regulations is an important step forward. California's regulations as well as EPA's SmartWay program have helped to significantly reduce fuel use through improvements to trailers as well as identify and incentivize further technology development. [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

However, the agencies' assumptions on aerodynamics underestimates the feasible reductions from trailers in this timeframe. We recommend that the agencies adopt the More Stringent Trailer Alternative out to 2024, with a stringency target in 2027 that will lead to approximately 1% additional benefit in fuel consumption. Furthermore, the agencies should identify opportunities to encourage innovation for improvements to non-box trailers as well as tractor and trailer integration. [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

### **Response:**

See response to CARB in this section on page 980. As discussed in that response, we do not believe that a more stringent program is feasible, and we do not agree that more emission and fuel consumption benefit is available through this program.

We did not propose, nor does the commenter specifically suggest, a regulatory mechanism that would encourage innovative improvements for non-box trailers or tractor-trailer integration in this program. In both of these cases, the agencies concluded that much more information would be needed to have proposed such technologies that are in their infancy, but we will continue to consider them as a part of potential future action.

**Organization:** Utility Trailer Manufacturing Company

### **The Proposed Rule's warranty provisions are unworkable.**

The Proposed Rule requires that all drag-reducing devices added to trailers be warranted for five years (one year for tires) to ensure that "these components and systems are designed to remain functional for the warranty period." Putting aside any issues concerning the Agencies' authority to prescribe warranties offered by manufacturers, the proposal is flawed. To the extent a warranty is provided, the warranty should be a pass-through warranty from the manufacturer of the device; the trailer manufacturer should not be required to offer a separate warranty, as it does not control the manufacture of many of those products. [EPA-HQ-OAR-2014-0827-1183-A1 p.23]

Utility Trailer also has the following specific warranty concerns:

**Tires:** some users will wear through tires in less than a year. This hazard is magnified by the anticipated overinflation problems associated with widespread adoption of automatic tire-inflation systems, as described previously. Tire wear and road-hazard damage must not be covered under any warranty. [EPA-HQ-OAR-2014-0827-1183-A1 p.23]

**Skirts and trailer tails:** As noted previously, these devices are damaged in routine operations. Manufacturers must have clear protections against turning normal wear and tear, collisions, or abuse into a warranty claim. [EPA-HQ-OAR-2014-0827-1183-A1 p.23]

Tire-inflation systems: A 5-year warranty is excessive. Utility Trailer is not aware of any system that has a baseline warranty of more than 3 years. The proposed warranty period for these devices should be reduced. [EPA-HQ-OAR-2014-0827-1183-A1 p.23]

**Response:**

Manufacturers of motor vehicle parts “may certify that use of such part will not result in a failure of the vehicle ... to comply with emission standards.” CAA section 207 (a)(2). We are adopting an emission-related warranty period for trailers of five years for any technologies that may affect trailer CO<sub>2</sub> emissions, except for tires. For trailer tires, the rules specify a warranty period of one year. An emission-related warranty does not apply to components that are damaged in collisions or through abuse, nor does it cover components that experience wear with normal use. The emission-related warranty is meant to apply to defects in the product or to improper installation by the manufacturer. Trailer manufacturers are free to stipulate what is and is not covered under their 5-year emission-related warranties. A copy of a manufacturer’s emission-related warranty statement must be provided to EPA at the time of certification, and customers must have clear access to the terms of this warranty, the repair network, and the process for obtaining emission-related warranty service.

The agencies view the emission-related warranty period offered by many component manufacturers as a business decision, rather than as a reflection of the actual durability of the systems. With proper maintenance, which can include replacement of worn subcomponents, we are aware of no reason that these systems would be unable to meet the durability requirements of the trailer program. We believe these components should be designed to last the full useful life of the trailer if properly maintained and a five year emission-related warranty is justified. We do note that trailer manufacturers can specify that the emission-related warranty depends on the proper maintenance of components.

**Organization:** Utility Trailer Manufacturing Company

**The Agencies should modify the Rule to encourage customers to voluntarily adopt the technologies, and to encourage manufacturers to continue to develop new technologies.**

Customers will understandably be concerned about the effect of the required technologies on their operations and bottom line. The Agencies could ameliorate these concerns somewhat by adding provisions to the Proposed Rule that would encourage customers to accept the new requirements. For example, exempting the required devices from excise taxes attributed to those devices, or permitting weight limits on trailers to increase by the weight of the added devices would make the technologies more attractive to the customers and mitigate some of the additional costs imposed by the regulations in the form of additional trips due to displaced cargo. [EPA-HQ-OAR-2014-0827-1183-A1 p.23] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.219-220.]]

Additionally, the Agencies should consider modifying trailer width, length, and height limitations to accommodate required devices and to encourage new, more efficient aerodynamic configurations. For example, permitting trailer sidewalls and roof to expand in width and height, respectively, would allow potential future designs with rounding of the front and rear box-van corners in a more aerodynamic configuration. And measuring overall length at the allowed extreme width or height would permit manufacturers to consider rounding the front of the trailers without sacrificing capacity. [EPA-HQ-OAR-2014-0827-1183-A1 p.23-24]

**Response:**

Please see our response to Wabash in Section 5.1 on page 975 regarding exemptions for federal excise tax, and trailer size and weight. Such actions outside the authority of our agencies and are beyond the scope this program. The commenter does not suggest that our regulations conflict with current size, weight or safety requirements in other agencies, simply that these suggestions would complement our Phase 2 rulemaking.

**Organization:** Wabash National Corporation

**Wabash Opposes Alternative #4**

EPA is requesting comment on whether its Alternative #4, which would accelerate the 2027 standards to 2024, is more appropriate than its current proposal. Wabash has significant concerns regarding whether this accelerated timeline, with respect to the trailer industry, would be achievable with demonstrated technologies, whether such technologies would have demonstrated reliability, and what the associated costs would be. Wabash believes that such accelerated standards would not be feasible for every application. EPA might consider adopting Alternative #4 for some regulatory categories (*e.g.*, engines), and not others (*e.g.*, trailers). [EPA-HQ-OAR-2014-0827-1242-A2 p.19]

**Response:**

The agencies are adopting standards based on the implementation schedule of Alternative 3.

## **5.4 Projected Trailer Technologies, Effectiveness, and Cost**

**Organization:** Aluminum Association

Trailer Floor Crossmembers

Table 3 in Section 1037.515 Weight Reduction for Trailers indicates that aluminum floor crossmembers achieve a 203 pound credit for the GEM calculations. The 2015 NACFE Lightweighting Confidence Study as well as aluminum industry data support that the best value for use in the weight credit for aluminum floor crossmembers is 250 pounds. In view of this differential, the Association asks that EPA revise the table to reflect 250 pounds. [EPA-HQ-OAR-2014-0827-1260-A1 p.5-6]

Wheel Lightweighting

Table 7 of 1035.520 Wheel-Related Weight Reductions (80 FR 40630) indicates that a dual wide aluminum wheel is eligible for a weight reduction credit of 21 pounds. Based on information previously submitted to EPA by the Aluminum Association, the Association notes that given current wheel manufacturing technology that the correct value for this credit is 25 pounds and requests that the entry in the table be changed accordingly. This can be seen in the difference between the Accuride 50408 22" x 8.5" steel wheel at 70 lbs and the Alcoa 88367 LvL ONE 22" x 8.5" aluminum wheel at 45 lbs (70 lbs – 45 lbs). The credit value of 30 lbs as noted for a lightweight aluminum wheel in the table remains correct based on the 40 lb weight of the Alcoa ULTRAx Ultra-ONE lightweight aluminum alloy wheel previously noted (70 lbs – 40 lbs). [EPA-HQ-OAR-2014-0827-1260-A1 p.6]

Also in Table 7, the heading of the right hand column is "Weight Reduction (lb per tire or wheel)." Because the table applies to both dual width and wide base wheels, this nomenclature is unclear. The

Association suggests that the column heading remain “Weight Reduction” but that the units be specific to each row in the table indicating that for wide-base the weight reduction is “lbs per wheel/tire set” and for dual width that the weight reduction is “lbs per wheel.” This clarification is important because wide-base wheels have a corresponding additional weight reduction in the tire weight (one wide base tire weighs less than the sum of the two tires that it replaces on a dual width wheel set) in addition to the reductions in wheel weight. [EPA-HQ-OAR-2014-0827-1260-A1 p.6]

The Association also proposes changes to the Table 7 of 1037.520 as follows – Consolidate the categories of wide base ‘Aluminum Wheel’ and ‘Light-Weight Aluminum Alloy Wheel’ into a single category as there is no weight differentiator in wide base wheels similar to what there is in dual width wheel sets (between the Alcoa Lvl-ONE and Ultra-One, for example). Subsequently, based on calculations made by the Aluminum Association and its member companies, the weight credits for wide base drive wheel/tire sets should be 159 lbs and for wide base trailer wheel/tire sets should be 131 lbs. Corresponding changes should therefore be made to the table. Supporting calculations for these values are shown below. Recognize that the 159 lbs and 131 lbs are based on a wide base wheel/tire set which replaces two dual width wheel/tire sets. If these values were to be recognized in the GEM on a pre-replacement basis they would be input as half those amounts. [EPA-HQ-OAR-2014-0827-1260-A1 p.6-7]

[Tables of weight calculations can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1260-A1]

**Response:**

The agencies updated the weight reduction assigned to trailer crossmembers in our respective regulations to reflect these comments, which are persuasive. Also, we agree with the commenter’s assessment that aluminum and aluminum alloy wheels provide about the same weight reduction for wide-base tires, and we conservatively apply the same values to both of these wheel technologies for dual-wide tires as well.

The commenter provides specific values for trailer wheel weight reductions that are reasonable. The final Phase 2 program uses the Aluminum Association weight-reduction value for both aluminum and aluminum alloy wide-base single trailer wheels and tires (131 lb). We have also accepted the commenter’s weight-reduction value for aluminum dual-wide wheels and tires (25 lb), which has mentioned above, we apply to both aluminum and aluminum alloy dual-wide wheels, including trailer wheels. The aluminum and light-weight aluminum alloy wide-base single drive wheels for vocational and tractors were similarly combined into a single value for Phase 2. However, we are maintaining the more conservative Phase 1 light-weight aluminum alloy value of 147 lb per wheel instead of adopting the 159 lb per wheel value recommended in the comment. Manufacturers that wish to receive additional weight reduction have the option to use our off-cycle provisions to determine appropriate values for their specific applications.

The agencies agree with the commenter that it may be unclear that the units for the wide-base tire weight reduction includes the reduced weight of the wheel and the tire. We are changing the units to “(lb per wheel)” and adding a footnote to the table indicating that the wide-base reductions also include reduced tire weight.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Van trailer aerodynamics

For 53' van trailers, we find the proposed standards to be well within the technical capabilities of the industry. The required average reduction in drag in 2027 is  $\Delta C_dA = 1.1$ , only marginally higher than the Bin VI (SmartWay Elite) value of  $\Delta C_dA = 1.0$ . The agencies state: "To date, SmartWay has verified over 70 technologies, including nine packages from five manufacturers that have received the Elite designation." (p.40254) Whether or not the mix of bins will include more advanced trailers as the agencies assume in their compliance packages, reaching an average aerodynamic performance twelve years hence that matches that of multiple packages being produced today is a reasonable, and perhaps overly lenient, requirement of the industry. [EPA-HQ-OAR-2014-0827-1280-A1 p.18]

To put the agencies' overall aerodynamic targets for long-haul combination trucks with dry vans in perspective, Daimler reported a 54% reduction in drag for its SuperTruck.<sup>15</sup> By comparison, the agencies' compliance package for 2027 contains tractor and trailer aerodynamic parameters resulting in a 41% reduction in drag ( $C_dA = 4.2$ ) from the (adjusted) 2010 baseline level of  $C_dA = 7.4$ . Thus, the 2027 targets do not even require the industry to match levels of improvement being demonstrated today. [EPA-HQ-OAR-2014-0827-1280-A1 p.18]

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<sup>15</sup> Daimler Truck NA 2014 DOE Merit Review Presentation (<http://energy.gov/eere/vehicles/downloads/vehicle-technologies-office-merit-review-2014-class-8-truck-freight>).

**Response:**

See our response to CARB in Section 5.3 above page 980 for our justification for adopting standards based on Alternative 3.

Also, the agencies caution against comparing reported performance from device manufacturers and programs such as SmartWay and SuperTruck to the performance we project in this rulemaking. In terms of aerodynamics, most device (and device combination) testing, including SmartWay verification, is performed at one constant speed. EPA's GEM model, which is the basis of our trailer program compliance as well as our determination of the stringency of the standards, uses a drive cycle-weighting of 86% (long box vans) or 64% (short box vans) of the miles at 65-mph. As seen in Chapter 2.10.2.1.1 of the RIA to these rules, device combinations with performance similar to SmartWay-Elite technologies will produce CO<sub>2</sub> reductions that are 1% and 2% lower for these long- and short-box van weightings, respectively. Additionally, in contrast to the reductions reported under SmartWay and comparable programs, the agencies report our reductions relative to a baseline adoption rate we project would be in place without regulation. For long box vans, this includes over 50% of the industry performing at an aerodynamic Bin III (i.e., skirts), almost 50% adoption of ATIS, and a high adoption of SmartWay-level LRR tires. In total, this long box van baseline is a 3% improvement over a no-control long van. This 3% difference, in addition to the 1%-2% difference due to drive cycle, must be taken into account when comparing to published performance data. EPA obtained additional aerodynamic test data since the NPRM and updated the trailer program's aerodynamic bins accordingly, as described in Chapter 2.10 of the RIA and summarized in our response to CARB on page 980. This new data, which includes many SmartWay-Elite combinations, provides a more complete assessment of the performance capabilities of today's box vans, and was used to update our baseline trailers and adoption rates for the new standards.

**Organization:** American Iron and Steel Institute

Specifically, for trailers, the agencies identified several components and associated weight savings, ranging from 50 to 430 lbs. The basis of these weight savings, however, is not adequately supported in the record for this rulemaking. [EPA-HQ-OAR-2014-0827-1275-A1 p.15]

In the Regulatory Impact Analysis ('RIA') for the Proposed Rule,<sup>45</sup> barely one page is devoted to the description of the information on which the associated weight reduction options were calculated. The agencies identified 11 common trailer components but referenced only unidentified, confidential data for this information.<sup>46</sup> Therefore, the Proposed Rule does not allow for informed comment on these values since the source of the data and how the values were calculated is unknown. [EPA-HQ-OAR-2014-0827-1275-A1 p.15]

It is furthermore impossible to determine how much weight is saved based both on the vague descriptions of the components listed in Table 2-73 of the RIA and the inability to verify the listed weight reductions. Calculating a weight 'savings' necessitates identification of a specific replaced component; but these are also unknown. Therefore, pursuant to CAA Section 307, EPA cannot finalize the proposed values. [EPA-HQ-OAR-2014-0827-1275-A1 p.15]

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45 Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, Draft Regulatory Impact Analysis, June 2015.

46 RIA at 2-166.

**Response:**

The agencies referred to four sources for trailer weight reduction information in the Draft RIA, as listed below. Although the name of the source was confidential in one case, the key information from that source, as well as from the other three, has been available in the public docket from the time of the NRPM.

The four references, as noted in our Draft RIA for the Proposed Rule, are listed below with their original reference numbers included in parentheses for convenience. We concluded that these four sources provided sufficient support for our proposed trailer weight-reduction values. For the final program, we have incorporated additional information into our assessments of trailer weight reduction.

- (155) Scarcelli, Jamie. "Fuel Efficiency for Trailers" Presented at ACEEE/ICCT Workshop: Emerging Technologies for Heavy-Duty Vehicle Fuel Efficiency, Wabash National Corporation. July 22, 2014
- (156) "Weight Reduction: A Glance at Clean Freight Strategies", EPA SmartWay. EPA420F09-043. Available at:  
<http://permanent.access.gpo.gov/gpo38937/EPA420F09-043.pdf>
- (157) Memo to docket regarding confidential weight reduction information obtained during SBREFA Panel, June 4, 2015 (The name of this source is confidential, however, the memo includes the components, materials, and weights.
- (158) Randall Scheps, Aluminum Association, "The Aluminum Advantage: Exploring Commercial Vehicles

We also received comments on our proposed weight-reduction table from the Aluminum Association, Meritor, Utility Trailer, and Wabash National in addition to American Iron and Steel Institute. These



parties had a wide range of comments about our proposed weight-reduction values, but none of them identified problems with the public availability of our data sources for comment.

Meritor and the Aluminum Association did not express disagreement with the general approach the agencies took with regard to the weight table, but stated some of the weight reduction values in the table were incorrect. The groups proposed specific weight changes to some components in the weight table based on their products, such as wheels and cross members. Utility Trailers and Wabash National stated the substitution of aluminum or high strength steel in trailers should not be the only way manufacturers can associate weight reduction with fuel savings. Utility said trailer manufacturers should also be able to use redesign as a means of apply weight savings to their compliance calculations or substitution of materials not included in the weight reduction table, such as plastic. Wabash National stated that rather than relying on an exclusive list of eligible technologies, the agencies should develop a process for adding to the list either by specifying criteria by which additional materials could be used for compliance, or by establishing a petition process for including additional components and materials on the list.

For the final trailer program, we note that the list of weight reduction values is not a manufacturer's exclusive means of applying weight reduction for compliance. The agencies have included the option for trailer manufacturers to use the existing Phase 1 process to demonstrate off-cycle technologies. (See Preamble Section IV.F.5.d). In the case of general lightweighting of a trailer, a manufacturer could measure the difference in trailer weight and use this value in the weight component of the compliance equation.

**Organization:** American Trucking Associations (ATA)

### **Tire Pressure Monitoring Systems Should be Given Credit Under the Rule**

TPMS have not historically been included in the EPA's SmartWay program since the agency had no way to determine the effect these systems have on fuel economy unless each requesting fleet provided a clear description of how it would respond to alerts. This information was necessary so that the EPA could calculate the resulting fuel savings. However, much has transpired since the inception of the SmartWay Program. The Federal Motor Carrier Safety Administration ("FMCSA") has studied TPMS since 2006. It found that these systems accurately reported inflation pressure values within 2 to 3 psi of the measured value and accurately warned of low pressure within 2 to 3 psi of the expected threshold. In 2007, the performance and durability of TPMS was examined in a field test using transit buses. This study found that TPMS-equipped buses did not experience increased average tire pressure due to diligent tire pressure maintenance and the location of the TPMS display is essential to impact tire maintenance practices, fuel economy, and tire life. [EPA-HQ-OAR-2014-0827-1243-A1 p.14]

In late 2011, the FMCSA published the results of a field test it conducted over the previous 24 months of tire pressure monitoring and ATIS on two fleets that were considered to have good tire maintenance. The test revealed that both TPMS and ATIS delivered a 1.4% improvement in fuel economy. [EPA-HQ-OAR-2014-0827-1243-A1 p.14]

Technology has greatly advanced since the tests that FMCSA conducted. Today, TPMS is much more advanced than the first generation of TPMS that was tested by FMCSA which just delivers alerts to the driver in the cab through an in-cab display. Second generation TPMS (TPMS 2.0 systems) are integrated with telematics and GPS so that the tire data and alerts are sent from vehicles and delivered to a fleet's operations and maintenance department. By providing the fleet with the location and visibility of its tire problems, dispatch can provide instructions to the driver to handle developing tire problems

immediately and maintenance is aware of the exact nature of these issues when the vehicle arrives at the fleet's location. With the reports these systems provide the fleet, problem tires are attended to before the vehicle sets out on its next trip, thereby dramatically reducing in-route breakdowns and optimizing the percentage of time tires are run properly inflated. In essence, a fleet is able to build its entire tire maintenance program around this technology and drastically improve its ongoing tire inflation maintenance. Therefore this technology has an even greater effect on fuel consumption and greenhouse gas emissions than the TPMS 1.0 systems which were proven to deliver 1.4% improvement in fuel economy by the FMCSA. [EPA-HQ-OAR-2014-0827-1243-A1 p.14-15]

Due to the advances that have been made in TPMS 2.0 systems and the impact they have on fuel economy and greenhouse gas emissions, the Tire & Wheel (S.2) Study Group of ATA's Technology and Maintenance Council ("TMC") requests that TPMS 2.0 systems, tire pressure monitoring systems that are integrated with telematics, be included in the technology options provided under Phase 2. Without inclusion of this technology, there will be no system available in the TMC standard to address tire inflation pressure for powered vehicles since ATISs that are plumbed inside an axle (a market requirement by US fleets) are currently only available for trailers and an advanced technology that can seriously impact GHG emissions will be overlooked. [EPA-HQ-OAR-2014-0827-1243-A1 p.15]

**Light-Weighting Must Account for Additional Weight and Impacts on Durability** Light-weighting is included as an efficiency improvement option for trailers. Whether the additional weight attributed to add-on trailer technologies – such as aerodynamic skirts – is accounted for in the fuel savings estimate figures needs clarification. In addition, any consideration to further expand current menu technology credits for trailer light-weighting should assess and disclose how such measures impact trailer durability and useful life. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

**Drop-Floor Trailers Should be Afforded Efficiency Credit** It remains unclear whether the agencies have considered the aerodynamic benefits of drop-floor trailers in their menu options. If such credits are not presently accounted for, ATA asks that such credits be added for all box-trailer categories. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

**Fleets Should not be Forced to Invest in Inefficient Trailer Technologies** Fleets should not be forced to purchase specific technologies only in the name of OEM compliance if such technologies do not add benefit to a fleet's operations. To pigeon-hole fleets into making financial investments on equipment that is ill-suited to their operations is not a good business model or good government. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

**Consideration Should be Given to Exempt Certain Trailers from Using ATISs** Certain tires loads, especially on heavy-hauls, have working tire pressures exceeding the capabilities of on-board compressors. Additional on-board compressor tanks can cost \$800 and add an additional 150 pounds of weight. Consideration should be given to exempt certain trailers from using ATIS and instead allow the use of TPMS as previously discussed. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

#### **Response:**

The agencies agree that TPMS generally promote proper tire inflation and that including these lower-cost systems as a compliance option will increase acceptance of the technologies. The final trailer program provides for manufacturers to install either TPMS or ATIS as a part of compliance. The performance standards provide ATIS a slightly greater credit in the GEM-based equation than it does for TPMS to account for the greater uncertainty about TPMS effectiveness due to the inherent user-interaction required. The effectiveness values adopted for ATIS (1.2%) and TPMS (1.0%) in the trailer

program are consistent with those in the tractor and vocational vehicle programs. For non-aero box vans and non-box trailers design standards, manufacturers can install either a TPMS or an ATIS with their lower rolling resistance tires to comply.

The component substitutions provided in our trailer weight reduction tables are not meant to indicate a specific make or model of component. The intent of these tables is to provide a generic weight reduction value for manufacturers that optionally choose to install these components on their trailers. We expect manufacturers will only install components that meet their individual durability standards. We do not anticipate the weight of these components to significantly change over the useful life of the vehicle and, therefore, any CO<sub>2</sub> or fuel consumption reductions observed from use of these components will likely be maintained throughout the full useful life. We accounted for some additional vehicle weight due to aerodynamic devices in our MOVES inventory analysis, such that our overall program benefits include the small fuel consumption increase. However, as noted in our response to Utility in Section 5.1 on page 971, the per-vehicle weight increase had a small relatively impact.<sup>153</sup> We did not include additional weight within our GEM vehicle simulation tool and it is not reflected in the GEM-based compliance equation for trailers.

The agencies proposed and are finalizing provisions that consider a drop-deck design for box vans to be “work performing equipment” that inhibits the use of aerodynamic technologies. The agencies are not providing any “credits” to these trailers, but they can be designated “partial-aero” box vans and meet less stringent performance-based standards based on use of a single aerodynamic device. Box vans with a drop-deck design in addition to rear work-performing equipment, such as a lift gate, can be designated “non-aero” box vans that have tire-based design standards with no aerodynamic requirements.

The performance standards for full-aero and partial-aero box vans do not require any specific technologies to be used. Trailer manufacturers can work with their customers to identify the appropriate aerodynamic, low rolling resistance tire, tire pressure monitoring and weight reduction technologies that are most likely to benefit the customer’s operations. In the years that we do not offer averaging flexibilities, manufacturers can specify a small portion of their production that does not need to meet the standards. In MY 2027 and later, when averaging provisions are in place, manufacturers can offer trailers with fewer technologies to some customers if they make up the difference in performance with other trailer sales.

In response to the comment about ATIS not being suitable for some trailers, the final program addresses this concern to some extent by allowing manufacturers to use either ATIS or TPMS at their discretion. In addition, by excluding many trailers designed for heavy-haul and off-road use, the final program is, in effect, more focused on trailer applications where ATIS is a viable option.

**Organization:** California Air Resources Board (CARB)

The proposed rule requires the use of LRR tires for all trailer types. The LRR tire requirement for short and long box type trailers begins with an 85 percent adoption rate of Level 1 tires, which have a coefficient rolling resistance of 5.1 (kilograms per ton) kg/ton, equivalent to today’s SmartWay-verified tire models, with the remaining 15 percent using the baseline tires with a coefficient of rolling resistance of 6.0 kg/ton. CARB staff believes that the adoption rate for Level 1 tires can be increased to at least 95 percent given that industry has already had years of experience with U.S. EPA’s SmartWay program

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<sup>153</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. “Impact of Additional Weight Due to Trailer Aerodynamic Devices”. July 2016.

and that the Truck Trailer Manufacturers Association stated in a October 16, 2014 letter to U.S. EPA informing them that SmartWay-verified LRR tires are now standard with new trailers. Furthermore, U.S. EPA and NHTSA propose a 100 percent Level 1 tire adoption rate for non-box trailers and non-aero trailers, indicating that it should be possible for box-type trailers to meet a higher adoption rate as well. [EPA-HQ-OAR-2014-0827-1265-A1 p.71]

**Response:**

The agencies adjusted our baseline adoption rate of LRR tires for box vans based on more recent information. In addition, the standards for all box vans are now based on nearly 100% adoption of SW-level tires in MY 2018, and CRR of 4.7 kg/ton in MY 2021 (one stage earlier than proposed). However, with the exception of the standards for non-aero/non-box trailers, the standards are performance standards and so do not mandate use of LRR tires (or any other particular technology).

**Organization:** FedEx Corporation

1. Trailer Aerodynamics and Rear Roll-up Doors: When the proposed rule is fully implemented it will establish a trailer aerodynamic efficiency requirement that includes the use of “Bo-Tails.” The operating companies of FedEx utilize rear roll-up doors on their trailers for a number of reasons we will expound on in the Addendum portion of this commentary (just below). Simply said, the operators of trailers utilizing rear roll-up doors request that roll-up doors be covered as acceptable “Partial Aero” or be given a “Qualified Exemption” to the mandate of Bo-Tail use until an effective, durable and cost efficient product is available which is compatible with the rear frame design utilized by rear roll-up doors. The “To Be” created technology efficiency should be verified by EPA. [EPA-HQ-OAR-2014-0827-1302-A1 p.3]

Rear Rollup Benefits:

A. Driver safety - Roll-up doors allow the trailer to be positioned against a dock without requiring the driver to approach a dock, stop, fold the Bo-Tail, swing open the doors and then reenter the tractor to complete the parking maneuver. Roll-up doors prevent the extra process steps and contribute to process efficiency. [EPA-HQ-OAR-2014-0827-1302-A1 p.3-4]

B. Dock worker safety - The roll-up door allows a worker to approach the door latches on a solid surface, unlatch the door and using their legs to lift the door properly. [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

C. Less space is required between parked trailers with roll-up doors [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

4. Components Ratings: While the proposal currently states that it is the responsibility of manufacturers to document the contributive benefit of the components installed on the Tractor and or Trailer; fleets such as FedEx need the verified efficiency of the available components separately, and/or when used in combination. There should be a government-provided rating of components to assist a fleet in its deliberation as to which components are the most effective and should be included in future purchases. Implementation would be inhibited if fleets were required to conduct their own evaluations of individual components. [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

**Response:**

The agencies recognize the benefits of roll-up doors for some operations and it is not the intent of the Phase 2 trailer program to restrict the use of roll-up doors. We are aware of some technologies that will provide small-scale improvements to the rear of trailers with roll-up doors, but are not aware of any existing technologies that match the performance of current boat tails designed for use with out-swinging doors. Current boat tail technologies are designed to conveniently fold when rear doors are opened. We expect that any future designs intended to work with roll-up doors will be designed with similar convenience in mind, including features that address the accessibility and safety concerns raised by the commenter.

While we expect many box vans with roll-up doors will include additional features (e.g., drop decks, side platforms) that would qualify these trailers for a partial-aero designation, we understand that some trailers equipped with these features may not be able to find suitable technologies to meet even the partial-aero standards. Because of the current limited availability of rear aerodynamic technologies for roll-up door trailers, the final trailer program includes an interim provision – through MY 2023 – that treats roll-up doors as work-performing devices equivalent to rear lift gates. We understand that innovations and improvements continue for all trailer aerodynamic technologies, and this provision is limited to the early years of the program to provide a degree of incentive for device manufacturers to continue to develop and improve aerodynamic technologies that are appropriate for roll-up doors. For MY 2024 and later, roll-up doors will not qualify as a work-performing device. We intend for this interim provision to allow trailer manufacturers time to obtain, become familiar with, and prepare to market these technologies to their customers.

For trailers, the agencies are not adopting a program to provide a rating of components to the fleets or public. We do not expect fleets will need to conduct their own testing to evaluate technologies. While some trailer manufacturers may choose to perform their own testing, we are adopting provisions for device manufacturers to submit aerodynamic test data to EPA to be pre-approved for use by trailer manufacturers, and we expect most trailer manufacturers to take advantage of this option to obtain performance information. The agencies are not committing to make this information public at this time. However, trailer or device manufacturers may make this information available to their customers to promote adoption of these technologies. The agencies cannot ensure that any fleet's individual trailer will experience the same performance in-use as suggested by the aerodynamic test results used for compliance, but our program will provide a relative basis from which fleets can compare performance. In general, aerodynamic technologies in higher bins will have better performance than others at most speeds.

**Organization:** Great Dane

Great Dane supports the use of tire technologies that save fuel and reduce emissions, but as previously stated, many factors come into play as far as the practicality of employing that approach. Not being our primary focus and since we don't directly operate trailers in revenue service we cannot offer firsthand information on the tradeoffs associated with these technologies. However, we do note that we have customers who have stated to us that low rolling resistance (LRR) tires and/or automatic tire inflation systems (ATIS) do not meet their expectations and thus they do not specify those components. Our sales records support that fact. [EPA-HQ-OAR-2014-0827-1219-A1 p.1-2]

Trailer Aerodynamics

Great Dane believes that trailer aerodynamics, generally referred to as trailer aero or trailer aero treatments, plays an important role in reducing fuel consumption and resultant emissions. We recognize that fleets operate a variety of equipment in both “long haul” and “short haul” operations which would include both high and low speed operations and “transient” conditions as stated in the Notice of Proposed Rulemaking. A variety of trailer aerodynamic solutions have emerged and become commercially available since approximately the year 2000. As is widely recognized, all of these devices and systems are more effective as to reducing drag forces as vehicle speed increases. [EPA-HQ-OAR-2014-0827-1219-A1 p.2]

Aerodynamic treatments are widely available in the marketplace today for box (dry and refrigerated van) type trailers. We believe that market penetration to date of successful trailer aero technologies depends on many factors, with device return on investment and regulations in California (CARB), tempered by economics, being the principal drivers. [EPA-HQ-OAR-2014-0827-1219-A1 p.2]

We believe that the growth in adoption of aero for box type trailers since approximately the year 2000 is largely a result of skirt use on trailers used in long haul or in some cases regional operations where highway speeds for extended distances allow sufficient payback of the devices to justify their cost (both initial costs and maintenance). We note that adoption rates of other aero technologies such as gap reducers, underbelly devices and rear devices has been much lower over the same time period, likely a result of their relative performance and resulting return on investment or incompatibility with a fleet’s operational constraints or both. [EPA-HQ-OAR-2014-0827-1219-A1 p.2]

As per our conversations with the Environmental Protection Agency (EPA), we note an absence of competition in the availability of rear aero solutions and we further note and believe that the reason that these technologies markedly lag the growth in use of trailer side skirts is due to the potential for damage of these rear devices during docking operations. This is exacerbated by the challenges that fleets face with equipment and personnel, and the great variation of facilities that shippers and receivers expect carriers to service. While we understand the intent of the proposed regulations, we do not believe that an approach to force technology and to require the use of rear devices via large technology penetration rates is appropriate due to the challenges many fleets face in docking operations. We do not believe that the operation of trailers at loading docks will change to a substantial degree over the period of proposed regulation. Therefore we believe that a technology forcing regulatory approach for rear devices will not result in cost effective deployment of rear devices at high penetration rates as anticipated by the agencies. [EPA-HQ-OAR-2014-0827-1219-A1 p.3]

Under the proposed regulations Great Dane and our customers will experience increased costs. The agencies believe that the fleets will recoup those costs in an acceptable timeframe thru fuel savings. Great Dane’s additional costs in complying with the rule will be passed onto our customers, although we are already taking measures to minimize this effect. [EPA-HQ-OAR-2014-0827-1219-A1 p.3]

**Response:**

The agencies developed our Phase 2 trailer standards using specific technology packages for each phase of the program. Our standards for full-aero long box vans (dry and refrigerated) are based on the performance of trailer configurations that include bolt-on aerodynamic technologies, ATIS, and LRR tires. In practice, however, trailer manufacturers have the option to comply with these standards using any combination of aerodynamic improvements, LRR tires, tire pressure systems (including TPMS), and weight reduction that best meets the needs of their customers.

It is possible that manufacturers could meet the standards by installing higher performing aerodynamics and substituting several light-weight components for heavier ones to avoid the use of LRR tires and tire pressure systems if customers do not have confidence in tire technologies. Similarly, it is possible that a different combination of existing or future aerodynamic devices would have comparable performance to skirts and a tail, and manufacturers could offer an aerodynamic package that does not involve a rear device. It is likely that the trailer industry, including both trailer manufacturers and aerodynamic device manufacturers, will continue to develop new technologies that will improve the aerodynamic performance of box vans over the next ten years, providing additional compliance avenues over time. Regarding the costs of the new technologies, we acknowledge and quantify the costs manufacturers will incur that will, in most cases, be passed on to customers, and the program accounts for these costs as well as the cost savings that end users will experience.

Trailer and device manufacturers have an incentive to develop innovative, high-performing designs that also account for their customers' varying preferences and operational characteristics. In addition, operators' experience and familiarity with these evolving technologies will grow as their use becomes more widespread. For example, driver experience with trailer tails is limited today, since only a small fraction of trailers use them. We expect these technologies will continue to evolve and increased market demand will lead to designs that address any deployment or collapsing concerns at loading docks. Additionally, the growing direct and indirect experience among operators will reduce the instances of damage and inefficiencies raised by the commenter.

**Organization:** International Council on Clean Transportation (ICCT)

## **Trailers**

The ICCT supports the agencies integration of trailers into the Phase 2 regulation. We believe that this proposal builds on the successes of the SmartWay program and California's in-use GHG regulation and will both promote the adoption of existing cost-effective technologies as well as spur new innovation. In designing standards for a tremendously diverse market, the agencies have developed a sound program that limits testing and compliance complexity in order to minimize the burden on trailer manufacturers. We support the agencies' high-level regulatory decisions, as they are congruent with previous ICCT recommendations (Sharpe et al, 2013; Sharpe, 2014) in key areas: trailer manufacturers are the regulated entity; the standards for trailers are expressed in grams (and gallons) per ton-mile; the classification framework facilitates improvements in aerodynamics, tire technologies, and lightweighting in box trailers, while for non-box trailer types, improvements are focused on tire technologies; aerodynamic testing procedures for tractors and trailers are closely aligned; and trailer aerodynamic testing utilizes an "A-to-B" approach in which the same tractor model is used to test a baseline and an 'enhanced' trailer in order to certify the enhanced trailer model's aerodynamic performance. [EPA-HQ-OAR-2014-0827-1180-A4 p.10]

The agencies largely incorporated the portfolio of commercializable trailer efficiency technology. With a rulemaking timeframe of 2027, we would encourage the agencies to consider greater penetration of higher aerodynamic bins for all box trailers, as well as ways to promote more aerodynamic improvement in non-box trailers. The agencies' analysis of technology adoption rates for trailers is firmly rooted in a fact-based assessment of the current baseline and target levels of penetration that are reasonable. Given the rapid acceleration of uptake of fuel-saving technologies over the past five years as a result of the SmartWay program, California's in-use tractor-trailer GHG regulation, and attractive returns on investment for many technologies, the agencies could consider advancing the proposed timing of the required technology penetration by several years and greater final penetration of technology in 2027. [EPA-HQ-OAR-2014-0827-1180-A4 p.10]

**Response:**

We appreciate the commenter's support for the proposed Phase 2 trailer program. See response to CARB in section 5.3 on page 980 regarding our preferred alternative, and our response to UCS in Section 5.4 on page 1026 regarding aerodynamic technologies on non-box trailers.

**Organization:** Meritor, Inc.

**Improve Automatic Tire Inflation Definition and Correct Misstatements about the Market.**

The definition of automatic tire inflation systems (ATIS) listed in Subpart 1, Definitions & Other Reference Information, is not consistent with the historical industry definitions. The Technology Maintenance Council, (TMC), of the American Trucking Association, in their Recommended Practice, RP239A (most recently updated in 2014) uses the following widely accepted definition of ATIS: [EPA-HQ-OAR-2014-0827-1254-A1 p.15][This comment can also be found in section 4.3 of this comment summary]

*Automatic Tire Inflation Systems maintain tire pressure at a single preset level and are pneumatically or electronically activated. These systems eliminate the need to manually inflate tires.* [EPA-HQ-OAR-2014-0827-1254-A1 p.15][This comment can also be found in section 4.3 of this comment summary]

The current definition included in the rulemaking states: [EPA-HQ-OAR-2014-0827-1254-A1 p.15][This comment can also be found in section 4.3 of this comment summary]

*ATIS means a system installed on a vehicle to keep each tire inflated to within 10% of the target value with no operator input.* [EPA-HQ-OAR-2014-0827-1254-A1 p.16][This comment can also be found in section 4.3 of this comment summary]

Assigning an arbitrary number of 10 percent is not consistent with the manner in which these systems are used in practice. Tire pressure increases by 15 – 20 percent when the tire is hot and running on a fully loaded vehicle at 75 mph on asphalt roads on a sunny day. Tires cool back down to the specified tire pressure after a few hours. The reduced fuel economy and increased greenhouse gas emissions are due to tire underinflation. ATIS systems assure that tires will always be running at the recommended cold tire inflation pressure. [EPA-HQ-OAR-2014-0827-1254-A1 p.16][This comment can also be found in section 4.3 of this comment summary]

**Response:**

The commenter is essentially correct. The agencies accordingly updated the definition of ATIS and removed the reference to 10% of a target value.

**Organization:** Meritor, Inc.

Page 40612, § Section 1037.107 Emission standards for trailers of the proposed rulemaking, discusses the use of low rolling resistance tires and that “qualified” automatic tire inflation systems are required on non-box trailers effective MY 2018. It is our recommendation that the term “qualified” be expanded. SAE Recommended Practice (RP) J2848-2, dated June 2011, is a RP on the subject of ATIS. It is the industry standard that details the basic operational requirements for any ATIS. This RP should be



referenced in the proposed rulemaking when “qualified” automatic tire inflation systems are discussed. [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

**Response:**

The use of the term “qualified” was intended to refer to the definitions of ATIS in our respective regulations.

**Organization:** Meritor, Inc.

In the Small Business Advocacy Review Panel Report, section 9.3.1.3 Automatic Tire Inflation (ATI) Systems states: [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

*“Most trailer SERs have experience installing ATI systems on some of their trailers, but ATI systems are not installed as a standard feature on any of the SERs’ current products. The non-box trailer manufacturers have installed tire inflation systems on some trailers, but indicate that the customers are reluctant to purchase the systems because of the added cost. **In addition, the manufacturers noted that inflation systems are often tied to a particular suspension system and they cannot be applied universally.**”* [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

In fact, all ATIS in the marketplace today *can be* universally applicable to all hollow tube trailer axles, regardless of the manufacturer or the suspension type to which they are affixed. [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

Page 40285 (IV.F.(6)(d)) of the NPR states:

*“We request that trailer manufacturers as well as tire and aerodynamic technology manufacturers provide information regarding the current projected availability of the technologies that trailer manufacturers can use to meet our proposed standards.”* [EPA-HQ-OAR-2014-0827-1254-A1 p.16]  
In this regard, it should be noted that ATIS are universally applicable to ALL trailer types contemplated in these regulations, and that while some suspension and axle manufacturers attempt to commercially limit the application of only *their* ATIS to *their* suspensions and axles, this is not a technical limitation of commercially available ATIS. [EPA-HQ-OAR-2014-0827-1254-A1 p.16]

**Response:**

The Panel Report that the commenter points to is referring to a comment made by a trailer manufacturer and we cannot change the contents of that report. The agencies did not refer to any technical limitations of connecting ATIS to particular trailer types in the Preamble or RIA of the final rulemaking. Our request for comment was intended to gather information on production capabilities of tire technology suppliers, since trailer manufacturers expressed concern that there would not be sufficient availability for the volume of trailers requesting the technologies.

**Organization:** National Association of Clean Air Agencies (NACAA)

NACAA commends EPA for including requirements to regulate GHG emissions associated with trailers for the first time at the national level. While we support the proposal as a first step by requiring nearly all trailer types designed for on-highway use to use low rolling resistance (LRR) tires and automatic tire inflation systems, we believe the proposed trailer provisions miss several opportunities to maximize fuel efficiency technologies in the heavy-duty trailer sector. [EPA-HQ-OAR-2014-0827-1157-A1 p.4]

Based on manufacturers' and fleets' experiences with EPA's SmartWay program and CARB's experience in implementing its Tractor Trailer Greenhouse Gas Regulation, we urge EPA to 1) consider expanding the proposed requirements for aerodynamic technologies on box type trailers to include other trailer types, such as tanker and flatbed trailers; 2) increase the proposed penetration rate for Level 1 LRR tires to at least 95 percent for short and long box type trailers; 3) adopt Alternative 4 augmented with revisions to include a nominal adoption rate in Bin VIII technologies (which represent as yet undeveloped technology) in order to further advance aerodynamic technology development; and 4) increase the final Alternative 4 stringency (applicable to MY 2024) for long box refrigerated van trailers so that the combined adoption of Bins VI and VII match or exceed that of long box dry van trailers. [EPA-HQ-OAR-2014-0827-1157-A1 p.4]

**Response:**

The agencies appreciate the commenter's support for the trailer program. In response to the comments about the stringency of the program, see the response to CARB in section 5.3 on page 980. We are not adopting performance standards for non-box trailers that would require the use of aerodynamic technologies. Of the tank, flatbed, and container chassis manufacturers that at the time of our analysis would be covered by the Phase 2 trailer standards, about 75% qualify as small businesses. We believe tire technology-based *design* standards achieve a balance between the most consistent CO<sub>2</sub> and fuel consumption benefit across this subset of trailers, and our desire to reduce the compliance burden for this newly regulated industry that is largely made up of small businesses. Also, see our response to USC regarding non-box aerodynamics on page 1026 of this section.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

**Aerodynamic Devices**

It should be understood that whenever an aerodynamic device is used, the benefit of the other devices will be affected. For example, installing a gap fairing will affect the aerodynamic drag of the side skirts. Therefore, the benefits gained by combining aerodynamic technologies cannot be summed by adding the individual estimated fuel savings. Combining all the various aerodynamic devices, such as side skirts, front gap fairings, and rear fairings, which individually are estimated to produce 4 to 7 percent, 1 to 2 percent, and 1 to 5.1% in fuel savings respectively, will not result in a grand total of 6 to 14 percent in fuel savings. [EPA-HQ-OAR-2014-0827-1244-A1 p.19-20]

The benefits of aerodynamic technology fluctuate greatly depending on the trailer type and cargo. For instance, as stated above, front trailer fairings are not designed for refrigerated-vans, and are most effective when installed on tractor-trailers with a gap greater than 36 inches. [EPA-HQ-OAR-2014-0827-1244-A1 p.20]

While aerodynamic technologies sound good academically, they often do not make sense in the real world. In some instances aerodynamic technology can actually cost fuel rather than save fuel. For example, a sleeper cab tractor with a full-height air deflector that is pulling a flatbed trailer will decrease fuel efficiency because the high roof sleeper increases the frontal area of the truck beyond what the trailer requires.<sup>20</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.20]

Trucking operations not only vary by types of cargo, but also by geographic region and length of haul, which greatly affects the benefits of aerodynamic technology. Truck drivers in costal and urban areas run very different routes than those who operate on the great plains of the Midwest. Short-haul

operations primarily use day cab tractors, which constitute approximately one-third of Class 8 trucks. [EPA-HQ-OAR-2014-0827-1244-A1 p.20]

In an article published in the Brow Beat, Susan King, a spokesperson for the American Trucking Associations, stated that aerodynamic technology does not make sense for every truck. The drag on a vehicle increases with the square velocity, so reducing drag becomes much more important as the average speed of a truck increases. Ms. King pointed out that this technology does not start to be effective until the truck is averaging 60 to 65 mph. “So you wouldn’t see these panels on trucks that handle local deliveries.”<sup>22</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.21]

Therefore, unless an owner-operator is running long-haul where they average 60 to 65 mph, these aerodynamic technologies would have little to no effect on fuel savings, and it would be difficult for owner-operators to see a return-on-investment. For example, in California, the speed limit for heavy-duty vehicles is 55 mph, thus these technologies would not be able to reach their maximum effect. Additionally, tens of thousands of owner-operators service our nation’s ports, and many never exceed 45 mph. [EPA-HQ-OAR-2014-0827-1244-A1 p.21]

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20 Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, National Academies Press (2010), pg. 98.

22 Mark Vanhoenacker, “What’s That Thing? Truck Fins Edition,” Slate Magazine (2013), [http://www.slate.com/blogs/browbeat/2013/04/03/truck\\_panels\\_what\\_do\\_they\\_do\\_explained\\_photos.html](http://www.slate.com/blogs/browbeat/2013/04/03/truck_panels_what_do_they_do_explained_photos.html)

**Response:**

The agencies recognize the possibility of dissynergies when aerodynamic devices are combined. We are accounting for these dissynergies by applying a correction to any individually pre-approved aerodynamic data that manufacturers intend to use in combination. Manufacturers would be able to claim 100% of the pre-approved effectiveness value for the highest performing device, 90% for the second-highest performing device, and 80% for any additional devices. See 40 CFR 1037.526(c). Device manufacturers and trailer manufacturers maintain the option to test combinations of devices and claim the effectiveness observed in their testing. It is possible that some device combinations will perform better in combination than the sum of their individual effectiveness values, but manufacturers will have to test those devices in combinations to claim those values.

The agencies also recognize that some aerodynamic devices may not be appropriate for all box vans. We are maintaining the performance standards for box vans that allow a manufacturer to install a variety of devices with similar performance that can meet a specific customer’s need. Gap reducers and other front fairing technologies are never required to meet the standards. Our aerodynamic testing described in Chapter 2.10 of the RIA indicates that the performance of these devices can be made up with other technologies. Especially in the early years of the program, manufacturers may be able to substitute large weight reductions to achieve the same performance as aerodynamic technologies. We expect refrigerated vans that are unable to use aerodynamic devices on the front of the trailer will have sufficient technology options to meet the standards. Additionally, the agencies are adopting provisions that provide manufacturers the option of designating box vans with work performing equipment (WPE) as “partial-“ and “non-aero”, which reduces or eliminates the need to use aerodynamic technologies to meet the standards. The agencies believe a large fraction of short-haul box vans would have WPE to qualify for these reduced standards.

The agencies designed our trailer program to achieve CO<sub>2</sub> and fuel consumption reductions for the majority of regulated trailers. Our standards are based on consistent pairing of appropriate tractors and trailers. We cannot control tractor-trailer pairings in use, and understand that there may be situations where a high roof tractor operator may be asked to transport equipment using a flatbed or other mismatched trailer. However, our experience shows that most trailers are matched with an appropriate tractor and we can expect consistent reductions in the real world.<sup>154</sup>

The agencies recognize that the performance of aerodynamic devices improves with increased vehicle speed. However, our evaluation in Chapter 2.10.2.1.1 of the RIA indicates that even a trailer that travels exclusively in transient conditions would experience a non-zero benefit by reducing drag. A long dry van pulled by a sleeper cab tractor may achieve 9% CO<sub>2</sub> reduction for a SmartWay-Elite combination of devices when traveling at 65-mph, and closer to 7% at a speed of 55-mph. While the CO<sub>2</sub> reduction decreases to about 1% under completely transient driving conditions, there is still a slight benefit for these trailers. The relatively few box vans that travel exclusively in transient conditions, but do not qualify for partial- or non-aero designation, may see a longer return on investment than their high-speed counterparts, but they will still benefit.

The majority of the drayage traffic at ports involves transport of containers using container chassis, and, in some cases, specialty trailers such as auto haulers and flatbeds to transport “breakbulk” cargo that will not fit in containers, or tanks to transport liquids. Container chassis, flatbed, and tank trailers fall under our non-box trailer design standards that require the use of tire technologies only. Many other specialty trailers are completely excluded from the program. We are not establishing standards for these trailers commonly used in port operations that would necessitate the use of aerodynamic technologies to comply. The drayage tractors pulling these trailers may be classified as vocational vehicles (see 40 CFR 1037.630 for these optional custom chassis standards). See the Preamble, Sections III.C.4.b, V.b.2.b, and V.B.3.b.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

### **Automatic Tire Inflation**

Automatic tire inflation technology is among the agencies’ list of approved technologies in order for OEMs to achieve compliance goals. The agencies have projected as part of the NPRM that 50 percent of dry van and refrigerated trailers will have automatic tire inflation (ATI) systems installed to maintain optimal tire pressure by MY 2018. This penetration rate is far too high, as many owner-operators would prefer to purchase tire pressure monitoring (TPM) systems rather than ATI systems because of the reduced cost and complexity while achieving similar savings. It is important that ATI systems are not forced onto consumers by assuming such high adoption rates. [EPA-HQ-OAR-2014-0827-1244-A1 p.23]

### **Response:**

The MY 2018 adoption rates referred to in this comment are the Alternative 1 baseline adoption rates the agencies projected would be in place without a regulatory program for trailers. We have adjusted those adoption rates for the FRM, based on an informal survey conducted by TTMA and provided in a

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<sup>154</sup> Memorandum to Docket EPA-HQ-OAR-2010-0162-0045. “Truck and Trailer Roof Height Match Analysis”, August 9, 2010.

letter to EPA.<sup>155</sup> TTMA's members observed an average ATIS market penetration of 40% for 53-foot vans, 26% for shorter vans and 3-20% for several non-box trailer types. Our new MY 2018 baseline adoption rates are 45% for long vans and 30% for short vans based on this information.

The agencies did not propose, but are adopting provisions to accept TPMS as a means of complying with the Phase 2 trailer standards. Design standards for non-aero box vans and non-box trailers (i.e., flatbed, tank, and container chassis) now require LRR tires and *either* TPMS or ATIS. Performance standards for full- and partial-aero box vans are based on the use of ATIS, but manufacturers have the option of installing TPMS and claiming a slightly reduced effectiveness. As with all performance standards, we do not require any specific technology be installed on full- and partial-aero box vans. Customers can work with their trailer manufacturer to determine an appropriate combination of aerodynamic technologies, LRR tire, tire pressure systems, or weight reduction options to apply to meet the standards for a given model year.

**Organization:** Pressure Systems International (PSI)

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 206-210.]

My interest in presenting at this hearing is to address the definition of an automatic tire inflation system and the requirements of a 'qualified ATIS system.'

Today we estimate that approximately half of the commercial trailers being produced in North America have some type of tire solution with the overwhelming majority being ATIS. We also estimate that over one million trailers are currently running with ATIS today.

The benefits of ATIS include increasing fuel economy, reducing greenhouse gas emissions, and significantly reducing tire and safety related roadside service calls. It also dramatically reduces road debris from tire casings and better utilization of casings for retreads for lower oil consumption by the tire manufacturers. A typical return on investment is well under 12 months.

The basic principle of ATIS is to ensure that tires maintain a minimum specified tire pressure as determined by the fleet. However, there are numerous tire solutions in the market today, and there are operational characteristics between some of those that classify themselves under the ATIS heading. With most ATIS systems, air is automatically added whenever an individual tire pressure below the system setting either while the trailer is in a static or dynamic state.

I wish to clarify two very important items in the proposed rulemaking: the definition of 'automatic tire inflation system' listed in Subpart 1. Definitions and other reference information is not consistent with the historical industry definitions. TMC, the Technology Maintenance Council of the American Trucking Association, in their recommended practice, RP-239(a), most recently updated in 2014, uses the following widely-accepted definition of ATIS, and I quote: 'Automatic tire inflation system maintain tire pressure at a single preset level, and are pneumatically or electronically activated. A warning indicates to the driver that the system has been activated, and air is being added to a tire. These systems eliminate the need to manually inflate tires.'

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<sup>155</sup> Letter, Truck Trailer Manufacturers Association to EPA, October 16, 2014, Docket EPA-HQ-OAR-2014-0827-0146.

The current definition included in the proposed rulemaking states, and, again, I quote, 'ATIS means a system installed on a vehicle to keep each tire inflated to within 10 percent of the target value with no operator input.' Assigning an arbitrary number of 10 percent is not consistent with the laws of tire physics. Tire pressures increase by 15 to 20 percent when the tire is hot and running on a fully loaded vehicle at 75 miles an hour on an asphalt road on a sunny day. Tires will cool back down to the specified tire pressure after several hours depending on the size type tire.

The issue with tires and reduced fuel economy and increased greenhouse gas emissions is because of tire under inflation. ATIS systems assure that tires will always be running at the recommended cold tire inflation pressure.

The second issue to address is a clarification regarding 'qualified automatic tire inflation systems.' Section 1037.107, Emissions Standards for Trailers, of the proposed rulemaking, discusses the use of low rolling resistance tires, and that qualified automatic tire inflation systems are required on non-box trailers effective model year 2018. It is our recommendation that the term 'qualified' be expanded.

SAE Recommended Practice J2848-2, dated June 2011, is an RP on the subject of automatic tire inflation systems. It is the industry standard that details the basic operational requirements for any automatic tire inflation system. This RP should be referenced in the proposed rulemaking when qualified automatic tire inflation systems are discussed.

**Response:**

The agencies updated our definition of ATIS and removed the reference to 10% of a target value. The use of the term "qualified" was intended to refer to the definitions of ATIS in our respective regulations.

**Organization: Schneider**

Trailer Aerodynamic Devices. Trailer aero devices are most beneficial at speeds above 45 MPH and most truckload fleets operate less than 60% of the time and miles above this speed. Many trailers are operated as a warehouse on wheels, consequently, low miles per year. The low miles per year at slow speeds limit the benefits of aero devices on trailers. In addition, certain applications cause the trailer and aero devices to be susceptible to damage. Any device which must be deployed by the driver, i.e. trailer tail, is susceptible to not being deployed and not producing a benefit. Any device which protrudes from the vehicle (ice trailer tail) creates a risk of contact with, and damage to, fixed objects in the operating environment if the driver forgets about the presence of the device (i.e. trailer tails hitting light poles in parking areas, trailer tails hitting dock doors). [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

**Response:**

See our response to Stoughton in Section 5.1 on page 965 for a comparison of the benefits we expect over the range of operation a trailer may experience. Also, see our responses to Utility in Section 5.1 (page 971) and Great Dane in this section (page 1000) for our assessment of the use of and potential damage to current and future rear aerodynamic devices.

The agencies believe it is in the best interest of fleets and owner-operators to be aware of technologies that will improve CO<sub>2</sub> emissions and fuel consumption. Aerodynamic devices must be designed to last the full useful life of the vehicle. While device manufacturers are not responsible for damage caused in-use, we believe they have an incentive to ensure their products can withstand typical driving conditions of those using their products. Problems with inadvertent damage and damage from environmental

conditions will decrease as new products are introduced to improve on previous designs, and the industry becomes more familiar with the available technologies.

**Organization:** STEMCO

STEMCO supports higher fuel efficiency standards in tractor trailers and has shown it is possible to gain an additional 5% fuel efficiency by using a TrailerTail® rear drag mitigation device. [EPA-HQ-OAR-2014-0827-1259-A1 p.1]

STEMCO believes requiring automatic deployment or “always deployed” technology puts undue burden on fleets, who have a variety of operating models and driver profiles. We feel it is best to give fleets choices and leave enforcement to the various safety agencies. [EPA-HQ-OAR-2014-0827-1259-A1 p.1]

**Available Technologies**

Automatically deploying boat tails

STEMCO believes that this regulation should not require boat tails to automatically deploy when the vehicle is in motion. Our company commercially sells both manual and AutoDeploy™ versions of our TrailerTail® product line and has found that both offerings are needed to satisfy industry demand. Smaller fleets, fleets with lower driver turn-over, and fleets with established driver training and/or MPG incentive programs typically prefer the lower-cost manual TrailerTail® option, whereas other fleets are willing to pay a premium to guarantee deployed TrailerTails® without driver interaction. Because manual boat tails are already deployed during the vast majority of their highway travel (and we see this percentage continuing to increase as boat tails become more commonplace with drivers) and because fleets who purchase boat tails are already financially incentivized to deploy them (free fuel savings at that point!), we think natural market forces are sufficient to ensure that boat tails are deployed frequently enough to meet the environmental goals of this regulation. We also believe that it would be unfair and unwarranted to force fleets who are already successfully deploying manual boat tails to spend additional capital on a redundant automatically deploying option when they purchase new trailers. [EPA-HQ-OAR-2014-0827-1259-A1 p.3]

STEMCO instead suggests including a stipulation in the final regulation requiring all aerodynamic devices (boat tails, side skirts, etc.) to be designed such that they can be easily positioned into their EPA approved aerodynamic shape before or during vehicle motion, and that they can properly maintain their EPA approved aerodynamic shape during vehicle motion. A more specific requirement could be that a manually deploying boat tail must take a single driver less than 10 seconds to unfold into the fuel-saving shape. We believe that this matches the spirit of the regulation and may close an unforeseen loophole if an inexpensive, but difficult to unfold, boat tail is commercialized with the intent of achieving compliance but rarely being deployed while in-service. [EPA-HQ-OAR-2014-0827-1259-A1 p.3]

**Response:**

The agencies see value in rear trailer devices that automatically deploy to ensure proper positioning in-use. However, we are not requiring auto-deployment as a criteria for rear devices in order to provide additional selection for customers, including possible use of less-expensive options. In response to the comment suggesting that boat tail technologies be required to demonstrate a specific degree of ease of deployment and that they maintain their shape in use, we did not propose, and the final program does

not include, such requirements. We expect that commercial factors will tend to result in designs that indeed achieve promised fuel savings benefits through effective aerodynamics and reasonable ease in deployment. In their application for certification, trailer manufacturers will provide basic information about devices used on their trailers. Where there may be some question on the performance values submitted, the agencies maintain the ability to test devices using our full-scale test procedures to ensure the actual production devices perform as claimed.

**Organization:** Stoughton Trailers

Unintended consequence: brake/wheel end warming;

Over the history of design of a wheel end for usage on trailers a continued goal is to provide for the safest, longest lasting, and cost sensitive components possible. The industry continues to reconfigure the brake drum toward these ends. Consequently the weight of a brake drum has been reduced approximately 18% over the past 30+ years (resulting in reduced fuel consumption and therefore reduce CO2 creation). The proposal may reverse this design due to the need to dissipate heat. The heat being created due to braking action, which up until now was cooled via air flow. The concern with the proposal is that with added side skirts and wheel deflectors for Aero purposes the air flow across the drum area is minimized resulting in an allowance of temperature increase. One way to manage the temperature would be to add mass to the brake drum, resulting in additional weight. Thus conflicting with the intended potential advantages of fuel conservation. If temperature is allowed to build it will affect bearings, lubricant, seals, brake lining, heat treatment of drum.....in extreme conditions the tire bead could break seal from the rim or the tire could actually ignite and burn the unit to the ground. [EPA-HQ-OAR-2014-0827-1212-A2 p.1]

Request 1: Provide direction to aero manufacturers to negate the potential hazards listed above or remove requirement for aero all together. [EPA-HQ-OAR-2014-0827-1212-A2 p.1]

**Response:**

Many trailers are using trailer skirts today and we do not have data to suggest that trailer brake overheating is a widespread problem (nor did the commenter provide any). We agree that skirts have the potential to reduce airflow to the wheels, but the agencies do not have sufficient information to determine the trailer design, operational characteristics, or environmental conditions that may lead to overheating, or the role of maintenance in preventing occurrences. Further, a study group (S.11 Sustainability and Environmental Technology) at the American Trucking Association's Technology & Maintenance Council (TMC) examined this potential issue. The study group interviewed several fleets that used trailer aerodynamic devices and found no evidence that use of these devices resulted in increased maintenance or component failures. As a result, the study group did not pursue the study. Additionally, we expect that manufacturers will continue to evaluate all aspects of their trailers' performance, and suppliers will have an incentive to create components that meet their customers' durability and performance standards while accommodating future trailer designs.

**Organization:** Stoughton Trailers

**EPA-HDGHG2: Reduction of GHG, Targeted vs projected Target:** Defined by joint consideration of US-EPA and DOT's NHTSA

- Projected to reduce GHG emissions by 270 MMT (530 million barrels of oil) over the life of the regulated vehicles [EPA-HQ-OAR-2014-0827-1212-A2 p.3]



### **Trailer Industry discussion:**

- Considering dry van production for a 5 year period and the life cycle of those units [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - Cost of devices employed to comply (see page 5): \$1,398,097,750.00 (this does not take into account any proof testing of performance see page 8) [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
    - Realized fuel savings: (see page 6) 85.34 million barrels (i.e. 164 barrels per full aero type unit) -- 16.1% of Target
  - Effect on purchase price: 7.4% increase (range 2.14 to 9.8% see page 5) [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
    - For an industry which operates in a single digit profit margin
  - Note break even payback period from 52 to 66 months not considering upkeep and maintenance (this is 2x to 3x acceptable timeframe) [EPA-HQ-OAR-2014-0827-1212-A2 p.3]

Request 7: Continue with voluntary program

- Components detracting from target: reduces to <16% of Target [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - Weight of aero devices added to equipment causes 1.03% more truckloads to deliver current payload amounts: consumes an additional (12,500 truckloads based on a 500 mile length of load trip) see page 7 76,401 barrels oil [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - Delivery of aero devices: 4,200 truckloads: 25,641 barrels oil (see page 7) [EPA-HQ-OAR-2014-0827-

Request 8: Continue with voluntary program (eliminates > 16,000 trips: safety?)1212-A2 p.3]

- Alternative consideration: Rail usage 6.6% of Target [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
- For every 30% reduction in Highway miles for 30% of the fleet (i.e. 173 barrels per unit) see page 7 35.05 million barrels of oil [EPA-HQ-OAR-2014-0827-1212-A2 p.3]

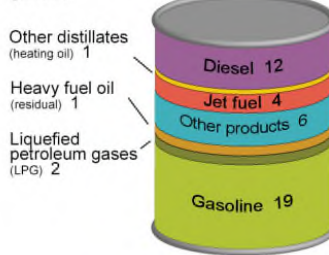
Request 9: Exclude rail use equipment from aero regulation: usage exceeds over the road full aero benefit.

- 33ft doubles legislation: 50.9% of Target [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - Saves 18% of miles traveled: see page 8 270 million barrels of oil [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - This savings accomplishes more than 50% of the program goals without installation of defined components and subsequent cost to the industry. [EPA-HQ-OAR-2014-0827-1212-A2 p.3]
  - Number of tractors on the road is reduced and therefore the # of potential accidents and deaths due to those accidents are diminished. [EPA-HQ-OAR-2014-0827-1212-A2 p.3]

Request 10: Exclude 33ft equipment from aero regulation: usage exceeds over the road full aero benefit by a factor of 3x. Recommend 33ft unit adoption.

Assumptions for consideration: provided by EPA presentation to TTMA

**Products made from a barrel of crude oil, 2013**  
gallons



T

Target savings of 530 million barrels of oil during lifecycle of units 2014 thru 2018  
equals(=) 6.36 billion gals of diesel (i.e. 270MMT GHG)

|  |   |
|--|---|
| EPA presentation to TTMA   | (1 gal equates to 93.6 lbs GHG)               |
| Units built in 2013 (135k) as avg/yr:  | 675k total units in program (2013 ACT report) |
| Average unit price:  | \$28,000 (Industry pricing)                   |
| Fuel cost:   | \$2.50 per gallon (current at pump)           |
| Average fuel economy (w/o program): 6.5 miles per gallon (mpg) (Stoughton Trucking fleet data) |   |

**Fuel Savings:**

|                                    |  |
|------------------------------------|--|
| Full Aero: 5% Fuel savings yields: | 6.825 mpg (calculated based on above)  |
| Partial Aero: 2.5% savings         | 6.6625 mpg   |
| Non-Aero: 1.25% savings            | 6.58125 mpg  |
| Price of components for full aero: | \$896 (Side skirt OEM installed with FET) +<br>\$1904 (boat tail) + \$795 (Tire inflation system) + Unknown tire differential = \$3595 |

Assume \$2750 ( volume price reduction)

Mileage traveled per unit annually: 45,000 miles (Large trucking fleet:top 3: data)

Number of Units in time (2014-2018): 135,000 per year; therefore 675,000 units

**Cost to Install fuel saving devices**

Full Aero: 60% of fleet: 0.6 x 675,000 units x \$2750 per unit  
 first year: \$222,750,000.00 (9.8% of sales)  
 program units (5 years): \$1,113,750,000.00 (9.8% of sales)

Partial Aero: 25% of fleet: 0.25 x 675,000 units x \$1325 per unit (omit boat tail)  
 first year: \$44,718,750.00 (4.7% of sales)  
 program units (5 years): \$223,597,750.00 (4.7% of sales)

Non-Aero: 15% of fleet: 0.15 x 675,000 units x \$600 per unit (include no aero)  
 first year: \$12,150,000.00 (2.14% of sales)  
 program units (5 years): \$60,750,000.00 (2.14% of sales)

Total Fleet: first year: \$279,618,750.00 (7.4% of sales)

program units (5 years): \$1,398,097,750.00 (7.4% of sales)

**Fuel Savings**

**Full Aero @ 5% efficiency @ highway speeds (60% distance):**

60% of miles considered to be affective as highway speed, 60% of fleet

First year: 135,000 units x 45,000 miles x 60% x 60% @ (6.825 vs 6.5)mpg

16,021,978 gal i.e. \$40,054,945.00 avg payback 66 months

1.34 million barrels oil

Full program period i.e. 675,000 units @ 10 year unit life (i.e. 15 year program)

801,098,901 gal i.e. \$2,002,747,252.00

66.76 million barrels of oil

**Partial Aero @ 2.5% efficiency @ highway speeds (60% distance):**

60% of miles considered to be affective as highway speed, 25% of fleet

First year: 135,000 units x 45,000 miles x 60% x 25% @ (6.6625 vs 6.5)mpg

3,419,325 gal i.e. \$8,548,114.00 avg payback 52 months

0.285 million barrels oil

Full program period i.e. 675,000 units @ 10 year unit life (i.e. 15 year program)

170,966,229 gal i.e. \$427,415,572.00

14.25 million barrels of oil

**Non-Aero @ 1.25% efficiency @ highway speeds (60% distance):**

60% of miles considered to be affective as highway speed, 15% of fleet

First year: 135,000 units x 45,000 miles x 60% x 15% @ (6.58125 vs 6.5)mpg

1,038,462 gal i.e. \$2,596,154.00 avg payback 56 months

0.086 million barrels oil

Full program period i.e. 675,000 units @ 10 year unit life (i.e. 15 year program)

51,923,077 gal i.e. \$129,876,692.00

4.33 million barrels of oil

**Commulative Fleet:**

First year: 20,479,765 gal i.e. \$51,199,412.00

1.71 million barrels oil

Full program period 1,023,988,207 gal i.e. \$2,559,970,518.00

85.34 million barrels of oil

**Effect of delivery of aero devices:**

- Approximately 160 understructure aero kits/load and 170 boat tails/load (average due to weight/space limitations)
- Equates to 4200 loads @ 500 miles delivery (proximity of supplier to OEM)
  - o 2,100,000 miles traveled
  - o 307,692 gallons used @ cost of \$769,231 (based on increased MPG)
  - o 25,641 barrels oil
- o Production of aero device adds approximately ????????MT GHG, to consider

Added Trailer loads due to aero device weight:

- Average weight of aero device equals: 300lbs (skirts) + 165lbs (boat tails)
- Average payload in trailer 45,000 lbs
- For each 97 loads (1) additional load will be required
  - o 1.03% increase in overall mileage required to deliver same amount of payload: 6,257,250 miles @ 6.825 mpg  
916,813 gallons used @ cost of \$2,292,033  
76,401 barrels oil

Rail service discussion: (30% used as number which provides for equivalent fuel savings: actual number is approximately 3 times if rail service were to be fully utilized)

- Consider mile reduction at a rate of 30% (i.e. 13,500 miles repurposed)
  - o 13,500 x (30% of fleet) 675000 units @ 6.5 mpg

Saves 420,576,923 gallons of fuel (35.05 million barrels oil)

Saves \$1,051,442,307 of fuel

39.37 billion lbs GHG (17.86MMT)

- General fuel consumption: locomotive moves 200 truckloads while consuming the same volume of fuel as a tractor over the highway for a single unit. i.e. 05%  
Therefore fuel savings would be: 35.05 million barrels oil

- These units need not be considered in the over the road fleet and should therefore be exempt from all of the requirements of the proposed regulation.

**33ft doubles proposed legislation:**

o Assume 20,000 units per year (15 year affect): Represents 5% of the fleet (i.e. 20 year life cycle) and is therefore extremely conservative for the present calculation.

o Saves 18% of miles traveled:

$$0.18x[(20000 \times 45000 \times 15) + (20000 \times 45000 \times 14) + (20000 \times 45000 \times 13) + \dots + (20000 \times 45000 \times 1)] = 19,440,000,000 \text{ miles @ 6 mpg}$$

$$= 3,240,000,000 \text{ gal (270 million barrels of oil)}$$

- Note mileage reduced (6 mpg vs 6.5) to compensate for increased coefficient of drag due to longer (combination) units.

**Units to be Tested for compliance**

In order to establish a coefficient of drag each model would need to be tested in a wind-tunnel to assure accuracy. Furthermore a subsequent test is required to record the percentage of drag reduction which can be assumed for each potential aerodynamic device. For accuracies consideration a corresponding track test would be required to correlate the drag reduction to the actual fuel savings. The following only considers the wind tunnel portion of the cost associated with Cd establishment.

- Considering multiple side (12), roof(6), understructure (7), height (6), width(2), length (5), and limited misc. options (3), the number of possible combinations would exceed 90,000 variations.
  - o Assuming an average order size of approximately 50 units per specification yields a requirement for establishing over 2700 (first year) base lines for coefficient of drag for the industry.

**Cost to Establish Coefficient of Drag (Cd):** number of models to be tested based on a declining percentage due to repeat business

|                                       |                                 |
|---------------------------------------|---------------------------------|
| Year 1: 2700 models x \$19000/model = | \$51,000,000.00 (1.4% of sales) |
| Year 2: 1620 models x \$19000/model = | \$30,780,000.00 (60% of models) |
| Year 3: 1080 models x \$19000/model = | \$20,520,000.00 (40% of models) |
| Year 4: 810 models x \$19000/model =  | \$15,390,000.00 (30% of models) |
| Year 5: 675 models x \$19000/model =  | \$12,825,000.00 (25% of models) |

Period Total \$13051500000 (0.7% of sales)

**Response:**

The agencies considered the calculations provided by Stoughton. The values assumed for barrels of oil and MMT of GHG saved were noted to be taken from an EPA presentation to TTMA. Any numbers presented to TTMA would be referencing Phase 1 results. Since trailers were not considered in Phase 1, we cannot speak directly to these values, but we will address the theme of the calculations. Note that additional details regarding the agencies' calculations in response to this comment are provided in a memo to the docket.<sup>156</sup>

To start, Stoughton calculates the cost to install devices and relates it to the total sales of the industry, then estimates the fuel savings by adopting those technologies. The comment indicated that a 7.4% increase in purchase price was unacceptable, due to the "single digit profit margin" of the trailer industry. The agencies recognize that trailer manufacturers have very low profit margins. However, we expect a majority of these costs will impact the overall cost of trailers across the industry and should not be isolated to individual trailer manufacturers.

We repeated Stoughton's calculations to address the concerns with payback. These calculations indicate there is an average payback across the industry of 66 months (5.5 years). However, the agencies' technology costs take into account a baseline adoption rate of technologies that we believe the industry would be applying if there were no Phase 2 trailer regulations. This market-driven adoption cannot be counted against the program. In the case of long box vans, we expect 45% of the trailers sold would have skirts or better in 2018 (TTMA indicated 35% of new long box vans have skirts today). To account for this, we applied a factor of 0.55 to the calculation for full-aero cost and the 5% benefit to 45% of the baseline, which resulted in a small reduction in payback to 65 months.

Additionally, these calculations assume that aero devices are only effective during 60% of trailer mileage, but the agencies make the more reasonable assumption that the effectiveness of the technologies is not zero for the remaining 40% of the miles. See RIA 10.2.1.1. Assuming these lower-speed miles are, on average, 25% of the high speed benefit gives 6.58 mpg, 6.54 mpg, and 6.52 mpg for the remaining 40% of the miles for full-, partial- and non-aero trailers, respectively. Applying these values in the calculation reduces the payback to 55 months. The agencies also disagree with the effectiveness that Stoughton applied. The full- and partial-aero effectiveness values appear to only account for aerodynamic improvements. If we add 1.25% (the value applied to the non-aero trailers) to the full-aero and partial-aero trailers to account for tire improvements, the new effectiveness values reduce the payback to 43 months (3.5 years).

Finally, most skirts are SmartWay-verified to achieve 5% reduced fuel consumption, yet these calculations apply a 5% reduction to the full-aero trailers that are assumed to include skirts and tails, and a 2.5% reduction to the partial-aero trailers that will likely include skirts. Applying an improvement of 9.25% to the full-aero trailers (a conservative 8% for skirt and tail aero and 1.25% for tires) and 6.25% to the partial-aero trailers (5% for skirts and 1.25% for tires) reduces the payback to 29 months; under 2.5 years. The agencies rely on EPA's MOVES model for a much more sophisticated analysis that applies the average effectiveness of technologies for each trailer subcategory over each year of the program with decreasing VMT over the trailers' lifetime. However, even the simplified calculation

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<sup>156</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Evaluation of Trailer Program Cost and Benefit Calculations Provided by Stoughton Trailers in Public Comments." July 18, 2016.

performed here with more closely-aligned assumptions, results in a 2.5 year payback that is close to the agencies' estimate.<sup>157</sup>

The agencies address Stoughton's safety concerns with the addition of weight due to aerodynamic devices in our response to TTMA on page 1019 of this section. Please see our response below. We conclude that the additional weight from aerodynamic technologies can easily be offset by substituting light weight components to accommodate manufacturers that believe their customers will frequently weigh-out. These components can then be applied in the Phase 2 program to offset use of some aerodynamic technologies for these trailers.

The agencies agree that intermodal trailers that spend some time traveling by rail have the potential to reduce fuel consumption and CO<sub>2</sub>. However, we do not have sufficient data to estimate the savings across the industry in order to quantify an appropriate credit value. Additionally, we would have to identify the characteristics of trailers that would indicate intermodal use, as well as the impact of the additional weight added to those trailers that may offset some portion of the rail benefits when they are on-road. The agencies are not adopting a credit for rail usage in this rulemaking, but could consider it in future rulemakings with additional data.

The agencies recognize the benefit of tandem trailers in reducing VMT and improving freight efficiency. However, we cannot guarantee that any short trailers, including 28-foot and 33-foot trailers, will be used in tandem when they are introduced into commerce. We are not adopting provisions to exempt any length of tandem trailer.

**Organization:** Thermo King

#### **Aerodynamic Packages available for Reducing CO<sub>2</sub> Emissions and Fuel Consumption as Calculated by the Greenhouse Gas Emissions Model (GEM) for Trailers [§IV.D(2)(a)]**

Section IV.D of the Proposed Rule sets new requirements for CO<sub>2</sub> emissions and fuel consumption in long and short trailers, and discusses the technology packages available to meet these standards. [EPA-HQ-OAR-2014-0827-1196-A1 p.2]

However, due to the size and performance requirements of today's transport refrigeration units (TRUs), some of the technologies discussed would not be possible to implement in a refrigerated trailer, especially those which seek to make aerodynamic improvements. Ingersoll Rand is supportive of EPA's recognition of these exceptions, which are reflected by the distinction of dry vans and refrigerated vans into separate classes with different consumption requirements. That said, since GEM is ultimately a performance-based metric using "binned" sets of technologies, it is difficult for Thermo King to analyze specifically which technologies EPA considers inapplicable to refrigerated vans. [EPA-HQ-OAR-2014-0827-1196-A1 p.2]

Ingersoll Rand requests that EPA specify those technologies which are not applicable to refrigerated vans due to TRU requirements, or otherwise provide clarification to truck manufacturers on the matter. As an example, most gap reducer technologies cannot be implemented in refrigerated vans, as this

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<sup>157</sup> The 2 year payback the agencies reference in our preamble and RIA to this rulemaking is a result of the combined tractor and trailer program costs and benefits. The calculations performed in response to this comment are for the trailer program only, based on the assumptions provided by Stoughton with modifications noted in our response.

would block the required airflow to the heat exchanger surfaces contained within the TRU, which is necessary to provide adequate refrigeration to the trailer's contents efficiently. Ingersoll Rand believes that added guidance from EPA on the specific technologies for reducing emissions and fuel consumption that are applicable to refrigerated vans, as well suggested approaches to meeting these new GEM requirements in refrigerated vans while only using applicable technologies, will go a long way toward ensuring that trucks with refrigerated trailers operate efficiently as a system. [EPA-HQ-OAR-2014-0827-1196-A1 p.2-3]

**Response:**

The agencies are adopting standards with the same stringency between dry and refrigerated vans in each length subcategory. We recognize that most current gap reducers would not be appropriate for refrigerated vans with TRUs, yet several technology combinations exist that can compensate for no gap reducer (see our response to CARB in Section 5.3 on page 980). We designed our standards with example technology packages, but we do not restrict our box van performance standards to any given set of technologies. Manufacturers can choose from many combinations of aerodynamic devices, tire rolling resistance levels, weight reduction options, and tire pressure systems to achieve their desired performance. The agencies cannot create a comprehensive list of technologies that may or may not apply for each trailer design. Instead, we rely on the judgment of trailer manufacturers in coordination with their customers to choose the most effective designs that will meet the requirements of the standards as well as the needs of the customers' applications.

**Organization:** Truck Renting and Leasing Association

We also support: (3) equal focus on the potential fuel economy savings from improvements in the design and aerodynamics of trailers. [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Response:**

The agencies designed the box trailer program to be based on performance standards. As long as a manufacturer can demonstrate improved aerodynamic performance through aerodynamic testing, it does not matter if the improvements were made to the trailer design or achieved with the use of third-party bolt-on devices. The agencies did not have the resources to evaluate trailer design changes in their analysis, but that does not preclude manufacturers from pursuing design changes as part of their compliance plan.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

TTMA is highly concerned with creating and maintaining a safe environment on and off the nation's roadways when it comes to the use of truck trailers. The current voluntary model of Federal GHG & fuel conservation relies on payback to incentivize end users to adopt technologies like aerodynamic features. Such a payback-based feature causes users to avoid the technology in end-use situations where either speeds or loads preclude payback; e.g. if a user needs to leave a pallet off their trailer because the aero devices put them over the weight limit, they will choose not to use them. The proposed rule will, of necessity, force aero devices on end users who otherwise would be avoiding them. For low speed users, this is simply a waste of resources<sup>12</sup>, but for users operating at or near weigh-out conditions, the weight of the aero devices forces more trips as freight has to be hauled on a second load. Those extra trips pose a safety risk which must be accounted for. [EPA-HQ-OAR-2014-0827-1172-A1 p.7]

Estimate of Safety Impact of Deadweight Load of Aerodynamic Devices

Using a 250 lb. weight of aerodynamic devices per trailer, and a cargo load of 50,000 lb. when tractor-trailer is in Weigh-out mode means that the 250 lb. for extra devices will have to be hauled on an additional trip. [EPA-HQ-OAR-2014-0827-1172-A1 p.7]

250 lb add'l / 50,000 lb cargo per Weigh—out Trip = 0.5% increase in Weigh—out Trips

Approximately 30% of tractor-trailers are operating at or near weigh-out conditions.<sup>13</sup>

0.5% increase in Weigh—out Trips x 30% VMT in Weigh—out Conditions = 0.15% increase in Vehicle Miles Traveled (VMT) [EPA-HQ-OAR-2014-0827-1172-A1 p.7]

Annual VMT for tractor-trailers is 122,705 M VMT/year.<sup>14</sup>

0.15% Increase in VMT x 122,705 M VMT/year = increase of 184 M VMT/Year [EPA-HQ-OAR-2014-0827-1172-A1 p.7]

Collision rate for Tractor-trailers is 134/100 M VMT.<sup>15</sup>

Increase of 184 M VMT/Yr x 134 Collisions/100 M VMT = Increase of 246 collisions/year [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

Approximately 3% of Tractor-trailer Collisions involve fatalities.<sup>16</sup>

Increase of 246 collisions/year x 3% Fatality Involvement/Collision = 7 extra fatal accidents per year [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

In general, the safety impact of additional weight on trailers is 1 extra collision per year for every pound of added trailer weight, and one additional fatality-involved crash per year for every 35 pounds additional trailer weight. [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

Note that since the proposal relies heavily on EPA methodology that favors “technology-forcing” regulation, where regulations are formulated to require devices that do not currently exist, the proposal goes beyond NHTSA’s mandate to reduce deaths, injuries and economic losses resulting from motor vehicle crashes. Some of these devices don’t yet exist in a form that would satisfy the proposal, and those that do have potential safety risks that have not been fully explored. [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

### **Weight:**

As described in our Safety Impact section, increased tare weight contributes to increased VMT. While the safety concerns associated with this are our first concern, we ought to consider the fuel consumption and GHG emission effects of these extra trips. This will serve to reduce benefit from applied devices. Similarly, light-weighting trailers will allow more cargo to be carried and thus result in a reduction in VMT and a corresponding reduction in Fuel consumption and GHG emissions. Based on our reading of the EPA documents, the factors applied to weight reduction strategies do not include this effect and most certainly should. [EPA-HQ-OAR-2014-0827-1172-A1 p.17]



**Response:**

NHTSA evaluated TTMA's safety impact analysis. NHTSA recognizes that regulatory and market factors that result in changes in trailer weight can potentially have safety ramifications, both positive and negative. NHTSA believes that the appropriate perspective is to evaluate the regulation and market factors in their entirety. One such factor is that incentives in the Phase 2 regulation could result in an average decrease in trailer weight. Since removing weight from trailers allows more cargo to be carried, fewer trips are needed to move the same amount of cargo, and fewer crashes – including fatal crashes – could occur. Fleets and other customers have a natural incentive to request lighter-weight trailers. From the trailer owners' perspective, reducing trailer weight not only allows them to increase cargo when they are near capacity, but also reduces fuel consumption whether the trailer is fully loaded or not. In pre-proposal meetings with trailer manufacturers, companies said that customers are requesting lighter-weight components when possible and manufacturers are installing them.

To further incentivize a shift to lighter weight materials, the Phase 2 program provides two compliance mechanisms, both of which are discussed in the Preamble (Section IV.D(1)(d) and Section IV.F(5)(d), respectively). The first is a list of weight reductions from which manufacturers can select. The list identifies specific lighter-weight components, such as side posts, roof bows, and flooring. Manufacturers using these lighter-weight components achieve fuel consumption and GHG reductions that count toward their compliance calculations. The NPRM identified twelve components, ranging from lighter-weight landing gear (which receives credit for 50 pounds of weight reduction) to aluminum upper coupler assemblies (which receive credit for 430 pounds). See proposed section 1037.515 at 80 FR 40627. The final program includes additional lighter-weight components. In addition, for a lighter-weight component or technology that is not on the list of specific components, the program provides for manufacturers to use the "off-cycle" process to recognize the weight reduction (Section IV.F(5)(d)). Through these mechanisms, the program provides significant flexibility and incentives for trailer light-weighting.

NHTSA also recognizes that the aerodynamic devices we believe may be adopted to meet the Phase 2 trailer standards inherently add weight to trailers. In comments on the NPRM, TTMA stated that they believe that this weight increase will result in added trips and increased numbers of fatal crashes. By its analysis, this additional weight – which TTMA estimates to be 250 pounds per trailer, will cause some trucks to exceed the trailer weight limits, necessitating additional truck trips to transport freight that could not be moved by the "weighed-out" trucks. By TTMA's analysis, these added trips would cause an additional 184 million truck miles per year and would result in 246 accidents and 7 extra fatal crashes, using an assumed accident rate of 134 collisions per 100 million VMT and a 3 percent fatality rate per accident. The agencies evaluated TTMA's estimate of additional fatalities and disagree with some of the assumptions made in the analysis. For example, the fatality rate used was developed in a study conducted for Idaho and is higher than the national average. According to FMCSA's 2014 annual report for "Large Truck and Bus Crash Facts" indicates there are less than 1.67 fatalities per 100 million vehicle miles traveled (VMT) by combination trucks in the U.S. for 2014. When multiplied by an estimated 184 million additional truck miles due to weighed-out trucks, the result is an increase of about 3 fatalities, or 2.7 fatal crashes.

Overall, the potential positive safety implications of weight reduction efforts could partially or fully offset safety concerns from added weight of aerodynamic devices. In fact, we believe that the Phase 2 trailer program could produce a net safety benefit in the long run due to the potentially greater amount of cargo that could be carried on each truck as a result of trailer weight reduction.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## 5 - SmartWay & Alternative 1

For the purposes of trailer manufacture and end use, the EPA's SmartWay program coupled with voluntary adoption bring the optimal solution to reducing greenhouse gas emissions and fuel consumption in the heavy duty freight sector. [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

Unlike the private car market, heavy duty trailers are used almost exclusively in a very competitive commercial market where fuel costs are second only to labor costs. As such, there is a huge financial incentive for end users to reduce the amount of fuel consumed and incidentally reduce greenhouse gas emissions released during operations. Innovators have been coming up with devices, methods and strategies to accomplish this for decades. These innovations often had varying degrees of actual effect compared to the claimed effect as each innovator would tout their product only in its best light. To complicate matters, not every innovation would be appropriate for every end user's operation. This double level of confusion created a barrier to new products coming into use. [EPA-HQ-OAR-2014-0827-1172-A1 p.8]

SmartWay, when it came on the scene, removed one side of the confusion. By setting a standard to test products against, it allowed end users to remove one layer of variables to be evaluated before selecting a new approach to control fuel consumption. End users could now consider how well their operations would respond to SmartWay verified technologies when making their decisions. In doing so, the adoption of workable fuel savings technologies in areas where they will actually perform was accelerated. [EPA-HQ-OAR-2014-0827-1172-A1 p.8-9]

SmartWay is not perfect. For example, it lacks ability to account for possible savings from tire inflation control strategies, and it's still limited in the types of trailers it considers, only recently expanding into refrigerated trailers. However, a voluntary program manages to get the maximum feasible improvement in fuel economy and greenhouse gas emission reduction without the unintended side effects of inappropriately pushing strategies into areas where they do not have an actual gain. [EPA-HQ-OAR-2014-0827-1172-A1 p.9]

We urge all parties concerned with creating an actual reduction in fuel consumption and greenhouse gas emissions to adopt Alternative 1 with respect to trailers. If the agencies feel the need to regulate, they should direct their regulations at end users who are selecting particular trailers to use with particular tractors for a given cargo and route. While California's blanket requirement for trailers to be SmartWay certified was poorly thought out as to which end users might actually see benefit and which wouldn't and had a host of unintended effects as a result, it was at least aimed at the correct market to effect change. [EPA-HQ-OAR-2014-0827-1172-A1 p.9]

We also note that in the current environment outside of California, end users that could benefit from SmartWay verified aero technologies are already using it. The proposal's cost benefit analysis seems to overlook this important factor. As such, it both undervalues the work that has been done, by failing to note that aero-device adoption is disproportionately adopted in long haul operations and overvalues the proposal by assuming that new devices fitted to trailers that currently don't have them would be used at fleet-average speeds, when that group of trailers are actually running at below average speeds. [EPA-HQ-OAR-2014-0827-1172-A1 p.9]

As we will describe below, any steps to pursue the agencies' goals of improving fuel economy and reducing greenhouse gas emissions must carefully consider areas to exclude and/or exempt from regulation to avoid unintended effects. [EPA-HQ-OAR-2014-0827-1172-A1 p.9]

**Response:**

See our response to Stoughton in Section 5.1 on page 965 regarding non-mandatory standards. See also our response to the TTMA comment in Chapter 1 of this RTC, relating to the statutory authority for the trailer program to focus on trailer manufacturers as the regulated parties.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## 11 - Miscellaneous Points:

## Automatic Tire Inflation Systems:

The definition of ATIS describes a system that does not exist. “Automatic tire inflation system means a system installed on a vehicle to keep each tire inflated to within 10 percent of the target value with no operator input.” State of the art systems only add air to underinflated tires. While overinflated tires do not have a detriment in terms of rolling resistance, they do have problems with accelerated tread wear.<sup>25</sup> As stated earlier, this proposal overlooks the full carbon footprint of the things it’s proposing to regulate. For tires, CO<sub>2</sub> emitted outside of use is 16% of the amount emitted during use.<sup>26</sup> An ATIS system is slated to give a 1.5% reduction in emissions, but if that results in a substantial reduction in tread life, the relative fraction of emissions will balloon to eclipse the savings.

**Response:**

The agencies updated our definition of ATIS and removed the reference to 10% of a target value. In general, manufacturers and users will adjust their ATIS to an appropriate value for their applications and these systems will maintain proper tire pressure. We are not aware of evidence, and the commenter did not provide any, that overinflated tires are a significant problem with use of ATIS and thus that excessive tread wear broadly occurs with these systems.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## Warranty Problems:

The proposal requires that all devices added to trailers be warranted for a period of five years, one year for tires. Such a warranty would be required “to warrant that these components and systems are designed to remain functional for the warranty period.”<sup>28</sup> This has a few significant problems. For tires, some users will wear through their tires in less than a year’s period. With the overinflation problems expected with the widespread adoption of ATIS, we would expect that number to grow. Tire wear must not be covered under any warranty. Speaking of ATIS, the useful life for these systems is on the order of 5 years alone and we are not aware of any system that has a baseline warranty of more than 3 years. The proposed warranty period for ATIS needs to be reduced. Further, the most common problem with aero-devices is with collisions with infrastructure and other road hazards. Any warranty requirement must also exempt collisions and other non-routine use. [EPA-HQ-OAR-2014-0827-1172-A1 p.17]

**Response:**

See our response to the Utility comment in Section 5.1 (page 971) related to damage to aerodynamic devices. See also our response to the emission-related warranty comment from Utility in Section 5.3 (page 990). Finally, see our response to the tire over-inflation comment immediately above on page 1021.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

Unintended consequence: brake/wheel end warming:

Over the history of design of a wheel end for usage on trailers, a continued goal has been to provide for the safest, longest lasting, and cost sensitive components possible. The industry continues to reconfigure the brake drum toward these ends. Consequently the weight of a brake drum has been reduced approximately 18% over the past 30+ years (resulting in reduced fuel consumption and therefore reduce CO2 creation). The proposal may reverse this design due to the need to dissipate heat. The heat is created due to braking action, which up until now was cooled via air flow. The concern with the proposal is that, with added side skirts and wheel deflectors for aero purposes, the air flow across the drum area is minimized resulting in an allowance of temperature increase. One way to manage the temperature would be to add mass to the brake drum, resulting in additional weight, thus conflicting with the intended potential advantages of fuel conservation. If temperature is allowed to build it will affect bearings, lubricant, seals, brake lining, heat treatment of drum in extreme conditions the tire bead could break seal from the rim or the tire could actually ignite and burn the unit to the ground. [EPA-HQ-OAR-2014-0827-1172-A1 p.17]

**Response:**

See our response to the Stoughton comment in this section (page 1010) relating to warming of brakes and wheel ends.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

DOE Super Truck Program

In the DOE Super Truck Program, a truck and trailer were paired together and optimized together as a pair for aerodynamic performance. At the end of this optimization, neither the trailer nor the tractor could be said to be interchangeable with other trucks or trailers. There are truck aerodynamic design specifications or characteristics that can counteract and negate the trailer aerodynamic device fuel savings. The trailer OEM should not be regulated to add aero devices to trailers because the truck, trucks, or variety of trucks, to be used to tow the trailer is not known and such an understanding of the effects of truck aero design and how it affects the aerodynamic characteristics of the trailer is mostly not well understood nor have been shown to be constant or changing over time. [EPA-HQ-OAR-2014-0827-1172-A1 p.18]

**Response:**

The agencies understand that there can be interaction between aerodynamic features of a tractor and those aerodynamic features on the trailer it is towing. We did not base our trailer program on the advanced integrated technologies demonstrated in the SuperTruck program (see our response to UCS on page 1026 regarding SuperTruck). However, the characteristics of the tractors that we assumed in developing the trailer standards, and that we specify for compliance testing, are meant to recognize a reasonable degree of tractor and trailer aerodynamic interaction that typically occurs with real-world tractor-trailers (see also our response to OOIDA on page 1005).

**Organization:** Truck Trailer Manufacturers Association (TTMA)

When push comes to shove, the motor carrier industry is very resourceful and may take action which actually detracts from the overall purpose of reducing CO<sub>2</sub> creation. One such scenario has been experienced in the CARB trailer regulations in the state of California; many shipments have found their way to container/chassis combinations as an over-the-road mode of transportation which will not be required under the current proposal to be equipped with any of the aerodynamic features that trailer manufacturers will have to install on trailers. Cargo containers are also, by common design, inherently less aerodynamic given their ribbed sides and square edges. The combined weight effect of this diversion is a 5,000 lb. increase per container-chassis shipment to the empty weight of the unit of transference. Thus the proposed regulations will create an arbitrary and unreasonable outcome by diverting substantial cargo on a nationwide basis to far less efficient container chassis modes of transportation, and this will significantly undermine the desired goals of the proposal. Container and chassis manufacturers will be unreasonably favored in the marketplace by exclusion from the regulations, while their unregulated products will continue to produce less efficient aerodynamic outcomes than trailers currently in production today. [EPA-HQ-OAR-2014-0827-1172-A1 p.19]

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12 Draft RIA, p2-155 “It can also be seen that very little benefit is seen for tractor trailers driving under highly transient conditions.”

13 “.weigh-in-motion data for 3-S2s indicate that over 70 percent operate at 70,000 pounds gross vehicle weight or less.” (Comprehensive Truck Size and Weight Limits Study, November 2013, Modal Shift Analysis, p8.).

[http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/deskscan/modal\\_shift\\_dksn.pdf](http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/deskscan/modal_shift_dksn.pdf)

14 Base Case for VMT total: 122,705,589,552. Ibid. Table 1, p12.

15 “The rate for tractor-semitrailers was 42/100 million VKT (134/100 million vmt)” (Comprehensive Truck Size and Weight Limits Study, November 2013, Highway Safety and Truck Crash Comparative Analysis, p16.). [http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/deskscan/safety\\_dksn.pdf](http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/deskscan/safety_dksn.pdf)

16 “For example, in Idaho, about 3% of crash involvements for each involved a fatality, about 30-33% included an injury, and the remainder involved only property damage (PDO).” Ibid. p17.

25 TIRE PRESSURE MONITORING AND INFLATION MAINTENANCE Developed by the Technology & Maintenance Council’s (TMC) S.2 Tire & Wheel Study Group; Study Group Information Report: 2010-2. “.10 percent overinflation will reduce tread wear by five percent. ... Overinflated tires are more vulnerable to tread surface cutting, impact breaks, punctures, and shock damage which also shortens tire life.”

26 <http://www.bridgestone.com/responsibilities/environment/mission/emissions.html> Total Lifecycle CO<sub>2</sub> emissions for a tire are 86.4% during use.

28 80 FR 40282

#### **Response:**

The agencies recognize the potential for carriers to shift to use of containers in a situation where container chassis were completely unregulated. However, the agencies are adopting design standards for non-box trailers that require adoption of lower rolling resistance tires and tire pressure systems on all lengths of container chassis. While these non-box standards are not based on adoption of aerodynamic technologies, container chassis manufacturers will have appropriate regulatory requirements and we expect that this will help to limit the shift away from the lighter and more fuel-efficient box vans.

**Organization:** Union of Concerned Scientists (UCS)

#### **LONG DRY VAN AND REFRIGERATED VAN TRAILERS**

The EPA has recognized the benefits of trailer aerodynamics for many years through its SmartWay certification program. Most recently, it has created a new category in this voluntary program, SmartWay Elite, which can achieve 9 percent or more savings in fuel through a combination of aerodynamics and

additional savings from low-rolling resistance tires. In fact, the agencies even note that five manufacturers now offer a total of nine aerodynamic technology packages that meet SmartWay Elite certification. Therefore, it is surprising that the agencies' trailer regulation for van trailers in 2027 does not even achieve, on average, the same level of aerodynamic improvement as these SmartWay Elite packages offer today. [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

In addition to EPA's own work outlined in the RIA on the effectiveness of different trailer packages on the market today, other resources further confirm the conservative nature of the agencies' trailer package. TIAX noted numerous trailer packages that yielded more than 20-percent reduction in CdA (2009). The National Research Council looked at what was already available on the market and anticipated that trailers could achieve as much as a 12.1-percent reduction in fuel in the 2015-2020 timeframe through efficient trailer aero packages (NRC 2010). And the agencies themselves have identified synergistic effects of different trailer technology combinations, suggesting that there is further room for improvement well beyond the first advanced packages certified as SmartWay Elite (Waltzer et al. 2015). [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

As one would suspect, industry is not standing still in light of this potential. Modeling by Navistar's SuperTruck team shows possible reductions in fuel use up to 16 percent from the static aerodynamic package and an additional 2- to 3-percent reduction from dynamic pitch control (Zukowski 2015). Daimler showed a 39 percent reduction in the drag coefficient from trailer technology alone. Peterbilt's advanced trailer led to a 9% reduction in fuel consumption compared to the full SmartWay package, well exceeding SmartWay Elite levels (Damon 2013). A Freight Wing package based on work for the Volvo SuperTruck is being commercially developed and will offer between 12 and 14 percent savings in fuel (Amar 2015). Those are exactly the levels of innovation one would expect from industry when looking out at a longer time horizon, as the preferred alternative does. [EPA-HQ-OAR-2014-0827-1329-A2 p.16]

Further innovation could be developed in a move towards full-vehicle optimization. While this exceeds what is likely to be widely deployed in the timeframe of this rule, moving towards a fully integrated vehicle could lead to even further reductions in aerodynamic drag. Volvo was able to reduce the aerodynamic drag of their SuperTruck by 20 percent through trailer devices alone and 4 percent further by applying modifications to the tractor; however, through even further optimization, they have achieved a 30-percent total reduction in aerodynamic drag and have modeled a path to a 42-percent reduction (Amar 2014). We recommend that the agencies incentivize this approach by crediting tractor manufacturers for tractor-trailer integration, as noted in the section on tractor vehicle standards. [EPA-HQ-OAR-2014-0827-1329-A2 p.17]

All of this evidence speaks to the possibility of a much more ambitious standard for long van trailers. The product cycle for trailers can be much shorter than the tractors that pull them, and there are technologies already available today that can meet the standard the agencies have set for 2027. At a minimum, the More Stringent Trailer Alternative that is part of Alternative 4 is more appropriate, pulling these targets forward to 2024. Furthermore, with 2027 yielding the adoption of many SuperTruck technologies on the tractor side, we would expect SuperTruck trailers to see an even broader adoption in that timeframe, with a target that pushes innovation. A reasonable estimate of the market shift would be to have only 5 percent of the industry as laggards, while 10 percent of the industry could move toward a more fully optimized design (Table 4). This would result in an additional improvement of 0.14  $\Delta$ CdA, up to 1.27 in 2027 for long vans, yielding additional fuel consumption reductions of 1.5 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.17]

Refrigerated long van trailers would see less adoption of the most advanced levels of aerodynamic improvement because of their design but would nonetheless improve up to a  $\Delta$ CdA of 1.13 in 2027 as the market shifted to more advanced designs. However, the agencies should further consider crediting

technologies to improve the efficiency of refrigeration, which results in significant consumption of fuel. [EPA-HQ-OAR-2014-0827-1329-A2 p.17]

However, we think there is further room for advancement beyond the agencies' deployment of a standard skirt and gap reducer. For example, aerodynamic wheel covers are simply deployed and can improve aerodynamics on short and long van trailers alike (e.g., Deflektor, RealWheels). Rear fairings can also be designed in a way that would not prevent their deployment on a middle trailer (e.g., Smart Truck Systems). This suggests that there is still further room for technology development beyond the levels achieved under the More Stringent Trailer Alternative. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

EPA's SmartWay program is also considering the development of a SmartWay certification for pup trailers. Such a program would further incentivize the development of technologies for short van trailers, which again indicates that additional innovation can be found in this sector. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

Given the improvements that will be made to trailer aerodynamic technology for long vans in the time period of the rule, we would again expect levels of improvement in 2024 according to the More Stringent Trailer Alternative, yielding  $\Delta C_d A$  values of 0.26 and 0.20 for short dry van and short refrigerated van trailers, respectively. Incremental improvements to aerodynamic devices can improve these values to 0.30 and 0.24 by 2027. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

#### NON-BOX TRAILERS

The non-box trailer market is much more complex than van trailers due to the much greater rate of customization for specific applications. Furthermore, many of these trailers spend a significant amount of time at lower speed due to either heavy loads or off-road duty cycles. However, that should not preclude the agencies from incentivizing innovative approaches to reducing fuel use by vehicles pulling these trailers. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

The agency's current approach does not provide a path for capturing aerodynamic improvements to non-box trailers, despite ongoing demonstration of its effectiveness. For example, Prime Inc., a for-hire carrier, has designed custom trailer skirts to improve the fuel economy of its flatbed fleet (photo). Freight Wing has tested its aerodynamic devices on flatbed, chassis, and tanker trailers as well, leading to fuel savings of 3 to 6 percent (Freight Wing n.d.). [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

Because the adoption of these technologies is so dependent on duty cycle and still at the nascent stages of development, the agencies should encourage the continued testing and development of such promising technologies. Currently, the agencies have set only a "design standard" for non - box trailers, which means that technology implemented beyond the threshold design is not currently captured, and non - box trailers are excluded from averaging. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

While we recognize that this approach may make sense from a regulatory perspective for the small businesses that manufacture many of these custom trailers, we recommend that the agencies provide an option for manufacturers to include them in the averaging set. Furthermore, aerodynamic devices could be considered as an innovative technology for non-box or non - aero trailers, so an additional incentive to such as a 1.5X or 2.0X multiplier in the Phase 2 timeframe could help bring these technologies to market sooner without significant detriment to the overall environmental benefits of the rule. [EPA-HQ-OAR-2014-0827-1329-A2 p.18]

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Amar, P. 2014. SuperTruck: Development and demonstration of a fuel-efficient class 8 highway vehicle. Presentation at Department of Energy Merit Review, June 19, 2014. Online at [http://energy.gov/sites/prod/files/2014/07/f17/vss081\\_amar\\_2014\\_o.pdf](http://energy.gov/sites/prod/files/2014/07/f17/vss081_amar_2014_o.pdf).

**Response:**

The agencies caution against comparing reported performance from device manufacturers and programs such as SmartWay to the performance we project in this rulemaking. In terms of aerodynamics, most device (and device combination) testing, including SmartWay verification, is performed at one constant speed. EPA's GEM model, which is the basis of our trailer program compliance as well as determination of standard stringency, uses a drive cycle-weighting of 86% (long box vans) or 64% (short box vans) of the miles at 65-mph. As seen in Chapter 2.10.2.1.1 of the RIA to these rules, device combinations with performance similar to SmartWay-Elite technologies will produce CO<sub>2</sub> reductions that are 1% and 2% lower for these long- and short-box van weightings, respectively. Additionally, in contrast to the reductions reported under SmartWay and comparable programs, the agencies report our reductions here relative to a baseline adoption rate we project would be in place without regulation. For long box vans, this includes over 50% of the industry performing at an aerodynamic Bin III (i.e., skirts), almost 50% adoption of ATIS, and a high adoption of SmartWay-level LRR tires. In total, this long box van baseline is a 3% improvement over a no-control long van. This 3% difference, in addition to the 1%-2% difference due to drive cycle, must be taken into account when comparing to published performance data. EPA obtained additional aerodynamic test data since the NPRM and updated the trailer program's aerodynamic bins accordingly. This new data, which includes many SmartWay-Elite combinations, provides a more complete assessment of the performance capabilities of today's box vans.

The agencies value the work accomplished in the SuperTruck program, but it is difficult to separate the combined improvements for these tractor-trailer combinations into the individual tractor and trailer vehicles considered in the Phase 2 program. Tractors and trailers are manufactured by separate companies and the industries are distinctly different. We recognize that each vehicle plays an important role in the performance of the overall tractor-trailer and the performance (or lack of performance) of one can impact the potential improvements of the other. By specifying the characteristics of the tractors that we assumed in developing the trailer standards, and that we specify for compliance testing, the program recognizes a reasonable degree of tractor and trailer aerodynamic interaction that typically occurs with real-world tractor-trailers. However, we did not develop a formal incentive program for manufacturers to address tractor-trailer integration. Instead, manufacturers can petition EPA through off-cycle provisions and may be eligible for credit for innovative strategies that they may develop.

For non-box trailers, the final trailer program does not predicate its standards on the expectation that manufacturers will incorporate aerodynamic technologies on non-box trailers. The agencies are aware that some side skirts have been adapted for the non-box trailers considered in this rule (e.g., tank trailers, flatbed trailers, and container chassis), as noted by the commenter. However, there is currently insufficient information to develop aerodynamic performance standards on these relatively new and untried technologies. We did not receive data to allow us to sufficiently assess the degree of CO<sub>2</sub> and fuel consumption improvement that could generally be achieved across this segment of the industry, the associated costs of these technologies, and especially the likely disproportionate impact on small businesses. In the case of each of the general non-box trailer types included in the trailer program, the range of physical trailer designs is great, including the areas where aerodynamic devices would be installed, and technologies to date tend to be designed for narrow applications. The lack of basic information about the applicability of future technologies for these trailer types also inhibits our ability to estimate costs, either of the specific future designs themselves or of the size of the market for any particular product. As a result, only low adoption rates would be appropriate, and we expect that standards predicated on such low levels of adoption for these trailer types could result in relatively little emission and fuel consumption improvement at relatively high costs.



Moreover, a majority of the non-box trailer manufacturers are small businesses. The agencies have concluded that design standards for these trailers are the only way to ensure we achieve CO<sub>2</sub> emissions and fuel consumption reductions without disproportionately impacting that large fraction of the industry. Consequently, we are adopting tire-technology-based design standards for non-box trailers, as proposed. These design standards may not provide a direct incentive to develop aerodynamic technologies for non-box trailers, but it does not preclude customers from requesting these devices on their trailers.

Non-box trailer manufacturers may include aerodynamic improvements in their future trailer designs, but non-box trailer aerodynamic devices cannot be used for compliance at any point in the Phase 2 program. We do not provide an option for non-box trailer manufacturers to use our off-cycle provisions for innovative technologies, because it is likely that only the largest manufacturers would have the resources to do so. More importantly, we do not have a mechanism to provide additional credit to trailers in a program based on design standards. We will continue to monitor this segment of the trailer industry in this regard and may consider further action in the future.

**Organization:** United Parcel Service (UPS)

#### Trailer Concerns

UPS is not so much concerned about the technical challenges for trailers as the unrealistic cost and adoption rates on components. We anticipate generally an adoption rate of about half what EPA projects and a cost of about twice what EPA foresees. [EPA-HQ-OAR-2014-0827-1262-A1 p.13]

#### **Response:**

The agencies adjusted our compliance costs based on specific information provided by Wabash in their public comments (see our response in Section 5.6 on page 1092) and adoption rates based on a letter from TTMA.<sup>158</sup> However, we cannot justify a sweeping reduction in technology costs without specific information about the technologies the commenter considered. We continue to stand by our estimates, as described in Section IV of the Preamble, which are based on the references cited in Section IV.D and available in the full public record.

**Organization:** Utility Trailer Manufacturing Company

#### **The Proposed Rules' Projected Greenhouse-Gas Reductions Are Based on Unrealistic Assumptions that Fail to Account for Real-World Conditions and that Ignore Increases in Greenhouse Gases Cause by the Proposed Rules**

The Agencies project a 2.35% (2018) to 9.4% (2027) decrease in CO<sub>2</sub> emissions from tractor-trailers by adopting the required technologies. Those technologies yield benefits in two ways: decreasing road friction (through low-rolling-resistance tires; automatic tire-inflation systems; and weight reductions), and decreasing aerodynamic drag (through side skirts, trailer tails, and other air-deflection devices). [EPA-HQ-OAR-2014-0827-1183-A1 p.3]

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<sup>158</sup> Letter, Truck Trailer Manufacturers Association to EPA, October 16, 2014, Docket EPA-HQ-OAR-2014-0827-0146.

The Agencies will never achieve their projected savings attributable to aerodynamic devices. This is because the projected reductions are based on assumptions that are completely unrealistic, do not account for actual conditions operators encounter every day, and ignore the increases in greenhouse gases caused by adopting the Proposed Rules. The **net** savings attributed to aerodynamic devices will be marginal, at best. [EPA-HQ-OAR-2014-0827-1183-A1 p.3]

**Response:**

It is not the agencies' intent or responsibility to project the actual savings for individual vehicles in use. The 2% to 9% emissions decreases are industry-average projected reductions based on our test procedures and driving conditions represented in our model. The assumptions we have built into our projections have incorporated the information available in the public docket for this action, including public comments, for the effectiveness of the likely technologies and their industry-wide adoption rates, as well as accounting for average operational characteristics.

We recognize that the values we projected through this process will not match those of each trailer on the road under their varying technology choices and operating conditions. The values obtained in compliance are meant to provide a relative apples-to-apples comparison between trailers. The majority of the trailers in each of the covered trailer subcategories will experience benefits from these technologies, though the level of the improvement will vary, and the overall fleet-wide benefits should be in the range that we have projected.

In response to the comment about net savings, see also our general response to comments relating to "upstream" or manufacturing emissions in Section 1 and in our previous response on page 970.

**Organization:** Utility Trailer Manufacturing Company

**The Agencies employ unrealistic speed assumptions.**

The Agencies premise their projected aerodynamic savings on a computation concerning how much those aerodynamic devices will reduce drag. Drag reduction, of course, is determined both by how much more efficient the particular device is, and – more significantly – the trailer's speed. As mentioned earlier, because aerodynamic drag is a function of velocity squared, aerodynamic drag forces are not relevant at speeds much below cruising speeds. [EPA-HQ-OAR-2014-0827-1183-A1 p.4]

The Agencies' GEM model, however, computes savings based on the completely unrealistic assumption that trailers travel at the following speeds for the following percentage of time: [EPA-HQ-OAR-2014-0827-1183-A1 p.4]

65 mph cruise — 86%

55 mph cruise — 9%

"Transient" — 5%

On their face, these assumptions bear no relationship to how tractors and trailers operate on America's highways. Nor should they, because in reaching these speed assumptions the Agencies decided to ignore the significant amount of time the tractor/trailers spend idling, thus artificially boosting the percentages of time at higher-speed.[EPA-HQ-OAR-2014-0827-1183-A1 p.4]

It is both meaningless and misleading to compute projected fuel savings (and thus greenhouse-gas reductions) based on this unrealistic speed distribution, particularly when real-world data shows a dramatically different speed profile among trailer fleets. Utility Trailer obtained real-world speed data from four fleets showing the percent of time the fleet's tractor spent at each speed; two of the fleets are long-haul, nationwide carriers traveling both in the United States as well as Mexico and Canada; two are regional fleets for food-service customers. All operate long-box trailers and use a mix of refrigerated and dry-van trailers. Data recorders logged the percentage of time the tractor/trailer was operating at each speed between 0 mph and 70 mph. One of the fleets recorded data for 4,000 tractors operating over a 6-month period; another (with the highest average speed) randomly sampled 15 tractors; and a third provided data for 26 randomly sampled tractors. The fourth fleet did not provide detailed speed data recorded by data recorders; instead, it provided its calculations of the amount of fuel saved at various speeds. This was based on data from 342 tractors, which ran between 69,457 and 2,496 miles, with most travelling roughly 30,000 miles during the time records were kept. [EPA-HQ-OAR-2014-0827-1183-A1 p.4-5]

The real-world speed data the fleets provided to Utility Trailer (denominated Fleet 1, Fleet 2, and Fleet 3) differ dramatically from that the EPA used in its GEM model in generating the assumed savings. The following spreadsheet (and graph) shows the difference. The Agencies based their definition of "transient" on that employed by the California Air Resources Board, which defined "transient" as speeds between 0 mph and 47 mph, with an average speed of approximately 15 mph. For purposes of the speed chart, "transient" is listed in the nearest speed category, 17.5 mph. [EPA-HQ-OAR-2014-0827-1183-A1 p.5]

[Table, '% of Time at Speed-EPA vs. Real-World Data', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1183-A1, and a graph displaying the data can be found on p.6 of the same docket]

What is plain from the spreadsheet and graph is that the GEM assumption concerning the percent of time the tractor-trailers spend at higher speed dramatically exceeds what the real-world data shows. In fact, the weighted average speed of the GEM model equates to 62 mph and the average speed for these three fleets varies from 30 mph to 45 mph. [EPA-HQ-OAR-2014-0827-1183-A1 p.6]

To demonstrate further how far removed the EPA's GEM model speed assumptions are from the real world, one can focus only on Fleet 2, the Fleet that had the highest average speed of the three fleets. As shown in the following graph, the differences persist even with these assumptions favorable to the EPA's GEM model. Even in this fastest fleet, the single fastest tractor sampled was Truck 65000, which spent just 33.18% of the time at 65 mph, compared to 86% for the GEM model. Its average speed was 49 mph compared to the GEM average speed of 62 mph. And the slowest was Truck 651007 at 39 mph. [EPA-HQ-OAR-2014-0827-1183-A1 p.6]

[Graph, showing percentage of time individual trucks in Fleet 2 spent at each speed, can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

In addition to the information from the three fleets just summarized, Utility Trailer obtained information from a fourth fleet. This fleet's data did not show amount of time the tractor-trailer operated at each speed. Rather, the data showed the amount of fuel that fleet's tractors burned at various speeds. Tracking data over a total of 68 weeks encompassing 9.47 million miles, that data showed that 93.8% of the fuel consumed by the fleet was consumed at speeds lower than 55 mph. This confirms the relatively small gains available from tractors operating at higher speeds. [EPA-HQ-OAR-2014-0827-1183-A1 p.7]

The vast difference between the GEM assumptions and what happens in the real world is crucial to assessing the validity of the Agencies' projected CO2 reductions. Tractor/trailers with lower average speeds will benefit less from trailer aerodynamic devices. Additionally, to produce valid data, projected speeds must also account for the routes typically driven by a given fleet. Routes in rural areas are likely to be different from urban routes, and routes along the plains will have a higher average speed than mountainous routes. Differences in state speed limits and typical weather conditions also must be factored in. The Agencies' GEM model accounts for none of these factors. [EPA-HQ-OAR-2014-0827-1183 p.7]

#### **Failure to use real-world speed data overstates the benefits of the Proposed Rule.**

As noted earlier, the calculated emission benefits are based on speed assumptions that are radically different from those exhibited day-to-day on America's highways. By significantly overstating the amount of time spent at high-speed operations, the speed at which aerodynamic devices actually may provide a real benefit as aerodynamic drag at that point is roughly equivalent to the drag from non-aerodynamic friction, the estimates describe benefits that never will be achieved in the real world. [EPA-HQ-OAR-2014-0827-1183-A1 p.15]

#### **Response:**

The agencies have considered these comments from Utility, along with the information that we used to derive the drive cycle weightings in Phase 1. For the Phase 1 program, we developed the sleeper cab cycle weightings (which are also used for long box van trailers in Phase 2) based on three studies that characterized the operation of line haul trucks: An evaluation using the EPA MOVES model, a study conducted by University of California Riverside, and a tire test on line haul trucks conducted by Oak Ridge National Lab.

The following discussion, excerpted from the Phase 1 RIA, Chapter 3.4.3, provides more background on the analysis:

*The distribution of vehicle miles travelled (VMT) among different speed bins was developed for the EPA MOVES model from analysis of the Federal Highway Administration data. The data is based on highway vehicle monitoring data from FHWA used to develop the distribution of VMT among road types from 1999. The information on speed distributions on the different type of roads at different times of day came from traffic modeling of urban locations and chase car data in rural California. This data was used to characterize the fraction of VMT spent in high speed cruise versus transient operation.*

*The University of California Riverside and California Air Resource Board evaluated engine control module data from 270 trucks which travelled over one million miles to develop the heavy-duty diesel truck activity report in 2006. The study found that line haul trucks spend approximately 50% of the time cruising at speeds greater than 45 mph, 10% of time in transient stop-and-go driving, and 40% in extended idle operation. After removing the idle portion to establish weightings of only the motive operation, the breakdown looks like 82% of the time cruising at speeds greater than 45 mph and 18% in transient operation.*

*Oak Ridge National Laboratory evaluated the fuel efficiency effect of tires on Class 8 heavy trucks. The study collected fleet data related to real-world highway environments over a period of two years. The fleet consisted of six trucks which operate widely across the United States. In the Transportation Energy Data Book (2009) Table 5.11 was analyzed and found on average that the line haul trucks spent 5% of*

the miles at speeds less than 50 mph, 17% between 50 and 60 mph, and 78% of the miles at speeds greater than 60 mph. The table below summarizes the studies used to develop the weightings.

Table 3-14: Combination Tractor Drive Cycle Weighting

|           | MOVES |                   | UCR             |                 | Final                |                      |
|-----------|-------|-------------------|-----------------|-----------------|----------------------|----------------------|
|           | All   | Restricted Access | Short Haul      | Long Haul       | Sleeper Cab          | Day Cab              |
| > 60 mph  | 64%   | 86%               | 47%<br>> 45 mph | 81%<br>> 45 mph | 86%<br>65 mph Cruise | 64%<br>65 mph Cruise |
| 50-60 mph | 17%   | 9%                |                 |                 | 9%<br>55 mph Cruise  | 17%<br>55 mph Cruise |
| < 50 mph  | 19%   | 5%                | 53%             | 5%              | 5%<br>Transient      | 19%<br>Transient     |

The fleet data cited by Utility includes weightings of speed records, which represent the fraction of *time* spent at a given speed, as opposed to EPA’s drive cycle weightings based on the fraction of vehicle miles traveled (VMT). Heavy-duty vehicle standards, including trailer standards, are expressed on a ton-mile basis (in contrast to a time basis, such as miles per hour) and, as a result, miles traveled is a more appropriate metric to consider than time traveled. For comparison, the agencies used the vehicle speed information provided in the Utility comments and translated the weightings to a VMT basis. Based on our assessment, when converted to the same metric, Utility’s findings produce weightings that are closer to those we used in developing the standards, showing 80% or more of the vehicle miles traveled by these three fleets are at speeds of 55 mph or higher, with 12% to 20% at speeds lower than 55 mph. We attribute at least some of the difference to the more limited sample represented by the three fleets Utility examined compared to the broader Phase 1 analyses. See our memo to the docket with more information on our drive cycle comparison.<sup>159</sup>

While our proposed drive cycle weightings place a somewhat larger percentage of operation at 65-mph than does the more limited Utility analysis, trailers traveling at speeds of 55 mph will still experience a significant benefit with aerodynamic improvements regardless of the exact weighting. See Chapter 2.10.2.1.1 (including Figures 2-56 and 2-57). Without additional data representative of the range of national fleets, we continue to conclude that the proposed drive cycle weightings (originally developed for tractor-trailers in Phase 1), are appropriate for the Phase 2 program for trailers.

**Organization:** Utility Trailer Manufacturing Company

**The GEM model significantly overstates anticipated aerodynamic savings.**

To estimate accurately the cruise-speed fuel savings of a specific trailer aerodynamic device, first the aerodynamic fuel savings attained at each speed must be multiplied by the average percent of time the

<sup>159</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827, “Comparison of GEM Drive Cycle Weightings and Fleet Data Provided by Utility Trailer Manufacturing Co. in Public Comments”. July 2016.

tractor in a fleet travels at that specific speed. Then, the individual speed savings must be summed to an expected average fuel savings. The Agencies have failed to provide such a study using real-world speed data from in use tractors and trailers. Rather, by using the far-too-high GEM assumed speeds, the Agencies have significantly overstated the anticipated fuel savings from the aerodynamic devices. [EPA-HQ-OAR-2014-0827-1183-A1 p.7-8]

Appendix 1 to this submission describes in detail how the efficiency results were calculated. Using that Appendix, it is easy to track the conclusions stated in Sections 2.2.1 and 2.2.2.

[Appendix 1 can be found on p.27 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

### **Real-world savings from side skirts are substantially less than projected in the GEM model.**

Table 1-1 in Appendix 1 shows the drag force associated with the trailer, and the reduction in drag – projected fuel savings – achievable with side skirts at 19 specific speeds between 0 and 70 mph. That table also shows the minimal savings skirts provide at lower speeds – less than 1% at speeds below roughly 35 mph. [EPA-HQ-OAR-2014-0827-1183-A1 p.8]

Using this projected fuel savings at each speed, it is possible to calculate the weighted average of fuel savings from skirts from the EPA’s GEM model, and for each of the three fleets for which we have real-world speed data. As noted previously, the EPA’s GEM study assumes only three speeds: 65 mph (86% of the time); 55 mph (9% of the time); and “transient” (assumed 17.5 mph – 5% of the time). The weighted average of the fuel savings at each of these speeds is 1.99%, as shown in Table 1-6 in Appendix 1. [EPA-HQ-OAR-2014-0827-1183-A1 p.8]

In contrast, when real-world speed data from the three fleets is used to compute the efficiencies of side skirts, the weighted average savings range between 0.95% (Fleet 1) and 1.43% (Fleet 2), depending on the speed profile of the fleet. See Table 1-6 in Appendix 1. [EPA-HQ-OAR-2014-0827-1183-A1 p.8]

If cruising speeds below 55 mph are ignored, the GEM model fuel savings is reduced slightly compared to the fleet’s fuel savings because the GEM model assumes (9% @55 mph + 86% @ 65 mph)=95% of the time from 55 mph to 65 mph. At 65 mph and above, the cruise speed fuel savings for the GEM model is (1.79%), for Fleet 1 is (0.03%), for Fleet 2 is (0.21%), and for Fleet 3 is (0.54%). So, at this level, Fleet 3 provides greater savings than does Fleet 2. [EPA-HQ-OAR-2014-0827-1183-A1 p.8]

The following table and graph summarizes these comparisons. [EPA-HQ-OAR-2014-0827-1183-A1 p.8]

[Table, '% Fuel Savings - Side Skirts', and Graph, '% Fuel Savings At Cruise Speeds', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

The percentages of time at each speed for each fleet are averages for the entire fleet. Within the fleets, the tractor speeds exhibit substantial variation. As noted earlier, Fleet 2 shows the highest average speed. But even within that Fleet 2, the fuel savings for both the fastest and the slowest tractors are well below the EPA GEM assumptions: [EPA-HQ-OAR-2014-0827-1183-A1 p.9]

[Table, comparing fuel savings from side skirts between fastest and slowest trucks studied and EPA GEM, can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

Even for the tractor that had the highest average speed in the fleet that itself had the highest average speed, the fuel savings nowhere approximate those of the GEM model. [EPA-HQ-OAR-2014-0827-1183-A1 p.10]

**Real-world savings from side skirts combined with trailer tails are substantially less than projected in the GEM model.**

The EPA's model assumes that combining side skirts with trailer tails yields the most significant aerodynamic savings. According to the EPA, the skirt/tail combination produces a fuel savings of 5.56%. Again, this conclusion depends upon the GEM model's assumption that the tractor-trailer travels at 65 mph 86% of the time, and at 55 mph another 9% of the time. [EPA-HQ-OAR-2014-0827-1183-A1 p.10]

The following table shows the fuel reductions as calculated by the EPA and as determined using real-world data.<sup>5</sup> When actual speed data from the three fleets is used, the efficiency savings attributed to the skirt/tail combination drops by 28%, 35%, or 52% from the EPA estimates for 0–70 mph, depending on which fleet is used for comparison to the EPA's GEM-model projections. In addition, they all are less than 3.5% at 55–70 mph, and less than 1.25% at greater than 65 mph, all under *ideal* conditions.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1183-A1 p.10]

[Table, comparing fuel savings from side skirts and trailer tails between three fleets studies and EPA GEM, can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

The fuel savings generated from the combination trailer skirt and trailer tail, even under ideal cruising speed conditions, are very likely too small to be measurable in the field. [EPA-HQ-OAR-2014-0827-1183-A1 p.11]

But even these extremely modest fuel-efficiency gains overstate the results that will occur when the technology is actually mounted on trailers. Putting aside the fact that the estimates assume, unrealistically, that all trailers operate at optimum cruise conditions – level roads, no speed changes caused by traffic fluctuations, perfect weather, and the like – these estimates fail to account for human behavior: drivers do not want to deploy the trailer tails. [EPA-HQ-OAR-2014-0827-1183-A1 p.11]

Fleet 1 and Fleet 2 recently have installed trailer tails on many of the trailers in their fleet; one of the fleets has used auto deploy. But in both instances, the tails are not routinely deployed. A survey recently completed reported that the trailer tails were not deployed 58% of the time, even with auto deploy. This means that the drivers may be disabling the auto deploy feature and or the feature is still not reliable. A different fleet with trailer tails without auto deploy reported that the tails were not deployed over 20% of the time. [EPA-HQ-OAR-2014-0827-1183-A1 p.11]

The reason for the significant incidence of nonuse is that drivers consider deploying the tail to be a nuisance. Even with the auto-deploy feature, retracting the tail remains a chore for the driver since retraction is not automatic. More importantly, fleets often hold the drivers responsible for any damage to the tractor or trailer; drivers cannot see the tails when deployed, and the tails are easily damaged by both the trailer they are attached to and by the trailers parked adjacent to them. [EPA-HQ-OAR-2014-0827-1183-A1 p.11]

When other real-world factors are to be included, like the percentage of time that tractors accelerate or drive on significant road grades, in traffic, poor road conditions, etc.; the amount of fuel used for only ideal cruising conditions would diminish and so would the fuel savings and GHG emissions for a given

trailer aerodynamic device. Because of these varying factors and a small predicted fuel savings under ideal conditions that are not measurable, it would be better for the Agency to continue its voluntary program in regards to trailer aerodynamic devices. [EPA-HQ-OAR-2014-0827-1183-A1 p.11-12]

**Response:**

As discussed above in our drive cycle speed comparison, we converted the Utility data to a common metric and have concluded that the Phase 1 tractor-trailer analyses of average drive cycle weightings remain sufficiently robust to use for the Phase 2 trailer analyses. The three individual fleets that Utility analyzes are probably not atypical, but their experience does not disprove the agencies' overall conclusions about average tractor-trailer operation. For this reason, the subsequent analyses that Utility performed and presents in this comment, premised as they are on this limited sample, do not provide a meaningful counter to the agencies' broader analyses.

Further, the Phase 2 trailer compliance equation (which is based on GEM) is not a test for aerodynamic performance. Aerodynamic performance (as  $\Delta C_dA$ ) is measured using wind tunnel, coastdown or CFD test procedures. Users submit aerodynamic performance data as an input to the equation, and the overall performance of the vehicle is calculated.

Within GEM, the simulated vehicle is driven over three drive cycles: 65-mph cruise, 55-mph cruise, and a transient drive cycle. As discussed in RIA Chapter 3.4.2.1, the two cruise speeds account for grade changes, and the transient cycle involves stops and starts with accelerations and decelerations to several different speeds. The commenter is consequently mistaken in asserting that these phenomena are unaccounted for in GEM.

In response to the comment about frequency of deployment of current trailer tails, we observe that trailer tails are used on a very small fraction of box vans today, and that experience by fleets and drivers is limited at this point. However, we expect that the growing direct and indirect experience with these devices across the industry, as well as likely design improvements that ease deployment for operation as well as ease the collapsing of the devices at loading docks, and will tend to increase proper use of these devices in order for the fuel saving benefits to be achieved.

**Organization:** Utility Trailer Manufacturing Company

**Failure to consider the need to replace and repair the drag-reduction technologies overstates the benefits of the Proposed Rule.**

The Agencies' estimates understate the costs by failing to account for the emissions associated with replacing the items and repairing damaged trailers. At the more micro level, the touted cost-benefit calculation for the owner – savings in two years will pay for the devices – also is inaccurate in that the calculation does not account for the cost of replacing items or repairing trailer damage. Moreover, virtually none of those operators will see the fuel-reduction benefits described in the Proposed Rule for the reasons described previously. [EPA-HQ-OAR-2014-0827-1183-A1 p.16]

Additionally, the Proposed Rule fails to account for the costs associated with increased tire wear for low-rolling-resistance tires. Because low-rolling-resistance trailer tires are stiffer, they wear faster due to tire scrubbing, curbing, and other wear and tear. Scrubbing is a particular problem for the long-box trailers, as the "long wheel base" provides sufficient mechanical advantage, or leverage, to the tractor to easily scrub the trailer tires with a standard 49-inch axle spread and even an optional 121"-axle spread. Also, urban routes with tighter maneuvers are more susceptible to scrubbing. The stiffer low-rolling-



resistance trailer tires are likely to be more vulnerable to wear under these conditions. The TMC, the maintenance council division of the American Trucking Association recently published their findings on LRR tire wear for tractors and trailers where they report that low-rolling-resistance trailer tires are wearing sooner than conventional standard tires.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1183-A1 p.16]

[Graph, 'Trailer Tire Mileage', can be found on p.17 of docket number EPA-HQ-OAR-2014-0827-1183-A1]

Standard trailer tires outperformed low-rolling-resistance trailer tires by an average of 4,000 miles. Increased tire replacement or retreading and replacement will contribute to greenhouse-gas emissions and mitigate the emission reduction from claimed from using low-rolling-resistance trailer tires. The Agencies have failed to consider this in their GEM Model and Proposed Rule. [EPA-HQ-OAR-2014-0827-1183-A1 p.17]

**Response:**

EPA has not included maintenance costs associated with aero treatments on trailers due to lack of data that could be used to support the estimates. Some commenters provided estimated annual values, but did not provide data to support their estimates. It is possible that their estimates are based on anecdotal evidence of a small number of problem installations rather than an average of all trailers equipped with aero treatments. Without such more robust information, we continue to conclude that overall maintenance costs are negligible. Our understanding is that the majority of routine maintenance includes, at most, minor actions like tightening of bolts, and that any additional costs would be minimal.

The agencies are familiar with the TMC reference cited by Utility and recognize that this report showed that standard tires outperformed LRR tires for trailers.<sup>160</sup> However, we have two concerns with the report's results. First, the fleets were asked to indicate mile ranges in 50,000 mile increments, which makes it difficult to see how an average of 4,000 miles was obtained and whether this is a significant difference. Second, the report did not provide any indication of maintenance that may or may not have been performed. It is possible that properly maintained tires would show no difference.

The agencies agree that trailers with large axle spreads are more susceptible to scrubbing and we are adopting provisions to exclude trailers with axle spreads greater than 120 inches (see 40 CFR 1037.5(h)).

**Organization:** Utility Trailer Manufacturing Company

**AUTOMATIC TIRE INFLATION IS UNNECESSARY.**

Even with an automatic tire-inflation system, a prudent operator should check tire pressure manually. This is because systems become damaged, because the systems are not foolproof, and because at times the systems add pressure to cold tires, but the pressure increases beyond the recommended maximum level as the tires heat during normal operation. Only by checking the tires manually can the operator be sure that the tires are actually at optimal pressure. [EPA-HQ-OAR-2014-0827-1183-A1 p.18]

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<sup>160</sup> Parks, Jim. "TMC Survey Reveals Misinformed View of Fuel-Efficient Tires". March 2015. TruckingInfo.com. Available in Docket EPA-HQ-OAR-2014-0827 or online at: <http://www.truckinginfo.com/article/story/2015/03/tmc-tire-survey-reveals-discrepancy-in-fleet-view-of-fuel-efficient-tires.aspx>.

Of course, many trucking fleets already have incorporated ATI systems in their trailer fleets, and they have invested the facilities and expertise to manage them properly. They believe that it is easier on drivers and saves tire wear. But this is not a reason to foist the system on all operators, particularly when prudent operators will check pressure manually in any instance. [EPA-HQ-OAR-2014-0827-1183-A1 p.18]

Additionally, most of the automatic-tire-inflation systems on the market only add air to the tires; they do not remove the air when the tires are overinflated. But as noted, overinflation is a concern when air is added to tires that are cold. Overinflation, however, increases the rate of tire wear, which increases net greenhouse-gas emissions. [EPA-HQ-OAR-2014-0827-1183-A1 p.18]

The Agencies have not demonstrated that the tire-inflation systems will generate sufficient savings verses the manual method to justify their adoption, nor have they considered the erosion of any benefits that will occur as the systems overinflate tires and decrease tire life, resulting in increased greenhouse-gas emissions. For this reason, Utility Trailer urges the Agencies to remove automatic tire inflation system from the proposed EPA Phase 2 Rules. In other words, the term “• C5” at the end of the equation should be removed, and the maximum “eC02” grams per ton-mile should be adjusted up to compensate equivalently. [EPA-HQ-OAR-2014-0827-1183-A1 p.18]

**Response:**

The performance standards for box vans are based on use of ATIS, but do not require any specific technology be applied. Manufacturers have the option to install any combination of aerodynamic, LRR tires, tire pressure systems, or weight reduction to meet the standards. The agencies are including ATIS as an option for compliance in our Phase 2 program as a means to ensure proper inflation and rolling resistance.

Regarding the potential for tire over-inflation with ATIS and possible consequences, please see our response to the comment from TTMA on this subject earlier in this section 5.4 (page 1021). Additionally, the final trailer program provides for manufacturers to install either TPMS or ATIS as a part of compliance. Manufacturers can offer box van customers that are confident in their drivers' tire maintenance the option to choose no tire inflation or TPMS instead of ATIS. The final design standards for non-box trailers do require the use of LRR tires and a tire inflation system, but they can choose either TPMS or ATIS, and the trailer program does not require a specific make or model for these systems; manufacturers can already choose from several options on the market today, and these choices may expand as the program phases in.

**Organization:** Utility Trailer Manufacturing Company

Manufacturers should be given credit for net weight reductions, regardless of whether the weight reductions are attributable to switching to aluminum components.

The Regulatory Impact Analysis focuses on weight savings in trailers by substituting aluminum for steel components, although other portions of the Analysis recognize that weight savings are possible with high-strength steel or other materials. Aluminum, though lighter than steel, often is not the best material for a given application, since it only has approximately one-third the stiffness and lower yield strengths than steel. Manufacturers are in an excellent position to determine the best materials for their trailers and the stresses those trailers will encounter. They should be encouraged to reduce the weight of their trailers, while maintaining strength and longevity. Accordingly, since the Agency associates weight reduction with fuel-efficiency savings, manufacturers should be given credit for any weight savings in

their trailers, regardless of whether the savings come from redesign or substitution of materials, and if from substitution of materials, regardless of whether the previous material was steel, or whether the new material is aluminum, high-strength steel, plastic, or any other weight-savings material. [EPA-HQ-OAR-2014-0827-1183-A1 p.24]

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5 These calculations are described in Appendix 1 – using real-world speed data from the three fleets – at various speeds.

6 Utility Trailer developed this information in the same way as it developed the statistics for efficiency of trailer skirts, but it reduced the drag coefficient to 0.423, the appropriate number with 0-degree yaw as determined by the computational fluid dynamic analysis performed by Exa Corporation.

**Response:**

We did not propose, but after further consideration in response to similar comments, we are finalizing a provision that makes the existing off-cycle process available to trailer manufacturers that wish to demonstrate design improvements by means not currently available in GEM (or the GEM equation). We have outlined steps for evaluating lightweight components or designs that are not listed in our current lightweighting tables. (See Preamble Section IV.F.5.d). Additionally, manufacturers have the option to use a different test procedure, with advance EPA approval, that they believe will effectively capture the benefits of their new design. See 40 CFR 1037.61

**Organization:** Wabash National Corporation

**Wabash Supports EPA’s Proposed Bins for Trailer Aerodynamic Technologies, But Adjustments Are Needed for Bin VIII**

To evaluate performance and cost of certain aerodynamic technologies, EPA and NHTSA identified “packages” of individual or combined technologies that are being sold today on box trailers. The agencies also identified distinct performance levels, or “bins,” for these technologies based on EPA’s aerodynamic testing. Table IV-4 in the Phase 2 Proposed Rule illustrates the bin structure that EPA and NHTSA are proposing for trailer compliance. Sample technologies for a 53-foot dry van in each bin include: (1) Bin I – No Aero Devices; (2) Bin II – Gap Reducer; (3) Bin III – Basic Skirt or Basic Tail; (4) Bin IV – Advanced Skirt or Tail; (5) Bin V – Basic Combinations; (6) Bin VI – Advanced Combinations (including SmartWay Elite); (7) Bin VII– Optimized Combinations; and (8) Bin VIII– Changes to Trailer Construction. [EPA-HQ-OAR-2014-0827-1242-A2 p.14]

With respect to Bin VIII, EPA must recognize that potential changes to trailer construction are limited by other regulatory requirements, including NHTSA safety standards and Department of Transportation (“DOT”) length and height requirements. Trailer manufacturers’ design innovations are limited both by regulatory requirements and by the market demand that payload capacity not be reduced. On the other hand, trailer manufacturers are able to introduce some innovations within those constraints and should be rewarded for doing so. Manufacturers should have the option to demonstrate their improved designs and be able to enter different inputs into GEM accordingly. [EPA-HQ-OAR-2014-0827-1242-A2 p.14]

**Response:**

The agencies have reevaluated our proposed aerodynamic bin structure for trailers based on the use of wind-averaged CdA and new test results obtained following the publication of the NPRM. The most notable difference is that we expanded the width of the lower bins. The NPRM Bins III, IV and V were reduced to two bins. Bins V, VI, and VII are identical to the highest bins from the NPRM (NPRM bins

VI, VII, and VIII). See Chapter 2.10.2.1.3 of the RIA. See our response to CARB in Section 5.3 on page 980 for an expanded description of our bin adjustments. In adjusting the bins, we have also better aligned the technologies we expect will fit in those bins based on our test results.

We are maintaining a “future” aerodynamic bin (Bin VII), but we are not aware of any current technology packages that can achieve the performance of such future designs. These designs may be changes to construction, within the limits of existing regulations, or could be newly designed components. The final trailer standards are not predicated on the use of any such future aerodynamic design changes. We did not propose, but are finalizing an off-cycle option for trailer manufacturers that wish to demonstrate design improvements by means not currently available in GEM. We have outlined steps for evaluating lightweight components or designs that are not listed in our current lightweighting tables. Additionally, manufacturers have the option to use a different test procedure, with advance EPA approval, that they believe will effectively capture the benefits of any new designs. See 40 CFR 1037.610.

## 5.5 Exclusions and Less-Stringent Standards

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Short and non-box trailers

The proposal requires 4.8% and 4.6% fuel consumption reduction in 2027 from short dry vans and short reefers, respectively. The agencies projected 2027 adoption of 95% Level II tires and automatic tire inflation (ATI) can provide almost 3% fuel savings, more than half of the 2027 target. At the same time, based on industry effectiveness estimates<sup>16</sup> and the agencies’ bin adoption assumptions (30%, 60% and 10% for Bin II, III, and IV, respectively), these short trailers can achieve 4.4% fuel savings in 2027. Thus the 2027 requirements can be nearly met with aero technologies alone. Hence the total potential for fuel consumption from improvements in short trailers exceeds the proposed standard by more than 50%, and we would encourage the agencies to strengthen the 2027 requirements in order to drive advanced aero technologies for these trailers. With regard to non-box trailers, the proposed standards for 2027 would require improvement only in tires. We urge the agencies to consider adopting basic aero devices for non-box trailers in this timeframe. [EPA-HQ-OAR-2014-0827-1280-A1 p.18]

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<sup>16</sup> <http://www.arb.ca.gov/msprog/tech/techreport/epdo ve tech report.pdf> (P. III-4)

### Response:

See our response to CARB’s comment on the updated bin structure in Section 5.3 on page 980 and Chapter 2.10.2.1.3 of the RIA. It is important to clarify that the projections of adoption rates on which we base our performance standards are not “requirements” for box vans. The standards are designed to give manufacturers the flexibility to choose from multiple technology combination options to comply. It is possible that, in some model years, a manufacturer will be able to meet the required performance standard without certain technologies (i.e., large amounts of weight reduction, tires with very low rolling resistance, and ATIS could make up for use of aerodynamic improvements). See our memo to

the docket outlining possible combinations that can be used to meet the MY 2018 and MY 2027 standards.<sup>161</sup>

The agencies adjusted our short trailer aerodynamic technology adoption rates based on test data obtained following the NPRM. Our final MY 2027 standards for short box vans are based on 60% adoption of technologies in the new Bin IV, which is equivalent to NPRM Bin V and a significant strengthening of the stringency from that proposed. While we did not observe any technology combinations that meet this bin in our testing, we note that our short box van results are based on a limited number of data points. We believe that additional technology combinations already exist in the market, beyond what we evaluated in our testing, that perform close to Bin IV and it would only be a matter of optimizing those combinations to fully achieve Bin IV. Since many of the current technologies are simply modified from versions of those made for 53-foot vans, we are confident that, over the next 10 years, this program will provide an incentive for trailer and aerodynamic device manufacturers to develop new technologies specific to short box vans that can achieve Bin IV. We also reiterate that the adoption rates projected by the agencies are only one option manufacturers can use to meet these performance standards. Weight reduction, which is more effective on short box vans, can be used in place of aerodynamic improvements, or that less aerodynamic improvement than projected could be used with weight reduction making up the difference. See Chapter 2.10.2.5 of the RIA.

We did not propose standards predicated on aerodynamic technologies for non-box trailers. The agencies concluded that much more information would be needed to have proposed such technologies that are in their infancy, but we will continue to consider them as a part of potential future action. See our response to UCS in Section 5.4 on page 1026.

**Organization:** American Trucking Associations (ATA)

**Additional Trailer Exclusions are Needed for:**

Jeep, Dolly, and Load Divider: A trailer composed of a trailer chassis and one or more axles, with no solid bed, body, or container attached, and which is designed exclusively to support a portion of the load on a trailer or truck. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Heavy-Haul: Any trailer that has a gross vehicle weight rating (“GVWR”) of more than 120,000 pounds or any trailer equipped with an axle that has a gross axle weight rating (“GAWR”) of 29,000 pounds or more. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Expandable: Any trailer that has a width of more than 102.36 inches with extendable equipment in the fully retracted position and is equipped with two short track axles in a line across the width of the trailer. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Extendable: Any trailer that has air lines designed to allow extension of the vehicle frame or load deck. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Modular: Any trailer that has air lines designed to allow separation and removal of deck sections or insertion of deck sections to create longer or shorter load carrying areas. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

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<sup>161</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. “Example Compliance Scenarios for the Final HD GHG Phase 2 Trailer Program” August 2016.

Sliding: Any trailer that has an undercarriage system designed to move forward or back to allow the load deck to tilt, slide, or adjust into a position that facilitates the loading or unloading of equipment but must return to original position for transport. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Multi-Axle: Any trailer that has two or more permanently attached axles (including lift axles) and designed to accept additional removable axles, flip axles, and/or load transferring boosters; both mechanical, hydraulic, or air (or other gas). [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Dump: An open-topped trailer having a load-bearing container body structure with a hydraulic cylinder that allows the container to be tilted to discharge its contents through an open tailgate that is used in short-haul transport of construction, paving, demolition and other bulk materials such as sand, gravel, asphalt, sludge, scrap metal, farm products etc., from off-road mine/pit loading sites to off-road construction unloading sites. [EPA-HQ-OAR-2014-0827-1243-A1 p.25]

Refuse Transfer: A usually open-topped trailer having a load-bearing container body structure that can be tilted on an external hydraulic tipping platform or equipped with a self-unloading floor to discharge its contents through an open tailgate that is used in short-haul transport of refuse material (garbage) from off-road transfer station loading sites to off-road landfill unloading sites. [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

Lift Gate Equipped: Rail lift and lift gate equipped trailers operate at low speeds and perform local deliveries. As such, they ought to be classified as “non-aero” based solely on the inclusion of a lift. [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

Multi-Temp Food Service: Typically has a compartment in the nose of the trailer that takes up the full width with two narrow compartments behind it. The two narrow compartments can be unloaded through the rear door but the front compartment requires unloading through a side door. [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

Roll-Up Doors: Trailers utilizing rear roll-up doors should be given a partial or qualified exclusion from the aerodynamic requirements until an effective, durable and cost efficient product is available which is compatible with these types of rear frame designs [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

**Response:**

We recognize that many trailers in the proposed non-box subcategory have unique physical characteristics for specialized operations that may make use of lower rolling resistance (LRR) tires and/or tire pressure systems difficult or infeasible. Instead of focusing on trailer characteristics that indicated off-highway use, the agencies have identified three specific types of non-box trailers that represent the majority of non-box trailers that we believe are designed for and mostly used in on-road applications: tanks, flatbeds, and container chassis. We believe that customers purchasing tanks, flatbeds, and container chassis will see an in-use benefit from using these tire technologies. Consequently, the final program as it applies to non-box trailers is limited to tanks, flatbeds, and container chassis. All other non-box trailers, about half of the non-box trailers produced, are excluded from the Phase 2 trailer program, with no regulatory requirements.

Most of the trailer examples provided in the commenter’s list would be excluded under these final provisions. However, the comment did not include sufficient information to justify a blanket exclusion of trailers with GAWR of 29,000 lbs, lift gates, multi-temp compartments, or roll-up doors. We do not know an average axle weight rating of different trailer types or the fraction of the industry that exceed

29,000 lbs today to determine whether customers would simply ask for a greater weight rating to avoid standards. Similarly, the comment did not provide data to support the claim that lift gates and multi-temp compartments indicate trailers commonly used at lower speeds where no technologies would be useful.

As noted in our responses to STEMCO in Section 5.2 (page 976) and FedEx in Section 5.4 (page 999), we are adopting an interim provision to recognize roll-up doors as work-performing equipment until MY 2024. We expect this provision will provide an incentive for device manufacturers to continue to develop and improve aerodynamic technologies that are appropriate for roll-up doors, but will allow manufacturers time to obtain, become familiar with, and prepare to market these technologies to their customers.

**Organization:** Environmental Defense Fund (EDF)

We are also concerned that the decision to exempt container trailers from the standards would create a potential loophole that could erode the overall benefits of the trailer program. The number of container trailers is growing and becoming a larger percentage of total trailer miles, with containers being used for longer delivery routes, displacing the use of traditional trailers. We understand the challenges of including containers under the standards, but we encourage the Agencies to develop a workable solution to this problem. [EPA-HQ-OAR-2014-0827-1312-A1 p.36]

**Response:**

The agencies are adopting design standards for non-box trailers, which include container chassis of all lengths, based on adoption of LRR tires and tire pressure systems. See also our response to the TTMA comment relating to container chassis in Section 5.4 on page 1023.

**Organization:** Great Dane

While we recognize that many fleets successfully employ skirts, we agree with the agencies that certain fleet specifications lead to the use of “work performing devices” (WPD’s) such as sidedoor steps, platforms, ramps and liftgates that preclude the use of skirts, and this does not afford those operators the opportunity to utilize skirts for fuel savings. We further note a high correlation of trailers with these specific WPD’s in the population of trailers used in “foodservice” applications delivering to restaurants, schools, hospitals and other commercial establishments. These food service trailers are generally built to allow transportation of goods at multiple temperatures. This usually requires side doors and other associated WPD’s to operate efficiently and avoid delivery by multiple single temperature trailers. Our records indicate that there is a high correlation between trailers utilizing multiple refrigeration evaporators and side doors, and those specific WPD’s to allow “multi temp” food service operations involving the delivery and unloading of goods thru the trailers’ side door or side doors from the trailers’ interior compartments. [EPA-HQ-OAR-2014-0827-1219-A1 p.2]

We note that most food service fleets specify trailers with overhead or “roll up” rear doors as opposed to the more common swinging type doors. We believe that these fleets purchase and maintain these rear doors at a premium over swing type doors in order to be able to deliver goods thru the rear door opening, typically via a “walk ramp” used by the driver or assistant when the trailer is in tight confines such as alleyways and parking lots. Such trailer specifications do not lend themselves to the use of rear aero devices or treatments, and we believe that food service fleets operate their trailers in local or at longest regional and then local delivery modes at generally lower speeds than traveled by longhaul fleets. Thus, we believe that food service trailers as characterized by multiple refrigeration system

evaporators should be exempted from any trailer aero requirements, as the WPD's generally present on both the sides and rear of these trailers in addition to the roll-up doors and low speed operations we believe to be typical in those fleets hinder or preclude cost effective aero use. [EPA-HQ-OAR-2014-0827-1219-A1 p.3]

We agree with language in the proposed regulations that states there is consideration by the agencies of trailers "that have work-performing devices in two locations such that they inhibit the use of all (emphasis added) practical aerodynamic devices be considered "non-aero" box trailers." We note that these WPD's, whether installed by the trailer OEM, the customer or a third party, are there to increase the efficiency of the trailer and agree that such trailers should be exempted from aero requirements. [EPA-HQ-OAR-2014-0827-1219-A1 p.3]

The agencies have calculated and analyzed the impact on the industry based their understanding of the costs of the technologies, expected market penetrations and the fleet operational parameters such as speeds and distances traveled. As noted above we believe that certain trailers operate in regional or local delivery modes and thus we do not believe that such trailers benefit substantially from trailer aero, negating those fleets' abilities to achieve sufficient return on those investments. We note that some trailers are equipped with rear mounted lift devices, installed by the trailer OEM, a third party or by the customer, to allow loading or unloading of freight independent of a loading dock. We believe that such trailers operate primarily in lower speed operations than fleet long haul operations and we believe that such trailers should be exempted from any trailer aero requirements. [EPA-HQ-OAR-2014-0827-1219-A1 p.3-4]

**Response:**

The trailer program recognizes the potential for trailer WPDs to interfere with or prevent the use of some aerodynamic devices, and provides for trailers with WPDs to be designated as partial-aero or non-aero and be subject to less stringent standards. The agencies expect many box vans with roll-up doors will include additional features that would qualify these trailers for a partial- or non-aero designation. However, as noted in our responses to STEMCO in Section 5.2 (page 976) and FedEx in Section 5.4 (page 999), we are adopting an interim provision to recognize roll-up doors as work-performing equipment until MY 2024. We expect this provision will provide an incentive for device manufacturers to continue to develop and improve aerodynamic technologies that are appropriate for roll-up doors, but will allow manufacturers time to obtain, become familiar with, and prepare to market these technologies to their customers.

**Organization:** International Council on Clean Transportation (ICCT)

Compliance and real-world validation

Per agency discussion within the proposed rulemaking, there appear to be some discrepancies across various companies regarding the precise times when model years fall within a given calendar year (e.g., engines within tractors could have differing model years). Importantly, the agencies' analysis is based on a thorough investigation of the ability to introduce, and deploy in larger percentages, technologies in future years. We support the agencies approach to technology implementation timing, without including any delay in implementation due to industry-adopted convention for model years that differs across various regulated vehicle and engine manufacturers. Especially considering companies' latitude in selling products of given model years, that are independent of calendar year, any delay in technology deployment or stringency determination due to how companies' decisions about naming and marketing products by model year would be unwarranted. [EPA-HQ-OAR-2014-0827-1180-A4]



**Response:**

Consistent with Clean Air Act requirements and implementing rules<sup>162</sup> EPA's vehicle certification is an annual process. EPA CO<sub>2</sub> emissions standards start to apply for trailers built on or after January 1, 2018, with later standards being introduced by model year. Under the Clean Air Act, the term "model year" refers to a manufacturer's annual production period. Manufacturers may use the calendar year as the model year, or may choose a different period of production that includes January 1 of that year. Thus, manufacturers have the option to choose any year-long period of production that begins on or before January 1 of the named model year, but no sooner than January 2 of the previous calendar year. For example, at certification, a manufacturer could specify the 2021 model year production period to be July 1, 2020 through June 30, 2021. We believe this definition provides manufacturers some flexibility in the release date of their new trailers, but ensures a level of consistency between manufacturers for regulatory purposes.

**Organization:** SABIC Innovative Plastics US LLC

Likewise, the agencies propose using several yaw angles to better approximate highway and wind conditions that introduce drag on the side areas of the vehicle. It is particularly important to account for lateral yaw in this rulemaking because of the relatively large lateral areas of a tractor-trailer combination. As Exa Corporation testified at the Long Beach public hearing: [EPA-HQ-OAR-2014-0827-1207-A1 p.3]

Because of the significant impact to real world efficiencies due to wind yaw effects; we feel it is imperative that wind effects be part of the standard ...<sup>4</sup> [EPA-HQ-OAR-2014-0827-1207-A1 p.3]

The agencies note that a 'wind averaged drag coefficient is about 15 percent higher than the zero degree coefficient of drag.' This is directionally consistent with findings from SABIC's work with Exa to model the aerodynamic benefits of the optimized Class 8 Day Cab roof fairing.<sup>6</sup> That research showed an 8-10 percent higher wind-averaged drag coefficient, based on the use of both zero degree and 6 degree yaw in CFD modelling.<sup>7</sup> We believe the proposal to include yaw effects in CFD modelling for Phase 2 will result in more realistic estimates of on-road aerodynamic performance. [EPA-HQ-OAR-2014-0827-1207-A1 p.3-4]

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4 Testimony of Kevin Golsch, Exa Corporation, U.S EPA Public Hearing on Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 18, 2015.

6 Pereira, C. et al., Drag Reduction through Optimization of an Aerodynamic Day Cab Roof Fairing, SAE 2015 Commercial Vehicle Engineering Congress, October 6-8, 2015, 15CVA-0026 2015-012892 PPRES.

7 U.S. EPA, NHTSA, Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (Phase II), Draft Regulatory Impact Analysis, EPA-420-D-15-900 (June 2015), pp. 2-19 and 2-20.

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<sup>162</sup> See, e.g. CAA section 206 (a) requiring certification for section 202 standards; since the standards here apply model year by model year, annual certification is required.

**Response:**

The agencies evaluated the aerodynamic test data for our trailer program and concluded (consistent with this comment) that wind-averaging is able to better capture aerodynamic improvements from many devices, including several small-scale devices. We are adopting a wind-averaged approach for aerodynamic testing in the trailer program. See RIA Chapter 2.10.2.1.2.3.

**Organization:** STEMCO

STEMCO supports excluding trailers with work-performing devices from a portion of the compliance requirements as long as those devices are purchased primarily for their work performing purpose. [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

Work-performing devices

STEMCO agrees that work-performing devices such as rear-mounted lift gates and drop-deck trailer designs should qualify a trailer for a reduced “partial aero” compliance level. In addition to “partially interfering with the installation and effectiveness of some aerodynamic devices,” trailers with work-performing devices typically travel fewer highway miles each year and are therefore not as suited to receive aerodynamic devices. [EPA-HQ-OAR-2014-0827-1259-A1 p.9]

We have a small concern that a reduced “partial aero” compliance level could allow an unneeded work-performing device to be purchased specifically to reduce the aerodynamic device compliance standard in that region of the trailer. This scenario is highly unlikely because work-performing devices are generally more expensive and fleets do not want to pay more for zero (or substantially reduced) fuel savings, but there could be an example where steps for side-door access are purchased, but not used, by a fleet as a compliance alternative to sideskirts or another approved underbody aerodynamic device. It may not be necessary, but to mitigate this potential loophole, we simply suggest adding wording to the final regulation saying work-performing devices should be intended for work-performing purposes in that specific trailer’s application. [EPA-HQ-OAR-2014-0827-1259-A1 p.9-10]

Long van trailers with roll-up doors

STEMCO asks EPA and NHTSA to confirm in the final regulation that long van trailers with roll-up doors are subject to the “full aero” compliance level. We believe that the long van roll-up door subset of the industry contributes significant potential to the environmental goals sought by this regulation, with a conservative estimate of 23% of long van trailer highway miles being driven by trailers with roll-up doors each year<sup>8</sup>. We also believe that maintaining long roll-up door trailers in the “full aero” compliance level will spur additional research and development and have a significant effect on bringing aerodynamic technology advances to market in the coming years. [EPA-HQ-OAR-2014-0827-1259-A1 p.10]

**Response:**

The agencies are adopting reduced standards for box vans designated as partial- or non-aero box vans. Because the types of work-performing equipment identified generally add significant cost and weight to a trailer, we believe that the reduced standards available for trailers using this equipment are unlikely to provide an incentive for manufacturers to install them simply as a way to avoid the full aero standards.

As noted in our previous STEMCO response in Section 5.2 (page 976) and our response to FedEx in Section 5.4 (page 999), we are adopting an interim provision to recognize roll-up doors as work-performing equipment until MY 2024. We expect this provision will provide an incentive for device manufacturers to continue to develop and improve aerodynamic technologies that are appropriate for roll-up doors, but will allow manufacturers time to obtain, become familiar with, and prepare to market these technologies to their customers.

**Organization:** Stoughton Trailers

2. Exempt portion of production Volume:  
Official request for consideration of a graduated level of production volume subject to the regulation. The trailer industry has historically never been subject to regulation to the extent the GHG2 proposal of topic. The schedule is a declining progression from 20% to 5% over the period defined within the regulation. [EPA-HQ-OAR-2014-0827-1212-A2 p.1]

25% 2018-2020

20% 2021-2023

15% 2024-2027

10% 2027.....

Request 2: direct this type of graduation to allow for experience within the regulatory realm, in order to minimize potential non-compliance levels. [EPA-HQ-OAR-2014-0827-1212-A2 p.1]

**Response:**

The agencies are not finalizing the proposed provisions that would have allowed manufacturers to comply with the trailer standards using averaging before MY 2027. As a result, in the absence of mitigating provisions, manufacturers would need to comply with the applicable standards for all of their trailers. The agencies received comment, primarily from trailer manufacturers, that, without the flexibility of averaging, trailer manufacturers should be allowed to “carve-out” a set percentage of their sales that would not be required to meet the standards. In this comment, Stoughton Trailers suggests an up-to-20 percent carve-out.

The agencies considered this concept and this final program provides each manufacturer with a limited “allowance” of trailers that do not need to meet the standards. In determining an appropriate value for this allowance, the agencies sought to balance the need for some degree of flexibility in the absence of averaging while minimizing changes in the competitive relationships among larger and smaller trailer manufacturers. An allowance of 20 percent, as suggested by Stoughton, is problematic, since the annual production for individual trailer manufacturers varies so widely. An allowance of 20 percent for a very large manufacturer could very well represent the same volume of trailers as an entire year’s sales for a small manufacturer. This in turn could result in a situation where a large number of non-complying trailers would be on the market, potentially attracting customers away from smaller manufacturers that needed to market complying trailers.

Because of this, the agencies estimated a representative volume of trailers based on the 2015 Trailer Production Figures published by Trailer-BodyBuilders.com. The smallest box van manufacturer in the list produced 1800 dry freight vans in 2015. Twenty percent of that production is 360 trailers. Based on

this calculation, the trailer program includes an interim provision providing box van manufacturers an allowance of 20 percent of their production, up to a maximum of 350 units (i.e., rounding to the nearest 50 trailers) that are not required to meet the standards for model years 2018 through 2026, when the program does not include averaging and manufacturers are becoming familiar with the technologies and the program in general. All lengths of box vans, including both dry and refrigerated, produced by a given manufacturer count toward the allowance.

While averaging does not apply for partial- and non-aero box vans at any point in the program, the agencies recognize that manufacturers could also benefit from the ability to exempt some trailers from these subcategories in the early years as they transition into the full program. For this reason, for MY 2018 through 2026, the trailer program provides for manufacturers to choose to include partial- and non-aero box trailers in their 350 box-van allowance. By MY 2027, we expect that manufacturers of partial- and non-aero box vans will be able to meet the reduced standards for all vans in their given subcategories, and thus the program ends the allowance provision at that time.

Non-box trailers have design-based tire standards and averaging does not apply for this subcategory at any point in the program. Similar to the case of the partial- and non-aero box vans, we also conclude that non-box manufacturers can benefit from a transitional exemption allowance. For this reason, the trailer program also includes a separate allowance for non-box trailers, but a separate one because their production volumes differ and many non-box trailer manufacturers do not build box vans. Using the same trailer production figures referenced above, we found that the smallest non-box trailer manufacturer in the list produced 1325 trailers in 2015, and twenty percent of that production is 265 trailers. Accordingly, from MY 2018 through 2026, non-box trailer manufacturers can exempt 20 percent or 250 trailers (again, rounded to the nearest 50 trailers) from the applicable tire standards. By MY 2027, we expect that all non-box trailers will be able to incorporate the tire technologies required by the design standards.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## 6 - Further Areas Requiring Exclusion/Exemption

The proposal asks for input on the merits of exclusion versus exemption of various trailer types. Our objections to the agencies' authority notwithstanding, we feel that all regulations should be crafted in such a way as to minimize unnecessary negative impact on manufacturers. Tracking and reporting burdens are very real costs, and should only be used by the agencies when there is a definite social gain to be had. There is no gain to be had by requiring reporting and tracking for classes of trailers that are not the subject of this proposal, so we encourage the agencies to maximize the use of exclusions wherever practicable. [EPA-HQ-OAR-2014-0827-1172-A1 p.9]

TTMA recognizes that the agencies have made great strides in gaining an understanding of the trailer industry and have laid forth certain types of trailers which should be excluded from the proposal.<sup>18</sup> There are certain problems with the classification of some trailers and other types that also ought to be excluded. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

### Heavy Haul Exclusion

The proposal intended to exclude trailers designed for heavy-haul applications, but apparently used a simplistic combination of length and axle count to define a heavy-haul trailer. While such a metric is a useful test, it omits several other design characteristics that define certain heavy-haul trailers that

otherwise would not pass the proposal's "Trailers shorter than 35 feet in length with three axles, and all trailers with four or more axles (including any lift axles)." [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

Heavy-haul style trailers are designed to carry equipment used for construction, agricultural, mining, logging, power generation and other industries, specialized loads generally not transported on a regular basis, high center of gravity loads, and over-sized (length, width, height, and/or weight) loads. Most of these trailers operate in either very small fleets (two to three trailers) or are owner-operated where requirements for specific tire and equipment types would cause a larger financial burden than the perceived benefit of reduced fuel use. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

The following recommendations for exclusion are based on specific physical characteristics that are designed into each trailer type in order for it to perform its intended function. These trailers are not intended for nor are they used for over-the-highway long haul operations or at highway speeds for extended periods of time. These trailers will operate both on and off road, at various speeds, and in various terrains. There are not specific design characteristics that indicate that this trailer should operate at low speeds or on a specific type of terrain, but, these are physical characteristics that can distinguish heavy-haul style trailers from other trailer types. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

"Jeep; Dolly, Load Divider"

As defined in 49 CFR 571.121 S4, a load divider dolly means a trailer composed of a trailer chassis and one or more axles, with no solid bed, body, or container attached, and which is designed exclusively to support a portion of the load on a trailer or truck excluded from all the requirements of this standard. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

"Heavy Haul"

Any trailer that has a gross vehicle weight rating (GVWR) of more than 120,000 pounds or any trailer equipped with an axle that has a gross axle weight rating (GAWR) of 29,000 pounds or more. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

"Expandable"

As defined in 49 CFR 571.121 S3.(a), any trailer that has a width of more than 102.36 inches with extendable equipment in the fully retracted position and is equipped with two short track axles in a line across the width of the trailer. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

"Extendable"

Any trailer that has air lines designed to allow extension of the vehicle frame or load deck. [EPA-HQ-OAR-2014-0827-1172-A1 p.10]

"Modular"

Any trailer that has air lines designed to allow separation and removal of deck sections or insertion of deck sections to create longer or shorter load carrying areas. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

"Sliding"

Any trailer that has an undercarriage system designed to move forward or back to allow the load deck to tilt, slide, or adjust into a position that facilitates the loading or unloading of equipment but must return to original position for transport. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

“Multi-Axle”

Any trailer that has two or more permanently attached axles (including lift axles) and designed to accept additional removable axles, flip axles, and/or load transferring boosters; both mechanical, hydraulic, or air (or other gas). [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

Dump Trailer Exclusion:

There are a variety of trailer designs that nominally appear to be simple box trailers, but due to the design being used for in-field operations and short haul/low speed operations almost exclusively, should be excluded from the proposal. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

“Dump trailer”

An open-topped trailer having a load-bearing container body structure with a hydraulic cylinder that allows the container to be tilted to discharge its contents through an open tailgate or equipped with special doors/gates to allow discharge of contents by gravity that is used in short-haul transport of construction, paving, demolition and other bulk materials such as sand, gravel, asphalt, sludge, scrap metal, farm products etcetera from off-road mine/pit loading sites to off-road construction unloading sites. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

“Refuse transfer trailer”

A usually open-topped trailer having a load-bearing container body structure that can be tilted on an external hydraulic tipping platform or equipped with a self-unloading floor to discharge its contents through an open tailgate that is used in short-haul transport of refuse material (garbage) from off-road transfer station loading sites to off-road landfill unloading sites. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

ATIS Exemption:

Certain tires/loads have working pressures in excess of what tractors can provide. These trailers should be exempt from the ATIS requirement. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

Lift Gate Equipped Trailers:

Rail Lift & Lift Gate equipped trailers operate at low speeds and perform local deliveries. As such, they ought to be classified as “non-aero” based solely on the inclusion of a lift, however a better approach non-aero trailer classification will be discussed below. [EPA-HQ-OAR-2014-0827-1172-A1 p.11]

**Response:**

The trailer program includes provisions that exclude a large fraction of non-box trailers, as discussed in our response to the similar comment from ATA at the beginning of this Section 5.5 on page 1040. Similar to the list provided by ATA, many of the trailer examples in this TTMA’s list are now excluded

from the Phase 2 trailer program, with exceptions noted in the ATA response. In terms of TTMA's additional ATIS exemption request, the comment did not include sufficient information on which to base an exemption, such as an appropriate working pressure threshold, or the number or type of trailers that would require these pressures. However, this concern should be largely addressed by the provision in the final trailer program allowing manufacturers to choose to comply with TPMS, and for manufacturers of box vans subject to performance standards to choose to comply with no tire pressure systems at all if offset by higher-performing aerodynamic or LRR tire technologies.

**Organization:** Truck Trailer Manufacturers Association (TTMA)

## 7 - Non-Aero Box Trailers

TTMA recognizes that the agencies have tried to account for the variety of trailer designs and the various sorts of service they are put in by creating a "non-aero box" category of trailer that is defined by the deployment of certain equipment or design features similar to our call for a "work performing equipment" exclusion in our October 16, 2014 letter.<sup>19</sup> Unfortunately, the way that the proposal crafts this, it fails to capture the full extent of trailers that are operated at low speeds and for short trips. [EPA-HQ-OAR-2014-0827-1172-A1 p.12]

Consulting Figure 1-5 from the draft RIA<sup>20</sup> a significant fraction of the trailers are used on short trips and are therefore predominantly operated according to what the Agencies term "transiently." [EPA-HQ-OAR-2014-0827-1172-A1 p.12]

[Figure 1-5 'Tractor-Trailer Primary Trip Length' can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1172-A1]

As written, the proposal neglects the fuel costs and greenhouse gas emissions associated outside of operations on the trailer. The rule needs to account for the GHG and energy consumption of various devices during the entire lifetime of the component; construction, delivery, use and disposal, rather than just highway use as they do now. Although not required by statute, it would be foolish to require the use of devices whose GHG savings in use are small compared to the GHG emissions used during production, delivery, disposal, and necessary uses outside of running down the highway such as maintenance, retreading, etc. [EPA-HQ-OAR-2014-0827-1172-A1 p.12]

For aero-devices, estimating the carbon footprint of manufacture, distribution, service and disposal is difficult. One approach is to use a simplified cost of goods calculation based on the carbon footprint of the general automobile industry. This gives a rate of 460 kgCO<sub>2</sub>/\$1,000<sup>21</sup> Therefore, for a van trailer operated in a transient mode but still required to have \$900 of aero-devices fitted, there will be a CO<sub>2</sub> penalty of  $900 * (460 / \$1000) = 414$  kg CO<sub>2</sub> over the useful life of the aero-device. Additionally, this device will need to be hauled itself, its 250lb or 1/8th ton, would lend an additional 11g per mile (baseline emissions of 85 per ton mile times .125 ton, this would be higher on short trailers with their higher baseline). This in addition to the .15% decrease in performance from the effect of displaced cargo when operating at or near weigh-out conditions as described under "Safety Impact." [EPA-HQ-OAR-2014-0827-1172-A1 p.12-13]

For these transiently operated trailers, what benefit is available would come from LRR Tires and ATIS. As described above, applying aero treatments to these trailers will result in an increase of GHG emissions/fuel consumption relative to an untreated trailer with LRR tires and ATIS rather than the desired reduction. The appropriate solution here is to recognize that trailers operated in transient service are more appropriately categorized as "non-aero box trailers." The agencies can and should recognize

some fraction of the annual tractor-trailer combinations of each category as non-aero. End users eager to reap the rewards of aero-treatment payback, if it is realistic for their uses, can be counted on to select the correct type for their particular trip use. [EPA-HQ-OAR-2014-0827-1172-A1 p.13]

While we recognize the steps the proposal made to define a non-aero box trailer by certain devices fitted to it, by focusing solely on these items rather than on usage, you could create a situation where the market drives increased adoption of features to move trailers intended to be used transiently into the non-aero box category despite those devices not otherwise being needed to complete the job. An unneeded rear lift gate or side-mounted pull-out platform would have all the negative consequences of an unneeded skirt in terms of weight impact creating both a safety hazard and increased emissions described above. By allowing a fraction of tractor-trailer combinations with applicable trailers (Long vs Short/Dry vs Refrigerated) to be designated as “non-aero,” you eliminate these perversities that would arise between the proposed regulation and market forces and instead allow regulators and industry to focus on maximizing improvement. By removing the fraction of trailers that are used transiently, the standards that are set for the remaining trailers could possibly be raised from the proposed values and on a faster timetable. But this would only be possible with reasonable levels of non-aero box van classification. [EPA-HQ-OAR-2014-0827-1172-A1 p.13]

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18 80 FR 40259: “(5) Exclusions and Less-Stringent Standards”

19 EPA-HQ-OAR-2014-0827-0146

20 EPA-HQ-OAR-2014-0827-0243

21 How Bad Are Bananas? The Carbon Footprint of Everything: puts the carbon emission of automobile manufacture at 720 kgCO<sub>2</sub>/£1,000. Converting to dollars gets the quoted figure.

**Response:**

The agencies did not include a separate lifecycle analysis for trailer technologies in this rulemaking. However, we disagree with the lifecycle calculations provided in this comment. First, TTMA suggests that the carbon footprint of a relatively simple aerodynamic device is on the same order as a much more complex automobile with a rate of 460 kgCO<sub>2</sub>/\$1000. Considering a typical device may be constructed of 10 separate components, while an automobile consists of hundreds of components, an aerodynamic device may be 10% of this value. But even if we apply the 414 kgCO<sub>2</sub> calculated as the CO<sub>2</sub> produced by a device, we are confident that a trailer that applies this device will save more CO<sub>2</sub> during its use. The rule estimates that a full-aero trailer would save 4.8 g CO<sub>2</sub>/ton-mi with a skirt and tire technologies in MY 2018 compared to a no-control trailer. If a trailer travels just 20,000 miles/year carrying 10 tons of payload, this trailer would *save* 960 kgCO<sub>2</sub>/year, more than double the lifecycle CO<sub>2</sub>. If we assume that the technology is half as effective for this particular trailer (2.4 gCO<sub>2</sub>/ton-mi) and factor in that the trailer must carry 250 lb less payload because of the device (payload is now 9.875 tons), the trailer will still save 474 kgCO<sub>2</sub>/year and the lifecycle CO<sub>2</sub> would be made up in the first year of very limited operation. Trailers with additional devices in later years of the program will arguably be more effective, and overcome the CO<sub>2</sub> generated in the devices’ production sooner.

In terms of the comment suggesting a program based on usage, EPA’s authority is limited to the manufacture of new vehicles. We do not have the authority to regulate the use of vehicles. Because of this, we can only establish criteria for reduced standards or exemptions based on characteristics of the



trailer that can be determined at the time of manufacture. While we expect that most trailers exclusively performing local deliveries will have work-performing devices that will qualify them for partial- or non-aero designation, we recognize that some local delivery trailers will not have these features. Because the types of work-performing equipment identified generally add significant cost and weight to a trailer (beyond the cost and weight of the aerodynamic devices themselves), we believe that the reduced standards available for trailers using this equipment are unlikely to provide an incentive for manufacturers to install them simply as a way to avoid the full aero standards.

See also our response to Utility in Section 5.1 (page 973) for our estimate of the CO<sub>2</sub> impact of additional weight of aerodynamic devices, and our response to the TTMA comment about potential safety implications of the weight addition of aerodynamic devices in Section 5.4 on page 1019.

**Organization:** Utility Trailer Manufacturing Company

**The Agencies should develop clear use and category exemptions.**

The Agencies' Proposed Rule recognized that the proposed aerodynamic modifications are incompatible with certain trailer designs. For example, trailer tails are not designed to work on roll-up doors, and skirts are often incompatible with storage boxes and tire carriers mounted under the trailers. [EPA-HQ-OAR-2014-0827-1183-A1 p.19]

In addition to exempting such trailers from the Proposed Rule, Utility Trailer urges the Agencies to establish clear exemptions for trailers that would be used in certain operations. In these operations, the technologies are either incompatible with the options most often selected for that use, or the anticipated benefit from the technologies is extremely low due to the environment in which the trailers will operate. The trailer manufacturer would install a label on every manufactured trailer within this category, which would certify both the customer's representation as to the use of the trailer and as permanent identification that the trailer is exempt. If the trailer's use changed, or the customer sold the trailer to another user, the label would be removed. [EPA-HQ-OAR-2014-0827-1183-A1 p.19]

Specifically, the following categories / uses of trailers should be exempted: [EPA-HQ-OAR-2014-0827-1183-A1 p.20]

- Short-haul trailers that will travel fewer than 100 miles per day. Even California recognizes that aerodynamic regulation of such trailers is not cost-beneficial, as it exempts them from the side-skirt requirement in California. A similar exemption from the Proposed Rule's requirements is appropriate.
- Local delivery operations, particularly those in urban environments. A significant number of these trailers are outfitted with devices – such as roll-up doors, liftgates, or side ramps – incompatible with the aerodynamic technologies. Additionally, these trailers usually operate at lower average speeds, negating any anticipated aerodynamic savings. Finally, as noted earlier, low-rolling-resistance tires are not a good fit for these applications, as they lead to increased scrubbing and damage.
- Trailers with greater than 121" axle spreads should avoid low-rolling-resistance tires, as the large axle spread causes increased scrubbing, particularly with the stiffer tread formulations in those tires. [EPA-HQ-OAR-2014-0827-1183-A1 p.20]

**Response:**

The EPA's authority is limited to the manufacture of new vehicles. We do not have the authority to regulate the use of vehicles. California has its own authority under the CAA and they are able to regulate in-use vehicles. We do not have a means of determining or ensuring the number of miles per day a vehicle may travel, and we rely on physical characteristics of a trailer at manufacture to identify those that are likely to be used in urban or low-speed operations. This is part of the reason why the final trailer program completely excludes large numbers of non-box trailers that are not designed for primary use in highway applications. Also, the program provides reduced standards for trailers with certain work-performing equipment (either partial- or non-aero designation) and we expect many trailers that frequently operate in urban environments will qualify for these designations.

While some box vans may be operated transiently without work-performing equipment that would qualify them for partial- or non-aero designation, we expect these trailer will spend at least some time at speeds above 55 mph where trailers will see considerable benefit from aerodynamic improvements. See RIA Chapter 10.2.1.1. As noted in our response to Stoughton in Section 5.1 (page 965) and RIA Chapter 2.10.2.1.1, long box vans with skirts are expected to see reductions of 4% or more and short trailers with skirts could see 1% or more at speeds of 55 mph.

The agencies recognize that axle spread can indicate higher potential for scrubbing, but it is our understanding that axle spread can be a variable setting. The program excludes trailers from our regulations if their axle spreads cannot be set below 120-inches. However, trailers that have the ability to change their axle spread below 120-inches are included in the program. See 40 CFR 1037.5(h).

**Organization:** Wabash National Corporation

Wabash supports improvements in fuel efficiency as part of an overarching goal of improving overall freight efficiency. Wabash believes in two core principles with respect to the proposed regulations: (1) maximum compliance flexibility and (2) simplicity in compliance. The agencies should offer opportunities for compliance flexibility, including allowing for exemptions when the proposed measures are not economically feasible, and thus will not contribute to freight efficiency. Such exemptions are valid, and do not suggest that the industry is trying to avoid compliance, but instead represent common-sense and cost-effective regulation. Given that the composition and operation of the trailer industry is quite different from the engine and vehicle manufacturing industries, simplicity of regulation is essential. History has shown that the trailer industry has proactively and voluntarily embraced innovations when the fuel economy benefits are demonstrated, even without regulatory pressures. [EPA-HQ-OAR-2014-0827-1242-A2 p.8]

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, pp. 89-90.]

Two, not all trailer types or freight carriers will benefit from adopting fuel efficiency technologies. For example, tank trailers, flatbed trailers, and other specialty trailer types will not necessarily see benefits from the addition of aerodynamic devices, and for that, Wabash supports the EPA and NHTSA decision to exempt these trailers from aero requirements.

In addition, even some fleets operating nothing but van semi-trailers will not see benefits from the adoption of aerodynamic devices. This is because these types of trailers and fleets might operate in different duty cycles created by variations in operating locations and geographies, they may haul locally or regionally, and infrequently reach highway speeds, which is where aerodynamic devices provide payback. And they may have unique freight hauling requirements or operate off road for portions of the time.

The reality is some fleets and some trailer types simply will never demonstrate fuel savings through the use of aerodynamic devices. Thus, sensible final regulations should include exemptions for particular types of trailers or fleets whether through a fleet exception approval process or by including an extensive list of trailer characteristics that would define an aerodynamic exemption.

**Response:**

The trailer program is designed with a number of provisions that provide the kinds of compliance flexibility and simplification advocated by the commenter. For example, the agencies are adopting design standards for non-box trailer (tanks, flatbeds and container chassis) that are based on tire technologies only. The agencies also proposed a list of work-performing equipment (WPE) that we concluded impeded use of aerodynamic technologies and also indicated that they are more likely to be driven in short-haul operations. Trailers with these WPE can be designated partial-aero with reduced standards that are now based on adoption of a single aerodynamic device in the final program or non-aero with design standards based on tire technologies only. We are also offering a set allowance of trailers from each manufacturer that do not have to meet the standards in the years without averaging prior to MY 2027. Trailer manufacturers will determine which of their trailers would be included in this allowance. In MY 2027 and later, manufacturers can take advantage of our averaging provisions to allow some trailers in their production to meet lower standards.

The agencies are not adopting a provision for case-by-case exemption based on economic impact, as suggested by the commenter. Among other things, such an exemption leads to procedural complications, uncertainty ('am I exempt or not'), and delay, at odds with the commenter's (desirable) goal of simplicity and flexibility. In addition, the agencies have carefully considered costs in developing the final standards (including costs to small businesses) and have documented why the costs of the standard are reasonable. See Section IV.D.3 of the Preamble. As we describe above, we have also tailored the rules, via exemptions, simplified compliance procedures, and tire-based design standards, to reduce cost impacts on trailer manufacturers.

**Organization:** XL Specialized Trailers

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 203-205.]

As the current proposed regulations are presented, a very small list of exclusions and less stringent standards are laid out. We appreciate the regulatory agencies' proposal allowing of this list, but we ask the agencies to also consider a much broader breakdown to a specific characteristic of what defines a heavy haul trailer. Most of these trailers are not intended nor are they used for over the highway long haul operations or at highway speeds for extended periods of time.

These trailers will operate both on and off road at various speeds and in various terrains. There is not specific design characteristics that indicate that this trailer should operate at low speeds on a specific type of train, but there are physical characteristics that can distinguish heavy haul style trailers from other trailer types.

Heavy haul style trailers are designed to carry equipment used for construction, agriculture, mining, logging, power generation, and other industries, specialized loads generally not transported on a regular basis, high center gravity loads, and oversized length, width, height, and/or weight loads. Generally speaking, the trailer is a tool to move the primary pieces of equipment which is then used as a primary revenue generator for the end user.

Most of these trailers operate in very small fleets of a few trailers for a single tractor, or are owner operated where requirements for specific mandatory design standards for tires and specialty equipment types would cause a larger financial burden than the perceived benefit of reduced fuel use. This definition list will be submitted as a written comment, and we are asking the agencies to seriously consider this while developing the language for this regulation.

**Response:**

As the commenter observes, the proposed program was designed to include nearly all trailer types, with a limited number of exemptions or exclusions. We recognize that many trailers in the proposed non-box subcategory have unique physical characteristics for specialized operations that may make use of lower rolling resistance (LRR) tires and/or tire pressure systems difficult or infeasible. Instead of focusing on trailer characteristics that indicated off-highway use, the agencies have identified three specific types of non-box trailers that represent the majority of non-box trailers that we believe are designed for and mostly used in on-road applications: tanks, flatbeds, and container chassis. Based on this additional consideration and comments like this one, the final program as it applies to non-box trailers is limited to tanks, flatbeds, and container chassis. All other non-box trailers, about half of the non-box trailers produced, are excluded from the Phase 2 trailer program, with no regulatory requirements.

Tank trailers are defined for the trailer program as enclosed trailers designed to transport liquids or gases. For example, DOT 406, DOT 407, and DOT 412 tanks would fit this definition. These non-box trailers can be pressurized or designed for atmospheric pressure. Tanks that are infrequently used in transport and primarily function as storage vessels for liquids or gases (e.g., frac tanks) are not included in our definition of tank trailers and are excluded from the program.

Flatbed trailers for purposes of the trailer program are platform trailers with a single, continuous load-bearing surface that runs from the rear of the trailer to at least the trailer's kingpin. Flatbed trailers are designed to accommodate side-loading cargo, and this definition includes trailers that use bulkheads, one or more walls, curtains, straps or other devices to restrain or protect cargo while underway. Note that drop deck and lowboy platform trailers are not considered continuous load-bearing surfaces.

Finally, in the trailer program, container chassis are trailers designed to transport temporary containers. The standards apply to all lengths of container chassis, including expandable versions. The regulations do not apply to the containers being transported, unless they are permanently mounted on the chassis.

All non-box trailers that do not meet the definitions above are excluded and have no regulatory requirements. In addition, the rule excludes trailers intended to haul very heavy loads, as indicated by the number of axles. Specifically, the rules exclude all trailers with four or more axles, and trailers less than 35 feet long with three axles. We also exclude trailers with axle spreads that are set to be greater than 120 inches, and trailers intended for temporary or permanent residence, office space, or other work space, such as campers, mobile homes, and carnival trailers.

## **5.6 Compliance Provisions and Flexibilities for Trailer Standards**

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)  
Standard tractor for trailer certification

The Phase 2 proposal would permit manufacturers to test their trailers with tractors meeting Phase 2 Bin III or better (p. 40280). This will allow trailer manufacturers to gain credit for integration with tractors as both tractor and trailer aerodynamics evolve. Above we recommend that tractor manufacturers be given a comparable flexibility in their choice of test trailer while noting that a trailer already certified to

a higher delta CdA by virtue of such integration would negate any integration benefits on the tractor side. This is appropriate, since double counted of integration benefits cannot be permitted. However, tractor manufacturers may be far more likely than trailer manufacturers to pursue the development of integrated tractor-trailer aerodynamic designs, so the availability of an integration credit on the trailer side does not diminish the need for such a credit on the tractor side. [EPA-HQ-OAR-2014-0827-1280-A1 p.18-19]

#### Recommendations: Trailers

Consider strengthening the trailer standards for 2027 in order to increase the adoption of advanced aero technologies for both long and short dry vans and reefers. [EPA-HQ-OAR-2014-0827-1280-A1 p.19]

Promote aero technologies for non-box trailers by revising the 2027 standards. [EPA-HQ-OAR-2014-0827-1280-A1 p.19]

#### **Response:**

Tractor and trailer manufacturers that wish to include tractor-trailer integration strategies for compliance can use our off-cycle provisions to evaluate their performance. The individual tractor and trailer test programs are designed to maintain consistency between tests and be representative of tractor-trailers in use. The trailer program requires use of a standard tractor with minimum aerodynamic performance (Bin III) to ensure a poor performing tractor is not used to exaggerate the aerodynamic benefits of trailer devices (and to mirror real world conditions, where some effort is made to pair suitable tractors and trailers). We are not requiring that tractors of the same performance be used throughout the program, because we cannot guarantee that they will be available in the future.

Regarding the stringency of the trailer standards, based on the analyses for this final rule, we believe that the final standards in the program, as informed by all of the comments and slightly revised from the proposed Alternative 3 standards, are appropriate and represent the maximum feasible standards. Our final MY 2027 standards do include a small increase in adoption of high-performing aerodynamic technologies for the full-aero short and long box vans. For example, we proposed MY 2027 long box van standards based on 40% adoption of aerodynamic technologies that performed one bin higher than those we tested (Bin VII of the NPRM). The final MY 2027 full-aero long box van standards are based on 70% adoption of this level of performance (Bin VI in the updated FRM bins). Similarly, the final MY 2027 standards for full-aero short box vans are predicated on 60% adoption of technologies that perform in a bin higher than those we tested (Bin IV in the updated FRM bins). The agencies cannot predict the future technologies or trailer design changes that may be used to meet these standards. However, we are confident that the trailer industry has sufficient incentive to improve existing trailer performance in the timeframe of this rulemaking.

As explained in our response to UCS on page 1026, the final trailer program does not predicate the standards on the expectation that manufacturers will incorporate aerodynamic technologies on non-box trailers and we are adopting design-based tire technology standards for non-box trailers, as proposed.

**Organization:** American Trucking Associations (ATA)

#### **Establishing a Trailer ABT Program Will Provide Fleets More Flexibility**

ATA supports the use of Averaging, Banking, and Trading (“ABT”) by trailer OEM’s for a number of reasons. Fleets are wary of each trailer having to achieve a given compliance standard. As mentioned throughout these comments, maintaining fleet flexibility in spec’ing equipment is vital for our industry.

Fleets are best situated to determine what combinations of technologies perform effectively within their operational models and financial means. While it is certainly more convenient to conduct trailer compliance audits if each and every trailer were to hit a specific efficiency target, averaging will help maintain flexibility in purchasing decisions and promote greater acceptance. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

**Response:**

The agencies recognize that averaging, banking and trading have historically provided opportunities for vehicle manufacturers to maintain flexibility in complying with EPA's standards, which, in turn, provided some level of flexibility for customers purchasing those vehicles. However, the trailer industry is unique compared to other vehicle sectors.

The final program includes averaging, but limits the option for trailer manufacturers to apply averaging exclusively to MYs 2027 and later for full-aero box vans only. We believe this delay provides the box van manufacturers sufficient time to develop, evaluate and market new technologies and to become familiar with the compliance process and possible benefits of averaging. This will also allow customers to become more familiar with the technologies and to recognize their benefits. This approach attempts to balance the advantage of an averaging program to allow for introduction of the most reasonably stringent standards for trailers, with the concerns articulated by manufacturers.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Compliance requirements for trailers, trailer classification systems; Add aero requirements for non-box trailers; Change 50-foot demarcation to 47-feet; Remove belly boxes from the list of work-performing devices that inhibit the use of aerodynamic devices**

The NPRM includes U.S. EPA and NHTSA's proposal to regulate greenhouse gas emissions associated with trailers for the first time. The regulation will affect most trailers designed for use on highways. The proposed regulation requires that all affected trailers use LRR tires and ATIS, and that most box van trailers also use aerodynamic technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.69]

Although most aerodynamic technologies developed up until now have been designed for box van trailers, other trailer types, such as tanker trailers and flatbed trailers also stand to gain appreciable fuel economy benefits from these technologies. In wind tunnel testing conducted at the Auto Research Center in conjunction with Freight Wing, adding side skirts to a flatbed trailer reduced its wind-average drag coefficient by 8 to 9 percent at 50 mph, equivalent to a fuel savings of 3.5 to 4 percent at 50 mph, with larger savings possible at higher speeds.<sup>30</sup> Manufacturers are working on developing technologies for these trailers. For example, Wabash has already released its DuraPlate Tanker AeroSkirt product. CARB staff believes that there are significant benefits from the use of aerodynamic equipment on non-box trailer types, especially for longer non-drop-deck flatbed trailers (greater than 50 feet in length). For this reason, CARB staff recommends that U.S. EPA and NHTSA consider adding aerodynamic equipment requirements on certain non-box trailers. For example, as part of Alternative 4, longer non-drop-deck flatbed trailers should start with a 5 percent adoption rate of Bin III technology by the 2021 MY, increasing to 15 percent by the 2024 MY. CARB staff believes that this standard for long non-drop-deck flatbed trailers is feasible given the relatively low adoption rate of 5 percent combined with the extra lead time by starting the requirements in 2021, three years after aerodynamic equipment requirements will have taken effect for box van trailers. [EPA-HQ-OAR-2014-0827-1265-A1 p.69-70]

**Response:**

The agencies are aware that some side skirts have been adapted for the non-box trailers considered in this rule (e.g., tank trailers, flatbed trailers, and container chassis), and appreciate the information that CARB submitted that notes that some of these technologies have shown potential for large reductions in drag. However, technology effectiveness is only one factor that we must consider when developing our non-box standards. Please see our response to UCS in Section 5.4 (page 1026). Consequently, we are adopting design-based tire technology standards for non-box trailers, as proposed. Non-box trailer manufacturers may choose to include aerodynamic improvements in their future trailer designs, but non-box trailer aerodynamic devices cannot be used for compliance at any point in the Phase 2 program as now constituted.

**Organization:** California Air Resources Board (CARB)

In addition to distinguishing between box van trailers and non-box trailers, the proposed regulation also subdivides box van trailers into nine subcategories, each with different standards. The division of box van trailers is based on whether the trailer is a dry or refrigerated van, whether it is long (over 50 feet) or short (50 feet and below), and whether positions where aerodynamic equipment are typically installed are occupied by a work-performing device. CARB staff is supportive of this classification system to determine the stringency of the requirements to which a trailer is subjected since it recognizes the fact that there is a greater availability of aerodynamic technologies designed for long box van trailers and also takes into account the presence of work-performing devices that may partially restrict the installation of aerodynamic devices. However, CARB staff recommends two changes to this classification system. First, CARB staff believes that the 50-foot demarcation should be changed to a 47-foot demarcation to account for the fact that 48-foot trailers are much more similar to 53-foot trailers than they are to 28-foot trailers in terms of length and available aerodynamic technologies; and 28-foot trailers are typically used in tandem, limiting their ability to use rear aerodynamic technologies, unlike with 48-foot trailers. 48-foot dry van trailers constitute nearly 6 percent<sup>31</sup> of the dry van trailer population. Hence, including 48-foot van trailers in the long box van trailer category, which essentially lowers the standard for these trailers by 42 to 45 percent, can lower overall emissions attributed to long and short dry box van trailers by about 2.5 percent, a significant amount. [EPA-HQ-OAR-2014-0827-1265-A1 p.70]

**Response:**

The agencies have included an analysis of trailer length in a memo to the docket of this rulemaking.<sup>163</sup> While 48-foot vans are aerodynamically similar to longer vans and capable of adopting additional technologies, the agencies do not believe aerodynamic performance potential alone justifies a change in our proposed 50-foot demarcation for long and short box vans in the Phase 2 trailer program. In the analysis we show that 48-foot vans are more likely to travel fewer annual miles and their shorter trips indicate they are likely traveling at slower average speeds. These slower speeds would result in lower real-world performance, yet these trailers would need to adopt additional technologies compared to a 53-foot trailer in order to meet the same long box van standards. In addition, 48-foot trailers are estimated to make up less than 10 percent of the van trailer population and the additional CO<sub>2</sub> and fuel consumption benefits would be a relatively small improvement with more stringent standards. The agencies do not believe that standards predicated on the use of more effective aerodynamic technologies on 48-foot vans will provide a substantial enough additional reduction in CO<sub>2</sub> emissions and fuel

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<sup>163</sup> Memorandum to the Docket EPA-HQ-OAR-2014-0827: Evaluation of 50-Foot Trailer Length Demarcation to Distinguish between Long and Short Box Vans. July 2016.

consumption to justify more stringent standards for those trailers. For these reasons, the agencies are maintaining the proposed 50-foot demarcation between long and short box vans.

**Organization:** California Air Resources Board (CARB)

Second, U.S. EPA and NHTSA should remove belly boxes from the list of work-performing devices that inhibit the use of aerodynamic devices where the belly box is located. The NPRM defines “non-aero” and “partial-aero” trailers as trailers that have at least one of the work-performing features listed in paragraph (a)(1)(i) of the proposed 40 CFR 1037.107 in the redline version of U.S. EPA regulation. By including belly boxes on the list of work-performing devices, it is possible that certain fleets may exploit this as a loophole by specifying a small belly box in their trailer order instead of having side aerodynamic equipment installed. From CARB’s experience in implementing the Tractor-Trailer GHG Regulation, we know it is feasible to install a modified trailer skirt around the belly box. A wind tunnel testing project conducted jointly by Kentucky Trailer and Freight Wing at Auto Research Center showed that adding a modified trailer skirt around the belly box actually resulted in increases in fuel savings compared to the same trailer with unmodified trailer skirts and no belly box.<sup>32</sup> As a result, CARB has modified its “Implementation Guidance for the Tractor-Trailer GHG Regulation”<sup>33</sup> to allow the addition of a modified trailer skirt, as a CARB pre-approved modification, around a belly box. Pre-approval is based on testing demonstrating that a particular modification increases the wind averaged coefficient of drag (C<sub>dw</sub>) by no more than 10 percent of the difference between the C<sub>dw</sub> of the zero equipment baseline and the C<sub>dw</sub> of the same trailer with the skirt. CARB staff has not experienced any difficulties implementing this provision, and recommends that U.S. EPA and NHTSA remove belly boxes from the list of work-performing devices that inhibit the installation of an aerodynamic device at the location where the belly box is located. Instead, U.S. EPA and NHTSA should identify belly boxes as a work performing feature that may require the installation of an aerodynamic device modified according to predetermined guidelines to be fitted around the belly box. This may require the preparation of an aerodynamic modification guidance document similar to that of CARB. [EPA-HQ-OAR-2014-0827-1265-A1 p.70-71]

**Response:**

The agencies agree that aerodynamic devices are feasible with smaller belly boxes. For the final regulations, we specify that to be eligible for “partial aero” or “non-aero” designation and the associated reduced standards, a trailer’s belly box needs to occupy at least half the length of both sides of the trailer between the centerline of the landing gear and the leading edge of the front wheels. Trailers with belly boxes that do not meet these criteria will not be eligible for the reduced standards for non-aero trailers.

**Organization:** California Air Resources Board (CARB)

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment –Exclusively using zero-yaw testing for trailer aerodynamic performance**

U.S. EPA and NHTSA are proposing to determine the delta C<sub>dA</sub> for trailer aerodynamics using only the zero-yaw (or head-on wind) values for coefficient of drag. U.S. EPA and NHTSA are not proposing a reference method (i.e., the coastdown procedure in the tractor program). Instead, they are proposing to allow manufacturers to perform any of the proposed test procedures (e.g. coastdown, constant-speed, wind tunnel, computational fluid dynamics (CFD)) to establish a delta C<sub>dA</sub>. Since the proposed coastdown and constant speed procedures include wind restrictions, U.S. EPA and NHTSA are proposing to only accept the zero-yaw values from aerodynamic evaluation techniques that are capable



of measuring drag at multiple yaw angles (e.g., wind tunnels and CFD) to allow cross-method comparison and certification. [EPA-HQ-OAR-2014-0827-1265-A1 p.75]

CARB staff is concerned that using only the delta of the zero-yaw values to determine the delta CdA for trailer aerodynamics may not accurately reflect the aerodynamic benefit from improved trailer aerodynamics. U.S. EPA and NHTSA recognize that the benefits of aerodynamic devices for trailers can be better seen when measured considering multiple yaw angles. This is illustrated in Figure 22 from the RIA (shown below - Figure 4). The wind- average results were calculated at 55 mph vehicle speeds, consistent with the procedures in 40 CFR 1037.810. The wind-averaged analysis consistently results in a larger improvement (i.e., delta CdA) than the zero-yaw results. [EPA-HQ-OAR-2014-0827-1265-A1 p.75]

Therefore, CARB staff is recommending that U.S. EPA and NHTSA reestablish the performance bins and resulting proposed trailer standards based on wind-averaged drag results. Making this change is critical if the trailer standards are to reflect real-world gains in fuel efficiency and GHG reduction. In the real world, it is unreasonable to assume that tractor-trailers always travel when winds are coming straight at the vehicle. If the test method does not reflect wind-averaged drag, manufacturers run the danger of developing aerodynamic products that result in meeting standards that result in minimal or no benefit in real-world conditions. The opposite could also be true, where a technology that shows minimal benefit under zero yaw analysis can show measurable benefit when wind-averaging over multiple yaw angles are considered. This is illustrated in Figure 22 (shown below - Figure 4) for the gap fairing technology tested. [EPA-HQ-OAR-2014-0827-1265-A1 p.76]

CARB staff agrees with U.S. EPA and NHTSA decision to not require a reference test method, in order to reduce the test burden for manufacturers and allow them to choose an appropriate test method for their need and resources. However, the test method used must be capable of measuring wind-averaged drag. Wind tunnel testing and CFD are two viable methods. The use of reduced scale wind tunnel testing to evaluate the wind-averaged drag of aerodynamic technologies is common practice amongst trailer manufacturers. Several such manufacturers have submitted wind tunnel test results to CARB staff in accordance with requirements of California's Tractor-Trailer GHG Regulation. [EPA-HQ-OAR-2014-0827-1265-A1 p.76]

[Figure 4 can be found on p.76 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

#### Comment on Topic Where NPRM Requests Comment

#### **Comment – The use of Class 8 tractors for compliance simulation as well as performance testing**

The NPRM requests comment on the use of class 8 tractors when tractor-trailer combinations are used for compliance simulation as well as performance testing. We agree with the expediency of standardizing use of the class 8 tractors for determining trailer compliance even though the tractors pulling some trailer categories include a small portion of class 7 tractors. This approach will simplify compliance, and the differences between the results for a class 8 tractor pulling a trailer and a class 7 tractor pulling that same trailer are relatively minor. We recommend that this assumption be revisited if class 7 tractors grow in popularity or if the class 7 vs. class 8 tractor difference for tested trailers becomes significantly different due to evolving technology. [EPA-HQ-OAR-2014-0827-1265-A1 p.106]

**Response:**

The agencies evaluated the aerodynamic test data for our trailer program and concluded (consistent with this comment) that wind-averaging is able to better capture aerodynamic improvements from many devices, including several small-scale devices. We are adopting a wind-averaged approach for aerodynamic testing in the trailer program. See RIA Chapter 2.10.2.1.2.3.

Regarding the second comment, the final trailer program uses a Class 8 tractor for testing long box vans, as proposed. However, we allow short box vans to use either a Class 8 or Class 7 day cab tractor with a 4x2 axle configuration. The proposed 6x4 axle configuration was found to interfere with the landing gear of some trailers, which did not allow the tractor-trailer test vehicle achieve the regulation-specified gap spacing. We are confident that a 4x2 axle configuration will avoid similar interference and we based our short box van standards on aerodynamic testing with a Class 7 4x2 day cab tractor.

**Organization:** California Air Resources Board (CARB)

**Comment – Requirements for emission control labels for trailers**

CARB staff supports the proposal that emission control system identifiers be included on trailer labels. Having the emission control system identifiers on the emission control label is a simple and effective way of verifying that a vehicle is in a certified configuration, and is the most commonly used method of making a compliance determination during a vehicle inspection. CARB staff does recommend that an additional requirement be included to make labels readily visible to the average person (for example, amend 40 CFR 1037.135(b) to include: “Attached in a location where the label will be readily visible to the average person after the vehicle manufacture is complete.”) [EPA-HQ-OAR-2014-0827-1265-A1 p.110]

**Response:**

The labeling provision that CARB suggests is already part of EPA’s regulations and we are making a minor adjustment to clarify that it applies to trailers. (40 CFR 1068.45 and 1037.135).

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment****Comment – A to B testing for trailer aerodynamic performance - the issue of varying performance for devices across the range of short van lengths, full credit for aerodynamic improvement**

The NPRM requests comment on approaches to address the issue of varying performance for devices across the range of short van lengths. CARB staff supports U.S. EPA and NHTSA’s proposed grouping approach. [EPA-HQ-OAR-2014-0827-1265-A1 p.118]

**Comment on Topic Where NPRM Requests Comment****Comment – Trailer aerodynamic compliance testing; pros and cons of exclusive use of zero-yaw data, allowing the use of wind-averaged results for compliance, strategy, supporting data**

The NPRM requests comment regarding the pros and cons of exclusive use of zero-yaw data from trailer aerodynamic testing. CARB staff believes that there are advantages of using zero-yaw data. The primary advantage is that zero-yaw data is more reproducible than non-zero-yaw (multiple yaw angles) data. If U.S. EPA and NHTSA provide the option of using either zero-yaw or multiple yaw angle data, the same yaw angle must be chosen for both A and B cases to properly attribute aerodynamic benefits. [EPA-HQ-OAR-2014-0827-1265-A1 p.119]

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30 See Attachment 5 for Freight Wing ARC Wind Tunnel Flatbed Testing Summary Results [Attachment 5 can be found on p.37 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

<sup>31</sup> (ICCT, 2014) The International Council on Clean Transportation, “Recommendations for Regulatory Design, Testing, and Certification for Integrating Trailers into the Phase 2 U.S. Heavy-Duty Vehicle Fuel Efficiency and Greenhouse Gas Regulation,” February 2014, <[http://www.theicct.org/sites/default/files/publications/ICCT\\_trailer-test-procedure\\_20140218.pdf](http://www.theicct.org/sites/default/files/publications/ICCT_trailer-test-procedure_20140218.pdf)>.

<sup>32</sup> See Attachment 6 for Auto Research Center, Class Eight Semi Truck Aerodynamic Fuel Economy Component Test, 2011.

[Attachment 6 can be found on p.38 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

<sup>33</sup> (CARB, 2012) California Air Resources Board, “Implementation Guidance for the Tractor-Trailer GHG Regulation,” October 2012, <<http://arb.ca.gov/cc/hdghg/documents/modaeroguidev1.pdf>>.

<sup>35</sup> Figure 22 from the RIA, page 2-162

**Response:**

The trailer program incorporates aerodynamic test procedures for trailers that require wind-averaged delta CdA values, as represented by an average of results from +4.5 and -4.5 degree yaw angles, for compliance. We are adopting wind tunnel as our primary test procedure with interim provisions allowing CFD to be used without adjustment (see 40 CFR 1037.150(x)). We are tightening the allowable yaw angle difference between A and B tests to within 1 degree for the limited number of trailers that may be tested using the coastdown procedures, and the interim provisions also allow these near-zero values to be used without adjustment, noting that the delta CdA results from coastdown were found to be similar to wind tunnel results for most devices in our testing. Manufacturers that do wish to correct their coastdown results to a wind-averaged value, have the option to work with EPA to identify a proper adjustment method.

**Organization:** Cummins, Inc.

With the addition of a trailer ABT program in Phase 2, Cummins supports creation of a trailer averaging set such that no exchange of credits between engines, vehicles and trailers can occur. [EPA-HQ-OAR-2014-0827-1298-A1 p.31]

**Response:**

The limited provisions for averaging in the later years of the phase-in of the trailer program do not allow exchange of trailer credits with credits generated by engine, tractor, or vocational vehicle manufacturers.

**Organization:** Exa Corporation

Because of the significant impact of real-world efficiencies due to the wind yaw effects, we feel it is imperative that wind effects be part of the standard for both tractors and trailers. [EPA-HQ-OAR-2014-0827-1420 p.265]

The negative consequences of not adopting wind effects into the standard for tractors and trailers include truck and trailer buyers, not realizing the fuel savings implied by the levels of which the truck and trailers are certified and the overall emission reductions promised for the program will not be achieved.

Some of the proposals attempt to address the inadequacies of the coast-down results by adjusting the coast-down results through the use of alternate tools for when they have the drag. We feel, as stated above, that the variations of wind average drag between the tools and facilities themselves is too significant and it would be an adverse consequence to allowing alternative tools for adjusting coast-down results. A standard that holds all the tools accountable to a real-world measure of the wind average drag performance of a vehicle, such as constant speed aerodynamic testing, is imperative in ensuring predictable behavior.

**Response:**

As noted in our response to CARB previously in this section on page 1061, the agencies are adopting aerodynamic test procedures based on wing-averaged values. Also see RIA Chapter 2.10.2.1.2.3.

We are adopting wind tunnel as our primary test procedure for trailer aerodynamic testing with interim provisions allowing CFD to be used without adjustment (see 40 CFR 1037.150(x)). We are tightening the allowable yaw angle difference between A and B tests to within 1 degree for the limited number of trailers that may be tested using the coastdown procedures, and the interim provisions also allow these near-zero values to be used without adjustment, noting that the delta CdA results from coastdown were found to be similar to wind tunnel results for most devices in our testing. Manufacturers that do wish to correct their coastdown results to a wind-averaged value, have the option to work with EPA to identify a proper adjustment method. See RIA Chapter 2.10.2.1.2.4. The agencies conducted a significant amount of constant speed testing, but were unable to develop a robust constant speed test procedure in time for the final Phase 2 rule. We do not anticipate device or trailer manufacturers will prefer constant speed testing to the other test options available in the trailer program, but a constant speed procedure is available for use, subject to the approval provisions outlined in 40 CFR 1037.526.

**Organization:** Great Dane

While we do furnish and install both LRR tires and ATIS on a customer-specified basis, we do not manufacture these items. As such we rely on the individual manufacturers of the devices and system by “passing thru” the warranties on these items. We are unaware of any trailer OEM that manufactures these items and we believe that other manufacturers also pass thru individual warranties as offered by the device producers. We further note that tire warranties vary greatly depending on the tires and application, and that to our knowledge the warranties provided by the popular ATIS do not exceed three years in length. This contrasts with the intent of the NPRM for trailer OEMs to offer warranties on these

technologies for up to one half of the useful life of the vehicle, which the agencies presume to be 10 years. [EPA-HQ-OAR-2014-0827-1219-A1 p.2]

The agencies have proposed to allow trailer manufacturers to “pass thru” certification data generated by the providers of fuel saving tire and aero technologies. We believe that the methodology of certification under the EPA SmartWay program is efficient and cost effective and should be continued and available to the trailer manufacturers as needed. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

We note that under the proposed regulation that trailer manufacturers will be held responsible for the correctness of the compliance information being passed thru by the trailer OEM and in the event information from the technology supplier is found to be incorrect the trailer manufacturer will be held responsible. Under the proposed rule a trailer manufacturer installing a technology found to be unintentionally misreported could be forced to recall trailers and may be subject to substantial fines on a per trailer basis. Under such a scenario we believe that any such recall obligations related to compliance correction should be borne by the supplier of the technology, with assistance by the trailer manufacturer as would be the case in a NHTSA safety recall, and any applicable fines should be paid by the device manufacturer as well. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

As stated above we note that the agencies propose that the trailer manufacturer should offer a warranty on fuel saving technologies for one half of the useful life of the trailer, which the agencies assume to be 10 years. Since in many cases the trailer manufacturers will not be designing, or actually manufacturing the technology we believe that such a warranty obligation should fall on the device manufacturer. We further note that the operational characteristics of the trailers principally benefiting from these technologies are in many cases long haul operations and thus, issues with devices or systems that are actually warrantable would be administered by a great variety of local service providers. Many of those service providers will not have any affiliation with the trailer manufacturer that produced the trailer. Thus, the warranty model potentially resulting from the proposed regulation for these technologies differs considerably from the typical automotive model where the automobile OEM specifies, manufactures, warranties and services emission controls. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

Finally, we understand that many of our competitors do not support the adoption of averaging provisions under the proposed rule, for various reasons. We at Great Dane believe that averaging may be an option that is necessary for trailer manufacturers to continue to supply cost effective and fuel efficient equipment to certain customers due to their equipment specification needs as a result of their operations. Thus Great Dane believes that averaging is an option that trailer manufacturers need depending on the definitions of exceptions and exclusions, and we recommend that averaging options be included in any final rule. [EPA-HQ-OAR-2014-0827-1219-A1 p.4]

**Response:**

Section 207 (a) of the CAA requires manufacturers to warrant their products to be free from defects that could otherwise cause non-compliance with emission standards. For purposes of the trailer program, EPA requires trailer manufacturers to warrant all components that form the basis of the certification to the CO<sub>2</sub> emission standards. The emission-related warranty thus covers all aerodynamic devices, lower rolling resistance tires, tire pressure systems, and other components that may be included in the certification application. Note that the emission-related warranty is completely separate from any other warranties a manufacturer might offer.

The trailer manufacturer needs to warrant that these emission-related components and systems are designed to remain functional for the warranty period. Based on the historical practice of requiring

emissions warranties to apply for half of the useful life, we are adopting a warranty period for trailers of five years for everything except tires. For trailer tires, we apply a warranty period of one year. We view the warranty of third-party components, such as ATIS, as a business decision by those manufacturers, rather than as a reflection of the actual durability of the systems. With proper maintenance, we are aware of no reason that these systems would be unable to meet the durability requirements of the trailer program. The agencies believe these systems (and similarly, the TPMS) should be designed to last the full useful life of the trailer if properly maintained. We believe a five year emission-related warranty is justified, but we note that trailer manufacturers can specify that this warranty depends on the proper maintenance of components. NHTSA is not adopting any warranty requirements relating to its trailer fuel consumption program.

The commenter notes that the current operational characteristics of the trailer industry differs from the automotive industry where customers can relatively easily bring their vehicles to an appropriate dealership for warranty-related issues. The statute and our regulations (see 40 CFR 1037.120) require manufacturers to provide warranty coverage without specifying the business arrangements for making that happen. Manufacturers will presumably continue similar business arrangements already in place for warranties unrelated to emission control. Manufacturers may develop their own procedure for providing emissions-related warranty coverage (e.g., set up contractual agreements with dealers or distributors, limit warranty coverage to a network of authorized service providers, and/or arrange payment to independent shops acting on behalf of the manufacturer), as long as the owner's manual provides specific instructions describing how customers can get warranty coverage.

Similar to the proposal and EPA's SmartWay technology verification program, the final trailer program provides for trailer aerodynamic device manufacturers to seek preliminary approval of the performance of their devices (or combinations of devices) based on the same performance tests described previously. Trailer manufacturers could then choose to use these devices and apply the approved performance levels in the certification application for their trailer families. A device manufacturer would need to perform the required A to B testing of their device(s) on a trailer that meets the requirements specified in 40 CFR 1037.211 and 1037.525 and submit the performance results, in terms of delta CdA, directly to EPA. Once a device manufacturer has obtained this preliminary approval, it could supply the same information to any trailer manufacturers that wish to install its devices. Note that both device manufacturers and trailer manufacturers are subject to 40 CFR part 1068, including the recall provisions described in 40 CFR part 1068, subpart F. In the event a device manufacturer submits false or inaccurate data to EPA, it could incur liability for causing a regulated entity to commit a prohibited act. See 40 CFR 1068.101(c). This same potential liability exists with respect to information provided by a device manufacturer directly to a trailer manufacturer.

As a result of the many comments opposing averaging from trailer manufacturers—the very stakeholders meant to benefit from an averaging program—the agencies have reconsidered how averaging is incorporated into the program. The final program does not allow averaging as a compliance option in the early years of the program, in MY 2018 through MY 2026. In those years, all box vans sold (beyond a manufacturer's allowance of non-complying trailers) must meet the standards using any combination of available technologies.

However, the agencies have concluded that by late in the program, the value of an averaging option to many trailer manufacturers may well outweigh the concerns they have expressed. Therefore, the final program will provide a limited optional averaging program for MY2027 and later trailers. By that time, we believe that the trailer manufacturers will be experienced and comfortable with the program and the industry will be more familiar with the technologies. In addition, the final stage of the phase-in of the

standards for MY 2027 represents the most stringent standards in the program, and additional flexibility may be welcome by trailer manufacturers.

**Organization:** International Council on Clean Transportation (ICCT)

### **Trailer procedures**

While this proposal for trailer standards lays a solid foundation, there are certain areas where modifications are warranted in order to close potential loopholes, increase compliance flexibility, and safeguard the expected fuel and emissions benefits from this portion of the Phase 2 program. The following topics are discussed in this section: (1) Averaging versus design-based compliance pathways; (2) Test procedure requirements; and (3) Aerodynamic performance assuming zero yaw versus wind-averaged yaw [EPA-HQ-OAR-2014-0827-1180-A4 p.15]

*Averaging.* In general, the ICCT is supportive of compliance based on sales-weighted averaging, as this gives manufacturers maximum flexibility to meet the standards using the technology deployment path that best matches their overall business strategy. If the agencies consider eliminating averaging-based compliance for a design-based approach, it is critical that the agencies maintain at least the same technology penetration for any alternative standards to avoid compromising the environmental benefits. This is clear, based on the facts that the technologies for the proposed standards are available and cost-effective, and have been already found to be highly attractive by leading fleets (e.g., see Sharpe and Roeth, 2014; Sharpe, Delgado, and Lutsey, 2015). In an attachment to our comments, we propose a concept for a design-based standard that would result in fuel and emissions reductions that are equal—or more—to the savings that could be achieved under the proposed averaging-based standards (Sharpe, 2015c). [EPA-HQ-OAR-2014-0827-1180-A4 p.15]

### **Response:**

As proposed, the trailer program provides for manufacturers to comply with the box van standards through a combination of aerodynamic, tire, and tire pressure technologies of their choosing (or any other technologies), so long as the overall standard is met. We are limiting averaging to MY 2027 for full-aero box vans, where we have increased the stringency of the standards based on comments. Standards in the years prior to MY 2027, are similar to those proposed, indicating similar stringency and technology adoption. Design standards generally apply for trailer types where aerodynamic technologies provide little benefit.

The commenter also provides specific suggestions for flexibility if averaging is not available, as is the case in the final trailer program before MY 2027. The program addresses this concern through the allowances provided each manufacturer for a certain number of non-complying trailers. (See our response to Stoughton in Section 5.5 on page 1045).

**Organization:** International Council on Clean Transportation (ICCT)

*Test procedure requirements.* For assessing the aerodynamic performance of trailers, the agencies have proposed that manufacturers have the ability to use their choice of coastdown testing, wind tunnel testing, or computational fluid dynamics (CFD) software. Although there are merits to test procedure flexibility (e.g., among track testing, wind tunnel, or CFD) the lack of a ‘reference’ test method could open up opportunities for gaming. One of the important drawbacks of wind tunnel and CFD evaluation is that technologies are modeled as idealized versions, rather than the actual technologies themselves. For example, in wind tunnel or CFD testing, an aerodynamic device can be modeled as being

completely smooth and flush with the edges of the trailer, while in reality, there are small gaps and irregularities that affect the air flow and the overall performance of the trailer with the device. In addition, device vibrations that are part of normal operation and can take away from the efficiency benefits are all but eliminated in wind tunnel and CFD testing. Because of these inherent discrepancies between evaluating a modeled version of the device versus the actual device itself, there would ideally be a requirement to do at least one track test. This is aligned with the requirements for tractor manufacturers, who must perform at least one enhanced coastdown test and then can use wind tunnel or CFD testing for other models, provided that they adjust their results using a correlation factor that is linked to the coastdown results. We believe that requiring trailer manufacturers and device suppliers to also do track testing will decrease the opportunities for ‘cherry-picking’ the best results, which may not be reasonably representative of real-world conditions. We also recommend that the agencies consider allowing the SAE J1321 “Type II” fuel consumption test procedure, as it has been required for many years for SmartWay verification testing and is most familiar to the trailer industry. Trailer manufacturers would ideally be required to do at least one track test (coastdown or J1321) for each aerodynamic drag area (i.e., tractor-trailer gap, side or underbody, and rear) where they would like to certify products. We include further details in the associated memo attachment (Sharpe, 2015c). [EPA-HQ-OAR-2014-0827-1180-A4 p.15]

**Response:**

See our responses to CARB (page 1061) and Exa (page 1062) describing our use of wind-averaged drag results in the trailer program and the applicable test procedures. The protocols for coastdown, wind tunnel, and computational fluid dynamics analyses result in a CdA value. Note that SmartWay’s 2014 protocols allow SAE J1321 Type 2 track testing, which generates fuel consumption results, not CdA values. Commenters did not suggest a means of converting from the fuel consumption results to an appropriate delta CdA value for use in compliance. As a result and as proposed, the final program does not accept J1321 data for pre-approval.

**Organization:** International Council on Clean Transportation (ICCT)

*Zero versus wind-averaged yaw.* The Phase 2 regulation is meant to drive technologies into the market that provide real-world benefits to fleets and society as a whole. As such, trailer manufacturers would ideally have the option to certify their products under wind-averaged yaw conditions. The agencies acknowledge that evaluating under various yaw angles is a more realistic assessment of how the technology will perform on the road when faced with wind directions that can vary greatly. However, the agencies have proposed that aerodynamic performance be solely determined using zero yaw conditions. We propose that manufacturers be allowed to use wind-averaged results from wind tunnel or CFD testing, provided that these results are correlated back to the coastdown or J1321 results. We include further details in an associated memo attachment that we also submit to the docket (Sharpe, 2015c). [EPA-HQ-OAR-2014-0827-1180-A4 p.15]

**Response:**

As noted in our response to CARB on page 1061, we are adopting wind-averaged results using a surrogate yaw angle of the average of +4.5 and -4.5 degrees. Wind tunnel and CFD results must be submitted as wind-averaged values. Coastdown results can be submitted as near-zero values, or manufacturers can contact EPA to determine an appropriate adjustment factor to a wind-averaged result for technologies that are sensitive to yaw angle.

**Organization:** Michelin North America, Inc.



## **Trailer aerodynamic inputs to the GEM P2 v1.0 a.**

### **Trailer yaw angle at 0° vs Tractor yaw angle at 0° — 6°**

The NPRM appropriately proposes the inclusion of the 'total vehicle' for the tractor-trailer combination in the GHG and FE standards since that vehicle configuration makes up the majority of the commercial vehicles in use. In this NPRM, the trailer is now required to be part of the assessments and certifications. [EPA-HQ-OAR-2014-0827-1286-A1 p.6]

The NPRM states that tractor aerodynamic drag is determined by testing is conducted over a range of 0° — 6° yaw and averaged for the GEM P2 v1.0 input. [EPA-HQ-OAR-2014-0827-1286-A1 p.6]

The NPRM requires only a trailer aerodynamic drag delta  $C_{DA}$  for trailer aerodynamics using the zero-yaw, e.g. 0° (or head-on wind) values. [EPA-HQ-OAR-2014-0827-1286-A1 p.6]

For a realistic and complete assessment of the overall trailer aerodynamic performance, a range of yaw angles, e.g. 0° — 6°, needs to be included for an averaged aerodynamic drag delta  $C_{DA}$  GEM input, i.e. effects of real world cross winds on such tractor-trailer combinations. [EPA-HQ-OAR-2014-0827-1286-A1 p.6]

Michelin supports the use of wind averaging result for aerodynamic inputs into both the tractor and the trailer GEM models. From simulation results it has been found that different aero devices behave significantly different at changing yaw angles. While some devices do tend to improve their value as yaw angle increases, this is not always the case. Many devices improve, some remain constant, and others actually have a degradation of performance under cross wind conditions. [EPA-HQ-OAR-2014-0827-1286-A1 p.6-7]

The following chart is the normalized change of drag reduction for a number of aero devices going from a 0° yaw angle to a 6° yaw angle. The range of performance difference seen is 6% or approximately 3% fuel savings. This makes the yaw performance an important input to the GEM calculation. [EPA-HQ-OAR-2014-0827-1286-A1 p.7]

[Graph, 'Normalized change of drag reduction when going from 0 degree yaw to 6 degree yaw', can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

Actual inversions of total performance have been seen between two designs of comparable devices when 0° yaw is used instead of wind average results as shown in the following figure. Without the use of wind averaged results designs would sacrifice cross wind performance to improve the 0° yaw condition. [EPA-HQ-OAR-2014-0827-1286-A1 p.7]

[Graph, 'Drag reduction performance of two comparable devices', can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

In light of this understanding we also support  $F_{alt-aero}$  being centered about the wind averaged case rather than be centered about the 0° yaw condition. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

Therefore, the range of yaw performance of aerodynamic devices is a major design factor and the averaged aerodynamic drag delta,  $C_{DA}$ , GEM input should be considered in trailer aerodynamic performance. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

**Response:**

As mentioned in our response to CARB (page 1061), we are adopting provisions to incorporate wind-averaged aerodynamic results into the trailer program.

**Organization:** Michelin North America, Inc.

**Aerodynamic Formula for Adding Trailer Components**

As stated in a. above, the trailer is now required to be part of the assessments and certifications. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

The proposed drag formula provides a method for adding individual trailer components together that are not actually tested together. It provides 100% of the benefit of the most fuel saving device 90% of the savings of the 2<sup>nd</sup> and 80% of the savings for the devices added thereafter. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

Aerodynamics is a system, not just a collection of parts. As such, all too often devices do not work well together and the data supports this. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

Devices that have been tested together, and some designed to work together, have been shown to have less total benefit than the proposed formula. From our testing, the proposed formula favors a collection of devices that may only be effective when tested alone, and does not provide for integrated aerodynamic systems testing to assess the combined systems. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

One example would be using trailer skirts in addition to under-tray devices which would yield less savings than the EPA formula indicates. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

As an example, one of the best total performance combinations simulated was a particularly high performance trailer skirt and boat tail device. Each was also tested independently and their combined savings were significantly less than the EPA formula. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

For this example the second device only yielded 78% of the savings instead of 90% as currently proposed. In this example the end result may indeed be attractive as it does offer large fuel savings, but the proposed formula yields differing expectations and does not encourage the testing of these devices together. [EPA-HQ-OAR-2014-0827-1286-A1 p.8]

[Graphs, Simulations of skirts and other aerodynamic devices compared to EPA formulas, can be found on p.9-10 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

In another example, trailer skirts and a device designed for use with trailer skirts were simulated separately and together. Despite the design intent, actual simulation results of the paired devices returned only 69% of the second device's individually tested fuel savings. [EPA-HQ-OAR-2014-0827-1286-A1 p.9]

A final example was a trailer skirt and a device frequently used in the market with trailer skirts. In this case the second device returned less than 53% of the individually tested fuel savings. [EPA-HQ-OAR-2014-0827-1286-A1 p.9]

Therefore, the testing of combined systems will provide fleets with expected savings. If a formula for adding devices is included such as in the NPRM aerodynamic formula, it should provide an incentive to also test combined solutions, and which may modify the proposed percentage factors when the devices are tested individually. [EPA-HQ-OAR-2014-0827-1286-A1 p.10]

**Response:**

Our wind-averaged test data, which is summarized in Chapter 2.10.2.1.2.5, shows that combinations of devices perform better than the sum of their individual effectiveness. Use of our proposed device discounting strategy with individual device effectiveness values ranged from 10-20% worse than the performance observed when the same devices were tested in combination, suggesting that our discounting strategy is a conservative estimate of the performance of device combinations, and we are finalizing this approach to provide incentive for packages of devices to be tested together for pre-approval.

Additionally, we specifically indicate that devices may be used in combination subject to *good engineering judgment*. Manufacturers using combinations of devices from the agencies' pre-approved test data would be required to indicate which individual devices were combined in their certification application and the agencies' compliance representatives would be able to see if inappropriate device combinations, such as skirts and an underbody device, were used.

**Organization:** SmartTruck

A component-specific validation structure would also allow the EPA opportunity to clarify how it intends to apply "family" designations to component manufacturers. In providing aero-device manufacturers the ability to identify components, and combinations of such, into aerodynamic bin categories, as outlined in the NPRM, the EPA gives the trailer OEM the ability to create families based on a mix of multiple aerodynamic devices, manufactured by a variety of companies. We believe this structure is more in line with the current framework which allows the customers of trailer OEMs to designate the type of aerodynamic technology they would like to purchase and provides a more efficient reporting system. This also allows trailer OEMs to balance their families with different technologies in the event that a particular device fails the requirements of validation testing. The current designation of how families will be integrated into testing for component manufacturers needs to be clarified. A unique SEA and confirmatory testing structure should also disqualify trailer OEMs from using their own test results to validate or eliminate an aerodynamic device manufactured by potential competitors in the market. [EPA-HQ-OAR-2014-0827-1923-A1 p.5]

**Response:**

In the trailer program, the concept of "families" is associated with the trailer certification process and applies to trailer manufacturers. The program provides for aerodynamic data generated from testing of components to be pre-approved, but trailer manufacturers decide how to apply data for their individual compliance strategies. We are not adopting provisions outlining steps to retract pre-approval of test data submitted to EPA. However, we note that EPA may request more information or may perform our own confirmatory testing if needed prior to pre-approval. Similarly, we cannot prohibit OEMs from performing independent testing of devices and, while we would not directly use such test results to retract approval, we may use it to justify our own follow-up testing.

**Organization:** STEMCO

STEMCO requests the addition of an early adoption incentive for trailers that meet the MY2027 compliance level in MY2018. [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

[Note: The docket for this rulemaking includes several footnoted references from STEMCO's comments that are not included here.]

- STEMCO requests the addition of an early adoption incentive for trailers that meet the MY2027 compliance level in MY2018.

### **Early Adoption Incentive**

STEMCO recommends that the EPA and NHTSA provide a financial reward for fleets who purchase MY2027 (or MY2024 in Alternative 4) compliance-level trailers in MY2018, the initial program year. From decades of experience selling into the trucking industry, we project that even a small financial incentive such as reimbursing the Federal Excise Tax (FET) on the cost of aerodynamic fairings not officially required until MY2027 will push a large segment of the industry to voluntarily achieve the program's end goals nine years in advance of regulation (or six years ahead of the Alternative 4 schedule). If calculating MY2027 level device incremental cost on a per trailer basis is too cumbersome to implement for any reason, we suggest a simplified solution of a \$140 reduction in FET for each trailer<sup>3</sup> that achieves MY2027 greenhouse gas emission reductions in MY2018. We suggest that this reward apply only to trailers who achieve a MY2027 performance level at the "full aero" level, such that a "partial aero" trailer or trailer with work-performing devices would not qualify for the reward if it achieves its MY2027 compliance level in MY2018 through reduced standards. We also suggest that this reward only be available in MY2018 (i.e. not MY2019, MY2020, etc.). Finally, we ask the EPA and NHTSA to consider a weight exemption for these over-complying aerodynamic devices in MY2018. [EPA-HQ-OAR-2014-0827-1259-A1 p.4-5]

We believe that this MY2018 incentive achieves two fundamental EPA and NHTSA program goals while significantly building on the desired two-way partnership with industry. First, the program's environmental and economic achievements would significantly accelerate – each trailer that qualifies for this reward signifies 5-7% additional fuel savings and reduced green-house emissions<sup>4</sup>. Second, voluntary over-compliance in MY2018 further ensures that a suite of properly-designed, high-performing, and industry-proven technologies are available to fleets at the onset of full compliance standards. Table IV-13 estimates that long box trailer adoption of Bin VII Aerodynamic Technologies will jump from 0% to 40% in between MY2026 and MY2027 and we believe that is highly advantageous to reduce this single year adoption spike by accruing industry experience and acceptance of these technologies years prior to this regulated milestone. Early adopter trucking fleets will expose any needed design or quality modifications before full industry adoption and a small financial reward, in addition to the initial competitive advantage early adopter fleets receive from lower fuel costs, will encourage them to continue leading industry adoption. The lost revenue opportunity to the U.S. Government from this one-time FET reduction should be minimal – Table IV-13 estimates that 0% of trailers will achieve MY2027 compliance in MY2018, so these unsold aerodynamic devices would not have generated tax revenue in 2018 anyway. [EPA-HQ-OAR-2014-0827-1259-A1 p.5]

### **Response:**

While the agencies agree in principle that incentives for early compliance can sometimes be useful, in the case of trailers, there no appropriate mechanism for such an incentive in this program. Within the trailer program, an incentive system would require a credit banking program in the early stages to manage the offsetting of early compliance credits for some trailer families with appropriate non-

compliance of other families. However, for reasons discussed elsewhere in this and the other rulemaking documents, the final trailer program does not include banking, and reserves the availability of averaging provisions for MYs 2027 and later. In the early years, without averaging, manufacturers have the option to install high-performing aerodynamic technologies on their box vans, allowing them to avoid installing tire or weight reduction technologies, or they could simply sell an over-compliant trailer if that is what their customer desired. An early-adoption incentive for the trailer program would require some kind of mechanism for trailer manufacturers to generate early credits and then use them later. Because the program does not incorporate a banking system (per the requests of many industry commenters), early credits are not possible.

Regarding other potential incentives like FET reduction or a weight exemption, these approaches are outside the scope of this rule, as discussed in section 15.10 of this Response to Comments document.  
[ ]

**Organization:** STEMCO

### **Trailer Aerodynamic Performance Testing**

- STEMCO requests and recommends more stringency in the testing procedures used to certify trailer aerodynamic device performance (delta CDA value) in this regulation. We are particularly concerned that reduced-scale models and computer simulations can and do falsely represent the device rigidity required in the real world to achieve the stated reductions in fuel use. We believe at least a single full-scale test with a production model and two separate test methods should be required to achieve an EPA and NHTSA certified delta CDA value.
- STEMCO requests that on-road Type II testing, the most familiar method for trailer aerodynamic device manufacturers, be included as an acceptable testing procedure option. We also ask the EPA and NHTSA to clearly define a step-by-step process as a part of this regulation that will create a road map for approving additional aerodynamic testing procedures that are currently under development.

#### Number of test procedures needed to achieve approved CDA value

STEMCO requests that EPA and NHTSA require a trailer aerodynamic device be evaluated using two different test procedures before it achieves an approved CDA value. We further request requiring at least one of those two test procedures be conducted using a full-scale production unit of that aerodynamic device (as opposed to a computer simulation or scaled-down model). According to EPA and NHTSA's current proposal, it is our understanding that this would require either a coastdown or constant speed test (STEMCO is requesting the allowance of additional full-scale test procedures in a later section), and then either a wind tunnel, computational fluid dynamic (CFD) modeling, or a different type of full-scale testing could be used as the other test procedure. [EPA-HQ-OAR-2014-0827-1259-A1 p.5]

Establishing accurate and credible CDA values is of the utmost importance to the overall goals of this regulation. No single testing procedure is perfect or evaluates all types of devices equally – the National Research Council (NRC) has identified the drawbacks of approximate physics in CFD, approximate boundary conditions in wind tunnels, and approximate measurements in road/track testing<sup>5</sup>. In particular, coastdown testing measurement “uncertainties can exceed CD bin sizes.” STEMCO believes that only aerodynamic devices that can repeat their fuel saving results across multiple testing methods should be fully embraced by industry. We believe that the single greatest threat to the environmental goals of this regulation is if a lower-cost but under-achieving trailer aerodynamic device were to achieve

an inflated delta CDA value in a single test (either accidentally or mendaciously) and then be recognized by EPA and NHTSA as a valid compliance option. This aerodynamic device would instantly become an enticing option for trucking fleets interested only in regulatory compliance due to its low price, which would lead to a potentially significant percentage of trailers complying with this regulation but significantly underachieving CO<sub>2</sub> and fuel savings in real-world use. In an extreme (but not impossible) example, a 1% fuel saving aerodynamic device incorrectly labeled as 4% would weaken this portion of the regulation's environmental goals by 75% every time it is installed on a trailer. Requiring two separate test procedures does not completely eliminate this risk, but it would create a significant safety net in case an unforeseen testing loophole was discovered in a single test procedure. [EPA-HQ-OAR-2014-0827-1259-A1 p.5-6]

We are also specifically asking to require at least one full-scale testing procedure because, despite the existence of highly-calibrated wind tunnel and CFD facilities, both test procedures are limited by using device *models* instead of actual commercial devices. These device models are extremely rigid replicas and do not simulate the aerodynamic consequences of device movement or flutter during on-road travel. For example, a sideskirt or boat tail made out of a very thin, inexpensive material would not deform in CFD or wind tunnel testing, but it would most likely flutter during real-world travel, disrupting laminar air flow, and achieving much lower real-world drag reductions. It is important to note that if this device were accepted as a viable option for regulatory compliance, it would probably sell well in a very cost-constrained industry. [EPA-HQ-OAR-2014-0827-1259-A1 p.7]

As part of a two testing procedure compliance program, a trailer aerodynamic device would now have two delta CDA values – we recommend accepting the higher value as long as the lower value is at least 90% of that higher value. For example, if a sideskirt achieved a delta CDA value of 0.70 in coast down testing and a delta CDA value of 0.65 in wind tunnel testing, that sideskirt would receive an EPA/NHTSA approved delta CDA value of 0.7 because 0.65 is 93% of 0.7. However, we suggest that the lower delta CDA value be used when both values are not within 10% of each other. Therefore, if a sideskirt achieved a delta CDA of 0.80 in coast down testing and a delta CDA of 0.65 in wind tunnel testing, the EPA/NHTSA approved delta CDA value would only be 0.65. [EPA-HQ-OAR-2014-0827-1259-A1 p.6]

While this additional testing requirement would add to the financial burden placed on trailer aerodynamic device manufacturers, those companies, including STEMCO, will presumably benefit financially from increased sales of their aerodynamic devices as a result of this regulation, and therefore, this additional upfront testing investment should not be considered an undue burden. No additional burden would be placed on trailer manufacturers because the Aerodynamic Device Testing Alternative allows them to select devices that have been pre-approved by trailer aerodynamic device manufacturers. [EPA-HQ-OAR-2014-0827-1259-A1 p.6]

#### Accepted trailer aerodynamic test procedures

In addition to coastdown, constant speed, wind tunnel, and computational fluid dynamics (CFD) modeling, STEMCO requests that Type II Fuel Consumption testing (the SmartWay 2015 Verification Protocol version) be accepted as a procedure for generating the EPA and NHTSA's approved delta CDA value for a trailer aerodynamic device. We also request that, in the final regulation, EPA and NHTSA clearly define a review process to allow for the inclusion of additional testing procedures, so that newer but promising test procedures, such as alternating, short duration on-road testing (discussed later in this section), can be included in the coming years. [EPA-HQ-OAR-2014-0827-1259-A1 p.6]

Type II (also known as SAE Type II or SAE1321, although there are protocol differences<sup>6</sup>) is the test procedure used by 80% of Verified Trailer Aerodynamic Devices currently listed on the EPA SmartWay website. In the previous section of these comments, we presented the merits of requiring at least one full-scale device test and because both coastdown and constant speed tests are unproven and unfamiliar within the trailer aerodynamic device manufacturer community, we feel that it would be imprudent to eliminate Type II as an option. [EPA-HQ-OAR-2014-0827-1259-A1 p.7]

The rationale often presented for excluding Type II testing has been that it presents a “percent fuel saved” result instead of “delta CDA.” This can be easily overcome by applying the correlation between delta CDA and percent fuel saved already established in Table IV-9. As an example, if a sideskirt for a long dry van trailer achieved 5% fuel savings in a Type II test, it would receive a delta CDA value of 0.7 and qualify for Bin V. [EPA-HQ-OAR-2014-0827-1259-A1 p.7]

Alternating, short duration on-road testing is a methodology where a single vehicle drives a series of short laps (either on a closed track or public highway) while alternating between using an aerodynamic device and a baseline configuration. Engine data is used and analyzed instead of weighing auxiliary fuel tanks. Boat tails can quickly alternate between a deployed and baseline configuration by simply folding the tail closed, allowing 6-8 “A-to-B” lap sets to be generated in a single day (additional data and information are included as Confidential Business Information). Bolted-on sideskirts would not be as quick to “install” and “uninstall” as a boat tail, but because this testing is an inexpensive alternative to the other approved procedures, it would be financially feasible to hire a team of 10-15 technicians that could remove or reinstall a sideskirt in less than 5 minutes multiple times throughout a single day. STEMCO has been using this test procedure for the past 12 months with trucking fleets and we believe it to be even more reliable than Type II testing. The experimental design of short timed laps (<30 minutes) and alternating between two aerodynamic states minimizes the variability due to changing external variables and provides a smaller time effect than any currently accepted on-road test. Additionally, the method of data collection via the CAN Bus allows for a more granular data analysis of speed and operating condition effects than can be achieved through the single data point generated by weighing fuel tanks on a scale. We specifically request comment from the EPA and NHTSA on which steps STEMCO would need to take to get alternating, short duration on-road testing recognized as an accepted test procedure for this regulation. [EPA-HQ-OAR-2014-0827-1259-A1 p.7]

#### **Response:**

The agencies agree that no single test procedure is perfect for all devices. The final trailer program is designed to allow manufacturers to choose an appropriate test procedure for their device and resources. As described in Section IV.F.3.b of the Preamble to this rulemaking, we have structured our final regulations to make wind tunnel testing our primary method for measuring trailer aerodynamic performance as wind-averaged drag, but are adopting interim provisions that allow a manufacture to use wind-averaged CFD results or near-zero yaw coastdown testing without adjustment (see 40 CFR 1037.150(x)). Our test results in Chapter 2.10.2.1.2.4 and 2.10.2.1.3 of the RIA, show that most device performance from these three test methods are similar within the same aerodynamic bin. For devices that may be sensitive to yaw angle, manufacturers can work with EPA to establish an appropriate yaw adjustment for their coastdown results.

The protocols for coastdown, wind tunnel, and CFD analyses result in a CdA value. Note that SmartWay’s 2014 protocols allow SAE J1321 Type 2 track testing, which generates fuel consumption results, not CdA values. Commenters did not suggest a means of converting from the fuel consumption results to an appropriate delta CdA value for use in compliance. As a result, the final program does not accept J1321 data for pre-approval, as proposed.

**Organization:** STEMCO

- STEMCO requests that wind-averaged CDA values be used instead of zero-yaw CDA values.

Yaw and wind-averaged drag

STEMCO requests that trailer aerodynamic device manufacturers be allowed to use wind-averaged delta CDA drag values. As noted in EPA/NHTSA's proposal, many trailer aerodynamic devices increase in efficiency at higher yaw angles and crosswinds<sup>7</sup> and we believe that an accurate delta CDA drag value for regulatory purposes should reflect the full spectrum of real-world conditions. Not only would zero-yaw assessments be an unfair penalty to existing devices that have already been optimized for crosswinds, we believe a dangerous priority shift would occur in future research and development, potentially creating a next generation of aerodynamic devices whose zero-yaw delta CDA values (EPA and NHTSA's metric for environmental benefit) are substantially higher than their wind-averaged delta CDA values (real-world environmental benefit). [EPA-HQ-OAR-2014-0827-1259-A1 p.7]

EPA and NHTSA mention the benefit of cross-method comparison and certification as a rationale for only accepting zero-yaw values for wind tunnels and CFD. We believe that this cross-method comparison can still be accomplished by simply requiring trailer aerodynamic device manufacturers to submit both their zero-yaw and wind-averaged drag values. No additional testing is required and the zero-yaw value can be compared against coastdown, constant speed, or other wind-restricted procedures, while the wind-averaged drag value can be used as the official compliance value. If the EPA and NHTSA desire to apply a correction factor (such as "Falt,aero") to a zero-yaw value, that same correction factor (x 1.10 was an example used in the proposal) could also be applied to the wind-averaged drag value. We are also encouraged by recent research and efforts by the National Research Council (NRC) to develop a wind-averaged drag method for coast down testing, so it is possible that in the coming years an accurate direct cross-method comparison can be made using wind-averaged drag values directly. [EPA-HQ-OAR-2014-0827-1259-A1 p.8]

**Response:**

As noted in our response to CARB on page 1061, we are adopting a wind-averaged approach for trailer aerodynamic testing.

**Organization:** STEMCO

- STEMCO requests that the EPA and NHTSA publish the testing methods and vehicle settings used to achieve certification by each approved trailer aerodynamic device.

Publishing test procedure settings for all certified trailer aerodynamic devices

STEMCO requests that the EPA and NHTSA publish online the aerodynamic test procedure settings for all trailer aerodynamic devices that have been awarded a certified delta CDA value. Examples of test procedure settings include, but are not limited to: test procedure method, testing facility name and location, tractor make/model/year used as the standard tractor, and trailer make/model/year used as the standard trailer. [EPA-HQ-OAR-2014-0827-1259-A1 p.8]

Prior to the SmartWay 2014 update, there was no visibility into the test settings used for a verified trailer aerodynamic device on their website. It has been suggested that certain testing advantages could be achieved by using specific tractors, trailers, or tractor-trailer gap settings, but without publishing



these specifics for each verified device, those potential advantages became more trade secret than public knowledge. Although the test procedures presented here by the EPA and NHTSA appear more stringent, we believe test settings should be public information to better facilitate apples-to-apples device comparisons and to easily allow device manufacturers to match test settings with other high-achieving devices. This hopefully creates a level-playing field where the best aerodynamic devices rise to the top of EPA and NHTSA's delta CDA value rankings and not the aerodynamic devices that were tested with the most favorable standard vehicle and/or using the most favorable test procedure. [EPA-HQ-OAR-2014-0827-1259-A1 p.8]

**Response:**

The agencies agree that there could be value in an online repository for aerodynamic test settings and data. However, requiring, collecting, presenting, and maintaining information at the level of detail suggested by the commenter would go well beyond what we have done historically in our motor vehicle programs, and we cannot commit to publication of such information at this time. We encourage industry stakeholders to investigate other options for such publication; perhaps through applicable associations or technical groups.

**Organization: STEMCO**

- STEMCO supports the Aerodynamic Device Testing Alternative because it minimizes the testing and certification burden placed on trailer manufacturers and ensures that aerodynamic device manufacturers have full control over the testing and certification of their own products.
- STEMCO recommends an EPA and NHTSA created website for computing the Trailer Compliance Equation and submitting compliance data, which will reduce the reporting and fleet education burden placed on trailer manufacturers. [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

**Use of the Compliance Equation for Trailer Compliance**

STEMCO appreciates EPA and NHTSA's desire to minimize compliance reporting paperwork for the industry (trailer manufacturers, trucking fleets, and aerodynamic device manufacturers). We request additional details on how reporting would be completed and submitted and present a specific suggestion below: [EPA-HQ-OAR-2014-0827-1259-A1 p.8]

First, EPA and NHTSA could create a website prior to 2018 that interactively computes overall trailer CO<sub>2</sub> and fuel consumption using the Trailer GEM-Based Compliance Equation (IV-1). This website would display a pick-able list of approved trailer aerodynamic devices, tires, automatic tire inflation (ATI) systems, and light-weighting options, allowing a trailer manufacturer or trucking fleet to easily experiment with how different product choices can best satisfy regulatory compliance for their application. This website would also include, and make visible, the EPA and NHTSA's discounting equation for combining multiple aerodynamic devices that is outlined on pages 312 and 313 of the proposal. This website should also include approved trailer types and work-performing devices that allow for a lower "partial-aero" compliance standard. For example, a visitor to this website should be able to select a drop-frame trailer, which would lower the compliance standard in the 2027 Alternative 3 timeframe (or the 2024 Alternative 4 timeframe). Lastly, once the resulting overall trailer CO<sub>2</sub> and fuel consumption level has been computed, we request a color or message box that clearly indicates the model year of compliance achieved (ex. "Compliant with MY2021 but not MY2024"). [EPA-HQ-OAR-2014-0827-1259-A1 p.8-9]

By functioning as a central repository, this website would ensure alignment throughout the industry and assist trailer manufacturers when selling MY2018 and later new trailers to trucking fleets. A salesperson would be better equipped to show a trucking fleet the EPA and NHTSA website and let them choose a suite of options until the box at the bottom “goes green” than to perform the arithmetic outlined in the Trailer GEM-Based Compliance Equation. In the event that the EPA and NHTSA choose to allow the averaging option, this website could include an “over-compliance” indicator to inform trailer manufacturers about a surplus that may be applied to offset an under-complying trailer order. [EPA-HQ-OAR-2014-0827-1259-A1 p.9]

Second, this website could be used directly (or indirectly) as the end of year reporting submission tool for trailer manufacturers. Ideally, a trailer manufacturing representative would enter a password or manufacturer’s code to access additional cells to type in the number of trailers (and possibly VIN numbers) and then press a button to officially submit a batch of CO2 and fuel consumption values to the EPA and NHTSA. If this website was successful, it would allow trailer manufacturers to get in the regular habit of quickly submitting data every time they fulfill a trailer order, eliminating the need for end-of-year reporting. As an added advantage, the EPA, NHTSA, and the trailer manufacturer would be informed in real-time about their compliance progress for the year (we don’t recommend changing the three-year catch-up compliance provision, however). [EPA-HQ-OAR-2014-0827-1259-A1 p.9]

It is imperative that this website be well-built and easy-to-operate because taking more than a few minutes per order submission would quickly become an undue burden for trailer manufacturers. We also defer to trailer manufacturers if they would prefer to lump reporting into a year-end activity instead of this as-you-go basis. [EPA-HQ-OAR-2014-0827-1259-A1 p.9]

We are not aware of the complexity and burden that creating and maintaining this website would place on the EPA and NHTSA, but we believe that it is both a needed step and one whose cost may be offset by a reduction in the workload placed on each EPA and NHTSA compliance representative assigned to a trailer manufacturer. [EPA-HQ-OAR-2014-0827-1259-A1 p.9]

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**Response:**

The agencies have outlined the general steps for reporting in the Preamble to this rulemaking. The complete list of compliance steps for trailer manufacturers can be found in the regulations (40 CFR Subparts G through I, starting with 1037.601). The process for obtaining preliminary approval of test data for aerodynamic device manufacturers is outlined in 40 CFR 1037.211. As noted in our previous response, we agree that there could value in an online repository for aerodynamic device performance, including the test setting requested previously. However, we cannot commit to publication of such information at this time. We encourage the industry to investigate other options for such publication; perhaps through applicable associations or technical groups. EPA’s Compliance Division has an established, secure database system for submitting compliance information. To maintain consistency, we cannot justify conversion to a new system when EPA’s staff and all of the currently regulated industries are familiar with the existing system.

**Organization:** Stoughton Trailers

The regulation document is written to allow for several types of tests to establish the coefficient of drag related to a product and it’s incorporation of drag reducing aerodynamic devices. The variables associated with each test raise question as to the validity of the reported outcome. Many devices have been tested numerous times in order to reach the opportune conditions required to allow performance at

the claimed level. An additional means of submitting data for consideration is the CFD program. This program is based on the ability of the model creation and applied conditions to replicate a real world condition. Simply stated the use of CFD is a valuable tool to consider iteration of design which may lead to an advantageous coefficient of drag result, but it is too easily gamed. [EPA-HQ-OAR-2014-0827-1212-A2 p.2]

Request 6: Since coefficient of drag is the measurement being used for aerodynamic consideration, please restrict the submission of data to a format requiring wind tunnel testing alone. [EPA-HQ-OAR-2014-0827-1212-A2 p.2]

**Response:**

As noted previously in our response to Exa (page 1062), and described in Section IV.F.3.b of the Preamble to this rulemaking, we have structured our final regulations to make wind tunnel testing our primary method for measuring trailer aerodynamic performance as wind-averaged drag, but are adopting interim provisions that allow a manufacture to use wind-averaged CFD results or near-zero yaw coastdown testing without adjustment (see 40 CFR 1037.150(x)).

**Organization:** Truck Trailer Manufacturers Association (TTMA)

In our “Averaging” section (8), we discuss the problems with the proposal’s averaging provisions and how what the agencies regard as beneficial to industry would actually be harmful to the trailer industry. We discourage the agencies from using this scheme in regard to trailers. [EPA-HQ-OAR-2014-0827-1172-A1 p.2]

**8 - Averaging**

While we understand that the agencies view Averaging, Banking and Trading programs as beneficial to the regulated industry, it’s important to realize that the trailer industry is not the automobile industry. The six year annual production average for trailers is 187,666 while for cars, it is 13,906,666. It would take the trailer industry 74 years to build what the automobile industry builds in a single year. [EPA-HQ-OAR-2014-0827-1172-A1 p.13]

Averaging will cause unnecessary disruption in the trailer industry. Currently, most trailers are built to customer specification and most customers have found a preferred manufacturer to build to that specification. With averaging, a given manufacturer may find that the mix of customers in a given year does not allow them to meet their target, which would require that manufacturer to turn away customers and force customers to seek new vendors for established trailers. Manufacturers who specialize in making trailers that are typically used transiently, such as trailers used for intra-city distribution, would be particularly hard hit; the trailer they specialize in would have little to no real-world gains in efficiency while it would have many real-world penalties. Customers would be quick to recognize this and when the specialist manufacturers had to stop selling optimal trailers to meet the averages in the proposal, the customers would have to seek out a new trailer supplier. Large manufacturers aren’t looking forward to this either, as a flood of new customers looking for these trailers would skew their numbers and create problems for the larger customers they focus on. [EPA-HQ-OAR-2014-0827-1172-A1 p.13-14]

Rather than do this, we would prefer that averaging be done away with entirely: each trailer subject to regulation should be required to meet a given standard. This will require that certain users will have to change their specifications, but will cause minimal disruption to the industry. To do this with minimal

disruption to the greater freight industry, careful thought will be needed to be given to trailers that are excluded as mentioned above. The best option would be to allow market forces to work on the situation with the voluntary SmartWay program. [EPA-HQ-OAR-2014-0827-1172-A1 p.14]

More importantly, however, we request that the agencies demonstrate the commercial feasibility of the proposed rules before they can take effect –i.e., that EPA and NHTSA provide reliable evidence that the technologies imposed by the proposed regulations can be successfully marketed to motor carriers, given that these technologies already exist as options but are not being widely purchased by many motor carriers because their mix of drop-and-hook operations and multiple short, low-speed deliveries does not generate measurable fuel savings benefits. The proposed rules do not require motor carriers to purchase specific equipment or to attain specific fuel efficiency goals. Instead, the proposed rules will require trailer manufacturers to sell this equipment to an increasing majority of their customers whether these customers want it or not. More accurately, the proposed rules will require the larger manufacturers to sell this equipment, while exempting smaller manufacturers from that requirement at the outset, an exemption that will certainly divert sales to the smaller trailer manufacturers in early years and thereby fail to achieve the agencies' desired goals while arbitrarily and unreasonably imposing the sales obligation on the larger manufacturers. As noted above, however, the reality is that all trailer manufacturers are small manufacturers when compared to the manufacturers of the millions of other motor vehicles sold in the United States annually, which, because of those huge volumes, have the ability to sell expensive and highly fuel efficient vehicles at little or no profit in order to offset sales of more popular less fuel efficient vehicles. Trailer manufacturers, by contrast, do not have the sales volumes needed to absorb trailer sales that produce little or no profit, which will certainly be the effect of requiring them to install equipment that their customers have so far refused to purchase and which those customers will simply refuse to pay for if the new rules take effect. The EPA and NHTSA have produced no reliable, measurable evidence that those motor carriers can be forced to pay for the required technologies, and instead the agencies are proposing to put (some) trailer manufacturers in the completely unreasonable position of insisting that their customers pay for equipment that is not wanted or accept delivery of unwanted equipment at the trailer manufacturer's expense. In the latter instance, the cost of the proposed regulations, which are purportedly justified achieve a national benefit, will be arbitrarily and unreasonably (and in many cases impossibly) imposed solely on (some) trailer manufacturers and not passed on to the motor carriers and then on to their customers, the shippers and the public at large. Therefore, for the proposed rules to satisfy the legal requirements that they be reasonably drawn and achievable in fact, their commercial feasibility must be proven and not merely assumed, and the proposed rules must not establish unreasonable and arbitrary distinctions and sales requirements that disproportionately burden a minority of market participants. Alternatively, the legal requirements to purchase and install the desired equipment should be imposed on the motor carriers directly so that the free market for trailer sales will not be arbitrarily segmented and defeated. [EPA-HQ-OAR-2014-0827-1172-A1 p.14]

**Response:**

The agencies recognize that the trailer industry differs from other heavy-duty vehicles and we designed much of the Phase 2 trailer program to address these differences. As noted in our response to Great Dane (page 1063) the final program includes averaging, but the option is limited to MYs 2027 and later for full-aero box vans only. In the years prior to MY 2027, all trailers must meet their respective standards, consistent with this comment. In MY 2027 and later, when the standards for full-aero box vans are the most stringent, manufacturers have the option to average as an additional flexibility, but averaging is never a requirement. See our memo to the docket outlining possible technology packages

that can be used to meet the MY 2027 standards with and without averaging.<sup>164</sup> We are also adopting a minimum performance level (equivalent to MY 2018 standards) that box vans in an averaging program must meet to prevent manufactures with higher production volume or more diverse products from generating sufficient emissions credits to produce trailers with no emissions controls. This minimum performance level may also help manufacturers manage their relationships with customers seeking no-control trailers. Note that all non-box trailers and any box vans designated non-aero or partial-aero cannot be averaged at any point in the program, which partially aligns with this comment.

The partial- and non-aero designations, and their accompanying reduced standards, are intended to capture a majority of the box vans that are frequently used exclusively in urban environments where they would have less benefit from aerodynamic devices. Some box vans may also be used in urban environments, but may not have work-performing equipment that qualifies them for these designations. However, we expect they will spend at least some time at speeds of 55-mph or faster, where they will see a 1% or more benefit from aerodynamic devices (see our response to Stoughton on page 965, and RIA Chapter 2.10.2.1.1). We thus do not accept the premise of the comment that aerodynamic devices will be installed on trailers for no benefit and hence that trailer manufacturers will bear all of the cost because customers will not pay for devices which do not pay back.

The comment also makes note of the one-year delay for small business manufacturers, and claims that business will be diverted from large manufacturers to small manufacturers during that time. As seen in Figure 1-3 of Chapter 1 in our RIA, the cumulative annual production of all of the small business box trailer manufacturers is estimated to be less than 15 percent of the industry's total production, which is significantly less than the annual production of the four largest manufacturers. Small businesses do not have the same resources available to become familiar with the regulations, make process and staffing changings, or evaluate and market new technologies as their larger counterparts. We believe a one-year delay provides additional time for small businesses to address these issues, without a large CO<sub>2</sub> and fuel consumption impact or substantial negative competitive effects.

The agencies regard the costs of the trailer program as reasonable. First, the trailer standards are cost effective, even without considering payback. See Section IV.C.3 of the Preamble to the final rule and Chapter 7.2.5 of the RIA. The \$36 per CO<sub>2</sub>eq reduction presented for tractor-trailers compares favorably with the levels of cost effectiveness found reasonable for light-duty trucks (see 77 FR 62922). We present combined tractor-trailer values, because tractors and trailers are inherently used together in the real world. However, we understand that it may be of interest to ensure the tractor and trailer programs are individually cost effective as well. As described in a memo to the docket, we estimate the cost effectiveness of trailers in calendar year 2030 to be \$21 per CO<sub>2</sub>eq and tractors to be \$39 per CO<sub>2</sub>eq, suggesting that these programs are cost effective and provide significant net benefits both individually and combined.<sup>165</sup>

**Organization:** Utility Trailer Manufacturing Company

**The EPA's various test methods for establishing aerodynamic-drag coefficient are not repeatable.**

The scientific method requires that test results be repeatable, verified by third parties, and that equivalent tests yield equivalent results, all within reasonable margins of error. Coastdown, constant-

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<sup>164</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Example Compliance Scenarios for the Final HD GHG Phase 2 Trailer Program" August 2016.

<sup>165</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Tractor-Trailer Cost per Ton Values" August 2016

speed, and various wind-tunnel test results – which the EPA used – are not necessarily repeatable over time and by third parties. This is especially likely for tests that use human drivers. Utility Trailer has conducted fuel-savings tests of the same model side skirt at different times at the same facility, and at different test facilities. Although Utility Trailer employed identical test protocols, the results varied significantly. [EPA-HQ-OAR-2014-0827-1183-A1 p.12]

A vetted computational fluid dynamic (CFD) test controls for these variations. Utility Trailer employed Exa Corporation (the same entity used by the EPA) to perform CFD tests on the proposed aerodynamic devices. Exa Corporation advised Utility Trailer to increase the aerodynamic drag area provided by the EPA's Table 2-76 by 25% to match the CFD model to the EPA's coastdown test results. Although this adjustment roughly approximated the results the EPA achieves from the coastdown test, it does not produce equivalently acceptable results for the constant-speed or wind tunnel method of computing the aerodynamic-drag coefficient. This calls into question the validity of the EPA's tests used to establish the aerodynamic-drag coefficient. The Agency has failed to provide a proper analysis of equating the various test methods to one another; it also has not confirmed the results by independent, valid testing. [EPA-HQ-OAR-2014-0827-1183-A1 p.12]

**The Agencies should permit manufacturers to submit efficiency numbers for their aerodynamic technologies that include realistic yaw angles.**

The Proposed Rules permit manufacturers and suppliers to use alternative devices to achieve the required greenhouse-gas emission reductions, provided they establish the efficiency of those devices. The GEM model, however, requires that the efficiency be established at 0-degrees yaw – in other words, without cross winds. And for model years 2021 and beyond, the EPA requires that all aerodynamic devices be qualified again with 0-degree yaw angle. [EPA-HQ-OAR-2014-0827-1183-A1 p.21]

This requirement was done purely for the sake of the GEM model, regardless of the very significant and varying effect yaw angle has on the different aerodynamic device efficiencies. This is unrealistic and does not involve the real world, where crosswinds are more common than not. Constant-speed and coastdown tests all permit some amount of wind. This biases their results as compared with other test methods of determining aerodynamic-drag coefficients. [EPA-HQ-OAR-2014-0827-1183-A1 p.21-22]

Utility Trailer has performed computational fluid dynamic (CFD) analysis of many of the EPA SmartWay-approved trailer aerodynamic devices, using the same testing agency (Exa Corporation) that the EPA has employed for some of its tests. The EPA SmartWay-approved trailer side skirt reduce the tractor/trailer aerodynamic drag coefficient the most, especially with cross winds or with a significant yaw angle. As Utility Trailer and other manufacturers develop new devices and configurations to increase aerodynamic efficiencies, Utility Trailer urges the Agencies to permit the manufacturers to perform sufficiently sophisticated testing to account for the effect of yaw angle (crosswinds) on those devices. This will permit the proposed savings to better represent actual anticipated fuel efficiency savings. [EPA-HQ-OAR-2014-0827-1183-A1 p.22]

**Response:**

The agencies are aware that individual, *absolute*  $C_dA$  values may differ between aerodynamic test methods, wind tunnel facilities, or CFD packages. The tractor aerodynamic test program is designed to apply a correction factor to a reference test method to address these differences. However, our results (as shown in RIA Chapter 2.10.2.1.2) indicate that the variability in *delta*  $C_dA$  results are much smaller. The trailer program is designed such that we are measuring the improvement in aerodynamic performance, and that improvement is nearly the same for all three test methods.

The agencies proposed to determine the delta  $C_dA$  for trailer aerodynamic performance using the zero-yaw (or head-on wind) values from any of the approved test procedures. However, based on comments received, including the comment above, we are revising the final program to be based on wind-averaged results, similar to the tractor program. We thus agree with the comment that effects of wind must be accounted for in aerodynamic testing. We also note that our GEM vehicle simulation does not require a zero-yaw value. In fact, the tractor program, which uses the same model for compliance, requires wind-averaged  $C_dA$  values from its aerodynamic testing and GEM appropriately applies those results in its calculations. Our proposal to use zero-yaw values in the trailer program was for simplicity and to avoid the need to perform any corrections to wind-averaged values.

We received no comments in support of use of zero-yaw results for the trailer program, and several supporting the use of wind-averaged values. Additionally, comments directed to the tractor program indicated that the average of results from +4.5 and -4.5 degrees is a representative surrogate for wind-averaged results, which would maintain simplicity for wind tunnel and CFD testing. While our final trailer program does consider wind tunnel testing to be our primary test method, we are adopting interim provisions that do not require a correction to wind tunnel results. Our aerodynamic testing (summarized in Chapter 2.10.2.1.2 of the RIA) shows that similar devices perform within the aerodynamic bins of the program, including many coastdown results from tests performed at near-zero yaw angles. Some devices did display a yaw dependence and their coastdown values were notably lower than wind-averaged results. Consequently, we are adopting interim provisions to allow manufacturers that choose to perform coastdown tests to work with EPA to identify an appropriate means of converting to wind-averaged values. Our interim provisions related to trailer aerodynamic testing can be found in 40 CFR 1037.150(x).

**Organization:** Utility Trailer Manufacturing Company

**The Agencies' Compliance Program is Flawed; the Proposed Rule Should Delete Averaging and Bins from its Compliance Models as the Model as Drafted Imposes a Significant Administrative Burden and Allows Customers to Game the System**

As noted earlier, Utility Trailer does not believe the Agencies' Proposed Rule is necessary. The free market is quite capable of continuing to obtain increasing fuel efficiencies while allocating as appropriate the resources needed to accomplish those goals. Operators and trailers that would benefit from installing the technologies – or that would achieve the EPA's estimated two-year payback – should install those technologies. The Agencies have not offered any explanation as to why the free market is incapable of producing the desired results. [EPA-HQ-OAR-2014-0827-1183-A1 p.18-19]

But Utility Trailer also recognizes the political reality that the Agencies are unlikely at this point to rely on the free market to continue to solve this problem. Utility Trailer therefore offers the following suggestions to improve any Rule the Agencies adopt. [EPA-HQ-OAR-2014-0827-1183-A1 p.19]

The compliance program – with its system of averaging and bins – is unduly complex and unsuited to the trailer industry. Utility Trailer urges the Agencies to streamline the compliance aspects of the program in a way that will decrease the administrative burden on the trailer manufacturers while providing the Agencies with the level of compliance desired. Specifically, the compliance program should be modified as follows: [EPA-HQ-OAR-2014-0827-1183-A1 p.19] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.220.]]

- Develop clear categories of trailers that will be exempt from the Proposed Rules. These categories should include considerations of trailer configuration and the use that will be made of the trailer, including the environments and areas in which it will operate. Exemptions could relate only to some of the technologies required by the Proposed Rule. [EPA-HQ-OAR-2014-0827-1183-A1 p.19]
- Allow manufacturers to certify by label that the trailers manufactured comply with applicable Agency regulations. [EPA-HQ-OAR-2014-0827-1183-A1 p.19]

**The Agencies should delete the bin-and-averaging approach currently described in the Proposed Rule and permit manufacturers to certify their compliance with the Rule rather than obtaining Agency approval for each plan year.**

The Agencies' proposed bin-and-averaging compliance model is unmanageable in the trailer-manufacturing industry. Utility Trailer and the other major manufacturers build semi-custom trailers. Although orders start with a base model and standard options, customers routinely add a large number of customer-specific options. Additionally, customers make numerous specification and quantity changes throughout the process, often up to the time actual manufacture of the unit begins. Some of these option changes, as noted previously, conflict with the aerodynamic devices. [EPA-HQ-OAR-2014-0827-1183-A1 p.20] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.220.]]

Utility Trailer urges the Agencies to adopt a simpler, more straightforward approach: require the original equipment manufacturer to install specific approved devices on all non-exempt trailers. This provides the following advantages. [EPA-HQ-OAR-2014-0827-1183-A1 p.20]

*First*, it is manageable. The administrative burden required by the Proposed Rule is oppressive. The Proposed Rule would require each manufacturer to obtain Agency approval before the start of each year of a plan for weighted average compliance to the GEM formula for all production. Then, at the end of the year, the manufacturer would need to obtain Agency approval of the actual production results and for rollover into the next year. Also significant is the administrative burden associated with scheduling production slots and allocating those requiring different complying devices throughout the year. Because of the assembly-line manufacturing process, it is far more efficient to avoid changing technologies from order to order, to the extent practical. [EPA-HQ-OAR-2014-0827-1183-A1 p.21] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.220.]]

Far simpler and equally effective would be to require each manufacturer to install a label on each trailer certifying to that compliance and to keep records of the weighted averages to achieve compliance if the averaging approach is part of the Rule. The Agency, if it desired, could inspect those records as needed. This would be approximately the same system as trailer manufacturers use to comply with the NHTSA's Federal Motor Vehicle Safety Standards. This is a time-proven, successful system. [EPA-HQ-OAR-2014-0827-1183-A1 p.21]

*Second*, eliminating averaging avoids gaming the system. The Agencies' one-size-fits-all approach is unworkable in the trailer industry. For many operators, the aerodynamic devices are unworkable or undesirable. But because the Proposed Rule requires the manufacturer to achieve an average specified reduction in aerodynamic and rolling-resistance drag (i.e., some of its trailers will have a grouping of the devices (bins); others wouldn't), the manufacturer will be placed in the position of deciding which customers must buy the devices and which ones will be exempt. This provides huge incentives for larger fleets to use their market pressure to force the manufacturer to exempt them from purchasing the devices the larger fleets do not want, leaving the smaller customers without market power to purchase a



disproportionate amount of the technology. This, of course, would also increase costs for the smaller competitors. [EPA-HQ-OAR-2014-0827-1183-A1 p.21]

Thus, we urge the Agencies to modify the requirements from a maximum CO<sub>2</sub> output in grams per ton-mile as currently proposed. Rather, the requirements should be written to specify types of drag-reducing devices that meet specific qualification requirements for all non-exempt trailers. [EPA-HQ-OAR-2014-0827-1183-A1 p.21]

**Response:**

The commenter supports a simplified compliance approach that would be based on the agencies requiring trailer manufacturers to install specific devices, an approach that we generally call a “design-based standard.” However, an important principle of all of our motor vehicle programs is to focus on emissions or fuel consumption performance, and thus “performance-based standards” whenever possible. By focusing on performance, the agencies try to avoid pre-judging or restricting manufacturer choice in determining the best mix of technologies for a company and its specific applications in achieving the emission and fuel consumption reduction goals of the program. In some ways, it is the commenter’s preferred design-based approach which is one size fits all. Although the program applies design-based standards (specific tire and tire pressure technologies) to some trailer types for which aerodynamic technologies are generally not appropriate, manufacturers of most trailers covered by the program (i.e., box vans) comply by choosing whichever mix of aerodynamic, tire, and weight reduction technologies they believe best. The commenter expresses concerns about the additional administrative burdens potentially associated with performance-based standards, we have designed a unique compliance program for trailers (chief facets of which are the GEM equation, eliminating banking and trading, and limiting the option to average until MY 2027) that we believe provides an appropriate balance between manufacturer flexibility and reasonable compliance burden.

The commenter also proposes that the trailer compliance program not involve averaging. In response to suggestions elsewhere in this Response to Comments document from this commenter and others, final program includes averaging, but only late in the program, limiting the option for trailer manufacturers to apply averaging to MYs 2027 and later exclusively, and for full-aero box vans only. The commenter suggests a large customer may use its market pressure in an averaging program to purchase all of a manufacturer’s allotted trailers with limited technologies. This situation is avoided during the early years of the program when we do not allow averaging (i.e., all trailers sold will have to meet their respective standards using some combination of technologies). As noted in our response to TTMA (page 1078), if a manufacturer opts into the averaging program in MYs 2027 or later, we are adopting an minimum level of performance (based on MY 2018 standards) that each trailer must meet, which prevents a customer from requesting a no-control trailer.

The commenter requests that the agencies provide “clear categories” of trailers that will be exempt. In response to these and other comments, the final program applies to many fewer trailer types than did the proposed program. Only three types of non-box trailers are covered, with all other trailer types completely excluded from any requirements of the trailer program.

To clarify, the aerodynamic bins of the trailer program are similar to the performance metric used by EPA’s SmartWay technology verification program. Instead of levels of 1%, 4%, 5% and 9% fuel savings as used by SmartWay, the Phase 2 trailer program has seven aerodynamic performance thresholds measured as delta CdA. The bins are designed to account for variability between test procedures, device manufacturers, and tractor-trailer combinations in testing, and the performance values obtained from testing are used as an input to the GEM-based trailer compliance equation. We do

not have aerodynamic requirements, but the performance standards for box vans were designed using a reasonable combination of technologies, including some level of aerodynamic improvements each phase. These performance standards could be met with very little aerodynamic improvements if manufacturers can remove sufficient weight, install tire inflation systems, and adopt tires with very low rolling resistances. Manufacturers can use the equation to evaluate what technology performances will result in the desired CO<sub>2</sub> reductions.

We note that aerodynamic bins are unrelated to averaging. All manufacturers evaluate their overall trailer performance by applying the technology performance values (including aerodynamic bin values if aerodynamic improvements were made) in the compliance equation to get a CO<sub>2</sub> emissions rate in grams CO<sub>2</sub>/ton-mile. This emissions value is submitted for compliance. Manufacturers that opt to use averaging in MY 2027 or later would calculate a production-weighted average of all of their overall trailer performances (i.e., the CO<sub>2</sub> results) according to 40 CFR 1037.107(5). This average may include some trailers that do not meet their standard and others that over-comply with the standard, as long as the standard is met *on average* based on production volumes.

**Organization:** Wabash National Corporation

[Note: Wabash’s full comments placed in the docket include several footnoted references that do not appear in this summary.]

### **The Proposed Averaging Program Is Unnecessary, Unduly Complex, and Hinders Innovation**

EPA has proposed an “averaging” compliance program for trailers. Manufacturers could average the emissions of all their trailers in a given subcategory model year of trailers to comply with the proposed CO<sub>2</sub> emissions standards. Thus, a manufacturer could produce some individual trailers that fail to comply with the proposed standards when other trailers in the subcategory “over-comply,” such that, on average, the over-compliant trailers “make up” for any shortfall in the remaining trailers. The subcategory of trailers that EPA has proposed for averaging are “full-aero” trailers, i.e., short and long dry and refrigerated box trailers capable of accommodating aerodynamic technologies.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.9-10]

The proposed averaging scheme for trailers is a truncated version of an averaging, banking, and trading (“ABT”) program. For several years, EPA has used ABT programs to assist engine and vehicle manufacturers in complying with emissions programs under Title II of the Clean Air Act. In an ABT program, manufacturers may create “credits” from over-compliance that can be (1) used to achieve “average” compliance in a given model year, (2) banked for use in future years, or (3) traded to third-party manufacturers for their own compliance purposes. The Proposal limits averaging to a single model year, except compliance deficits could be made up within three years. Neither credit banking, nor trading, would be permissible. [EPA-HQ-OAR-2014-0827-1242-A2 p.10]

#### **A. The Proposed Averaging Program Is Impracticable and Creates Barriers to Innovation**

Wabash appreciates the opportunity to comment on EPA’s good faith efforts to develop alternative compliance methods for trailer manufacturers. Respectfully, however, Wabash opposes averaging because it is unworkable in the trailer industry. As EPA acknowledges in the Proposal, the “reality” of the trailer market “can limit the value of the flexibility that averaging could provide to trailer manufactur[ing] . . .” “Compared to other industry sectors,” trailer manufacturers “have little control

over their customers' demands and thus limited ability to manage the mix and volume of different products."<sup>12</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.10]

Wabash strongly agrees with EPA's observations about the trailer market. The reality is that an averaging program would fail to provide any flexibility, hinder compliance, and act as a drag on innovation. As the leading trailer manufacturer in the United States, Wabash provides these additional insights into the market to aid EPA's decision on whether to include averaging. [EPA-HQ-OAR-2014-0827-1242-A2 p.10]

- The theoretical flexibility offered by averaging is illusory because of the unique customization of trailers. While ABT programs have provided needed flexibility for engine and vehicle manufacturers, the trailer market differs markedly from those sectors. Engine makers and vehicle manufacturers typically produce a standard or base configuration of their products, which is then offered to customers with only limited customization. As a consequence, engine makers and vehicle manufacturers possess a high degree of control over the products they offer into the market. The reverse is true in the trailer market: trailers are highly customized and built to customers' specifications. Customers dictate the features for trailer applications, and in many cases, customers supply parts for the trailers they order—*e.g.*, tires and aerodynamic devices. [EPA-HQ-OAR-2014-0827-1242-A2 p.10-11]
- Market dynamics preclude reliable annual predictions of trailer sales needed for averaging. Averaging presupposes that a trailer manufacturer may predict with a reasonable degree of certainty the mix of trailers sold over a year, the relevant compliance period for purposes of EPA's emission standard. In other words, averaging assumes that a trailer manufacturer could plan in advance a year's worth of "over-compliant" and "under-compliant" trailers, so that, on average, the emission standard is met. However, such predictions would be impracticable because of the dynamic nature of the trailer market. The lead time for trailer design and manufacturing is far less than for engines and vehicles, providing customers flexibility in timing their trailer orders.<sup>13</sup> Trailer orders are taken year-round, but early spring and fall tend to be the busiest ordering seasons for the next year's production. Even after orders are made for trailers, order cancellations are common in the industry. Accordingly, trailer manufacturers are unable to reliably predict the product mix they will sell in a given year. Cancellation of large orders, for example, could easily derail a compliance strategy built on averaging. Additionally, the trailer industry is highly cyclical, with history demonstrating that it is common for manufacturers to experience 100-200% swings in sales volumes from one year to the next. Such large swings in yearly order volume would also upset any compliance strategy built on averaging. [EPA-HQ-OAR-2014-0827-1242-A2 p.11]
- Averaging could act as a barrier to innovation to aerodynamic trailers. Averaging creates a barrier to trailer innovation. While aerodynamic trailers provide fuel savings, the trailer customer may not reap those savings when the trailer is pulled by a tractor owned by another company.<sup>14</sup> Averaging entrenches this barrier to aerodynamic trailers because demand may cause all manufacturers to produce at least some conventional trailers regardless of whether averaging is optional. The continuing production of conventional trailers risks three scenarios that could impede progress toward advances in aerodynamic technologies: (1) customers may demand the conventional, non-compliant trailers that averaging allows; (2) customers could refuse to pay for the aerodynamic devices and the trailer manufacturer would have to absorb the costs, further reducing the profit margin in an already small operating margin business (typically less than 5%, and even less than 1% in some years); or (3) customers could take their business to another trailer manufacturer.<sup>15</sup> A single federal standard would best promote the market for innovative aerodynamic technologies. [EPA-HQ-OAR-2014-0827-1242-A2 p.12-13]

## **B. EPA Precedent Supports Forgoing an Averaging Program for Trailers**

Declining to create an averaging program for trailers would be consistent with agency precedent on ABT programs. Nothing in the Clean Air Act, or EPA's regulations, requires an ABT program for every mobile source regulation. EPA has declined to create ABT options where it would be unnecessary or inappropriate for a particular segment of the engine or vehicle industry.<sup>16</sup> In deciding whether to promulgate an ABT program, EPA has cited factors such as manufacturer interest in ABT and the impact of ABT on innovations and compliance, all of which cut against an averaging program for trailers.<sup>17</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.12]

## **C. CARB'S Tractor-Trailer Regulation Shows Averaging Is Unnecessary**

The experience with California's trailer greenhouse gas regulation shows that averaging is unnecessary. In 2008, the California Air Resources Board ("CARB") enacted the Tractor-Trailer GHG regulation, which became effective in 2010. The CARB regulation applies to long-haul tractor-trailers in California, specifically all model year 53-foot or longer dry van and refrigerated van trailers and the tractors that pull them. Covered trailers must be SmartWay certified or retrofitted with SmartWay aerodynamic devices (including skirts and end fairings) and use specified low rolling resistance tires.<sup>18</sup> Averaging is not an option under CARB's regulation. [EPA-HQ-OAR-2014-0827-1242-A2 p.12-13]

Despite the lack of averaging, EPA approved CARB's tractor-trailer regulation last year. The Clean Air Act preempts California's motor vehicle regulations unless EPA approves a waiver of preemption pursuant to Section 209(b), as it did for the tractor-trailer regulation. In granting the waiver, the agency found that CARB's tractor-trailer regulation is consistent with Section 202(a) of the Clean Air Act, the same authority that EPA relies upon in proposing the Phase 2 rule at issue. EPA also determined that CARB's regulation was reasonable and protective of human health and the environment. [EPA-HQ-OAR-2014-0827-1242-A2 p.13]

## **D. Averaging Imposes Undue Burdens on Trailer Manufacturers**

Averaging would be burdensome. As EPA recognizes, "an averaging program would inherently require a higher degree of data management, record keeping, and reporting than one without averaging," and specifically requested comment on whether "the burden of managing an averaging program could be more trouble than the flexibility is worth." As explained in detail below, the costs of setting up and maintaining compliance systems would be far higher than EPA suggests. The Phase 2 Proposed Rule represents EPA's first attempt to regulate trailer-related emissions. As trailer manufacturers enter the regulatory program, compliance would be facilitated by simplicity and clarity. To that end, EPA should require that trailers meeting specific characteristics meet a minimum stringency level without averaging. [EPA-HQ-OAR-2014-0827-1242-A2 p.13]

### **Response:**

As noted in our response to Great Dane on page 1063 and elsewhere, we are limiting the option for trailer manufacturers to apply averaging to MYs 2027 and later for full-aero box vans only. This approach attempts to balance the advantage of an averaging program to allow for introduction of the most reasonably stringent standards for trailers, with the concerns articulated by manufacturers.

The commenter proposes that the trailer compliance program not involve averaging. In particular, the comments notes that it would be difficult for trailer manufacturers to reliably predict their next years' sales. In the event that a manufacturer opts into the averaging program, the agencies understand that it

is possible for them to misjudge production and come up short at the end of the model year. While we are not adopting banking provisions as part of the final trailer program, the program provides for a manufacturer to generate a credit deficit that would need to be resolved through over-compliance within the following three years.

The comment refers to averaging as a “barrier to innovation” noting that some trailer manufacturers may continue to produce no-control trailers if they have sufficient demand for higher-performing trailers. As we described in our response to TTMA on page 1078, we are setting a minimum level of performance for trailers (based on MY 2018 standards) if manufacturers opt into an averaging program in the later years. While MY 2018 standards are relatively low performing trailers, they provide a level of confidence that some improvements will be made for all future trailers.

**Organization:** Wabash National Corporation

### **E. The Final Rule Should Provide a Flexible and Simplified Exemption Process**

Additionally, EPA should provide a simplified process for obtaining exemptions, rather than simply having an exclusive list of exemptions in the proposed regulations. This could be accomplished by specifying certain criteria, which, if met, would result in an automatic exemption for the proposed trailer configuration, or by establishing a process by which trailer manufacturers may petition EPA for additional exemptions. [EPA-HQ-OAR-2014-0827-1242-A2 p.13]

A similar process exists under the CARB tractor-trailer regulation. CARB allows “modified” SmartWay aerodynamic devices on trailers without prior approval where the modifications only have a “minimal” impact on aerodynamic surfaces. Additionally, CARB has pre-approved several modifications based on “necessity” and whether the modification had a “significant” impact on aerodynamic drag. As a third option, CARB allows companies to seek approval of new modifications to aerodynamic devices based on a description of the modification and wind tunnel testing.<sup>25</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.13-14]

Having a similar program for federal exemptions would assist the trailer industry in complying while meeting customer needs. It is impossible to predict in a rule all of the possible modifications and other issues that may arise in the trailer industry because it is a highly customized manufacturing process. Flexibility is necessary to allow for the future advancement of aerodynamic technologies and to address the development of currently unforeseen scenarios. Allowing for such exemptions would also be consistent with past regulatory approaches, including the Phase 1 provisions allowing off-road vehicle manufacturers to petition for an exemption for off-road vehicles that do not meet the listed exemption criteria in the regulations. [EPA-HQ-OAR-2014-0827-1242-A2 p.14]

#### **Response:**

As noted previously in our responses to ATA (page 1040) and XL Specialized (page 1054), the final program completely excludes all non-box trailers except flatbeds, tanks, and container chassis, as well as a small number of other specific exclusions. Specific definitions of the trailers excluded from the program are available in 40 CFR 1037.5. Although we believe that a formal process for excluding individual trailer models would be resource-intensive and would not be appropriate, the program does encourage trailer manufacturers to discuss any situations where the criteria for exclusion identified in the program may be unclear for specific trailer models before production begins.

**Organization:** Wabash National Corporation

## Light-Weighting Deserves Greater Credit and Compliance Flexibility

EPA and NHTSA recognize that reduction in trailer tare weight can reduce fuel consumption in two ways: (1) for applications where payload is not limited by weight restrictions, the overall weight of the trailer would be reduced, improving fuel efficiency, and (2) for applications where payload is limited by weight restrictions, the lower trailer weight would allow a corresponding increase in payload, thereby reducing emissions and fuel consumption on a ton-mile basis. The agencies note the weight reduction opportunities available in both the structural components of trailers and in the wheels/tires. Replacing heavier weight materials such as steel with aluminum or lighter-weight composites is currently feasible for trailer components such as roof bows, side and corner posts, cross members, floor joists, floors, and van sidewalls. Similar material substitution is feasible for wheels, and replacing two dual tires with single wide-based tires can also reduce weight. [EPA-HQ-OAR-2014-0827-1242-A2 p.15]

Because there is no clear baseline for current trailer weight against which lower-weight designs could be compared for regulatory purposes, EPA and NHTSA do not believe it would be appropriate or fair across the industry to apply overall weight reductions toward compliance. Instead, the agencies are proposing to allow manufacturers to account for weight reductions involving substitution of very specific, traditionally heavier components with lower-weight options that are not currently widely adopted in the trailer industry. EPA and NHTSA are proposing compliance provisions that would limit the weight-reduction options to the substitution of specified components and have identified several conventional components with available lighter-weight substitutes (*e.g.*, substituting conventional dual tires mounted on steel wheels with wide-based single tires mounted on aluminum wheels). The agencies are proposing values for the associated weight-related savings from these substitutions that would be used in GEM for compliance purposes. [EPA-HQ-OAR-2014-0827-1242-A2 p.15]

The agencies should give greater credit for light-weighting and include a process for manufacturers to add to the list of qualifying components and materials. As currently proposed, the equation for trailer compliance gives a 1% credit per 1,000 pounds of weight. The agencies appear to be unnecessarily discounting light-weighting by assuming that one-third of it goes to increase payload capacity. [EPA-HQ-OAR-2014-0827-1242-A2 p.15]

Instead, the agencies should award greater credit to light-weighting—2% per 1,000 pounds, consistent with the 2011 research by the Oak Ridge National Laboratory (“ORNL”) examining the effect of weight on the fuel economy of Class 8 freight trucks.<sup>30</sup> ORNL used the extensive database of information collected in the Department of Energy Heavy-Truck Duty Cycle (“HTDC”) project, which, in 2006-2008, had collected real-world performance and situational data for long-haul operations of Class 8 trucks from a fleet engaged in normal freight operations. The HTDC data was parsed by roadway grade categories (*e.g.*, severe and mild upslope, severe and mild downslope, and flat terrain), vehicle speed intervals (of 1 and 2 mph), and vehicle weight levels going from tractor-only to fully loaded vehicles by 5,000 lb. For two of the terrain categories (*i.e.*, flat terrain and mild upslope terrain), which cover over 70% of the total miles logged in the HTDC project, ORNL investigated the effect of vehicle weight and vehicle speed on fuel economy using the parsed data. [EPA-HQ-OAR-2014-0827-1242-A2 p.15]

In addition, EPA should incentivize the development of new weight-reduction technologies by providing credit for them, rather than relying on an exclusive list of eligible technologies in the regulations. In the Proposal, EPA lists only 11 trailer components with lighter weight options—only one of which includes a material other than aluminum: structure for suspension assembly, hub and drum (per axle), floor (aluminum and wood/plastic composite), floor crossmembers, landing gear, rear door, rear door surround, roof bows, side posts, slider box, and upper coupler assembly. EPA should incorporate a process for adding to the list either by specifying certain criteria, which, if met, would result in the

additional materials automatically receiving credit, or by establishing a process by which trailer manufacturers could petition and EPA would approve additional components and materials for inclusion in the list. [EPA-HQ-OAR-2014-0827-1242-A2 p.16]

A flexible approval process for new light-weight materials would be consistent with EPA and CARB precedent. In Phase 1 of this rule, the agencies allowed manufacturers to petition for innovative technology, or “off-cycle,” credits for components not measured in GEM. The agencies recognized that emerging and innovative technologies in various stages of development with CO<sub>2</sub> emissions and fuel consumption reduction potential existed that might not be adequately captured on the final certification test cycles or are not inputs to the GEM, and that some of these technologies would merit additional credit-generating potential for the manufacturer. Because light-weight materials are an innovative and emerging technology for trailers, the CARB GHG tractor-trailer rule also provides a petition process for obtaining approval for trailer technologies not previously verified through the SmartWay process. No reasonable basis exists for providing trailer manufacturers less flexibility than companies regulated under Phase 1 of this rule and CARB’s tractor-trailer rule. [EPA-HQ-OAR-2014-0827-1242-A2 p.16]

**Response:**

The comment requests that the agencies remove the distribution of weight reduction applied in GEM. For tractors and trailers, GEM assigns 1/3 of any weight reduction applied to increase the payload and the remaining 2/3 reduce the overall vehicle weight. The agencies apply this strategy to account for the nearly 1/3 of tractor-trailers that reach their weight limit before they reach the volume capacity of their trailer (weigh-out). The commenter interpreted this strategy as a penalty, noting that the full weight reduction is not being applied to the vehicle and the model would not predict sufficient benefit. However, the standards adopted in this rulemaking account for payload (i.e., g CO<sub>2</sub>/ton-mi and gallons/1000 ton-mi). We created a memo to the docket to demonstrate that this weight reduction distribution will not negatively impact the results from the model, and in some cases will even provide an additional benefit versus simply reducing the overall vehicle weight.<sup>166</sup>

In light of this comment and further consideration of the issue, the agencies believe that the off-cycle technology process is an appropriate way for box van manufacturers to receive credit for future lightweighting or other technologies that are not recognized in the compliance equation. For this reason, we have incorporated trailers into the existing off-cycle provisions. (See Preamble Section IV.F.5.d). In the case of lightweighting, a measured difference in trailer weight could substitute for the weight component of the compliance equation, for other such technologies (should any exist), the general off-cycle provision apply. See 40 CFR 1037.515(e).

**Organization:** Wabash National Corporation

**VIII. The Proposed Warranty, Labeling, and Owner’s Manual Requirements Are Unduly Complex and Burdensome**

Wabash has concerns with EPA’s proposed requirements for trailer warranties, emission control labels, and owner’s manuals. EPA must recognize that the composition and operation of the trailer industry is quite different from the engine and vehicle manufacturing industries, and adjust its regulatory requirements accordingly, as explained below. [EPA-HQ-OAR-2014-0827-1242-A2 p.16]

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<sup>166</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. “Evaluation of Weight Reduction Distribution in Response to Public Comments from Wabash National Corporation”. July 2016.

## **A. Warranty**

EPA's proposed regulations would require trailer manufacturers to provide a five-year warranty on aerodynamic devices and a one-year warranty on tires. The warranty "covers these components even if another company produces the component." [EPA-HQ-OAR-2014-0827-1242-A2 p.36]

Imposing the warranty burden on trailer manufacturers ignores the fundamental realities of the trailer manufacturing process, which differs substantially from auto, truck, or engine manufacturing sectors. In those industries, OEMs choose their suppliers and have a modicum of choice and commercial control over the devices installed in their vehicles (or engines). In the trailer industry, by contrast, aerodynamic devices and tires are frequently purchased directly by customers and shipped to the trailer manufacturer for installation, or in the case of aerodynamic devices, often installed by the customer at a later time. As a result, the warranties on these parts are extended to customers directly by the part manufacturers, with no involvement by the trailer manufacturer. Thus, the trailer manufacturer does not design, test, certify, or purchase the equipment. As a practical matter, trailer manufacturers cannot reasonably provide warranties on any potential third-party part which a customer happens to ask to be installed on a trailer. This is similar to a situation where a vocational vehicle is assembled in multiple stages under a customer's direction and according to their specifications. A cab-chassis manufacturer would provide a warranty on the components it assembled, as would the body-builder. Suppliers providing other components, *e.g.*, safety technology and air suspension and control systems, would extend their warranties for those components directly to the customer. The cab-chassis manufacturer would not be expected to provide warranties for those components for which it had no responsibility. [EPA-HQ-OAR-2014-0827-1242-A2 p.17]

EPA should re-orient the warranty program for trailers to place the obligation on suppliers who provide customers with aerodynamic devices or tires for installation on trailers. Trailer manufacturers would collect information on the parts and warranties provided by the suppliers and share that information with EPA. Those part manufacturers would then be responsible for the warranties they provide. Shifting the point of warranty obligation to the parts suppliers would simplify the warranty system, facilitate prompt remediation of warranty claims, and make compliance and enforcement more direct and expedient. [EPA-HQ-OAR-2014-0827-1242-A2 p.17]

### **Response:**

Section 207 (a) of the CAA requires manufacturers to warrant their products to be free from defects that could otherwise cause non-compliance with emission standards. For purposes of the trailer program, EPA requires trailer manufacturers to warrant all components that form the basis of the certification to the CO<sub>2</sub> emission standards. The emission-related warranty covers all aerodynamic devices, lower rolling resistance tires, tire pressure systems, and other components that may be included in the certification application. In response to this comment, we would note that the emission-related warranty is completely separate from any other warranties a manufacturer might offer. The trailer manufacturer needs to warrant that these emission-related components and systems are designed to remain functional for the warranty period.

To further clarify, we view commercial warranties offered by component manufacturers as business decisions rather than as a reflection of the actual durability of the systems. With proper maintenance, we are aware of no reason that the technologies that we anticipate that trailer manufacturers will use for compliance would be unable to meet the durability requirements of the trailer program. The agencies believe these components, including tire pressure systems, should be designed to last the full useful life of the trailer if properly maintained. We believe a five year emission-related warranty is justified, but



we note that trailer manufacturers can specify that their warranty depends on the proper maintenance of components. NHTSA is not adopting any warranty requirements relating to its trailer fuel consumption program.

**Organization:** Wabash National Corporation

### **C. Owner's Manual**

EPA is proposing to require that an owner's manual be provided for, and remain with, each trailer that is manufactured. This requirement simply does not fit the trailer industry. Again, each trailer is custom, so a unique owner's manual would be required for each potential configuration. Further, ensuring that a manual remains with the trailer would be difficult. Customers frequently create their own owner's manual, expressly outlining the information they wish their operators to have access to and limiting their access to other information that is not in keeping with the customer's business and operational practices. Wabash recommends omitting this requirement from the Phase 2 Proposed Rule. [EPA-HQ-OAR-2014-0827-1242-A2 p.18]

#### **Response:**

Our regulatory provisions were designed assuming vehicle manufacturers have an existing owner's manual. The agencies acknowledge that currently it is not common for trailer manufacturers to provide printed owner's manuals to their customers. We are not requiring manufacturers to create a comprehensive manual describing all aspects of each individual trailer produced. However, it is important for customers to have access to information about emissions-related components added to their trailers for compliance with our Phase 2 program, such that they can adequately maintain, repair, and possibly replace these components. We believe that with the new requirements of the trailer program, trailer manufacturers should be capable of providing basic information related to compliance to their customers. Additionally, we note that the "owner's manual" need not be a physical document, but can be made available on line.

**Organization:** Wabash National Corporation

### **IX. The Compliance Costs of the Proposal Far Exceed EPA's Estimates**

EPA appropriately recognized that "[t]railer manufacturers, who would be subject to CO<sub>2</sub> and fuel consumption standards for the first time, would have to put in place entirely new testing programs, reporting, labeling, and recordkeeping systems." Unfortunately, EPA severely underestimated the costs of these compliance systems. EPA estimated a 2017 compliance cost of \$127,000 for each large trailer manufacturer, which would then increase slightly to \$128,000 per year beginning in 2018, the first year trailers must comply with the rule. These total cost estimates include three components: (1) labor costs; (2) start-up and capital costs of acquiring test equipment, information management systems for recordkeeping, labeling, and reporting; and (3) operations and maintenance for laboratory time, use of test equipment, and other supplies. [EPA-HQ-OAR-2014-0827-1242-A2 p.18]

EPA's analysis of labor costs is flawed. EPA used outdated 2009 Bureau of Labor Statistics' estimates of labor costs, rather than the current version of those estimates.<sup>40</sup> Unsurprisingly, the current labor costs are materially higher than the 2009 estimates. As an illustration, the mean hourly rate of an engineering manager increased from \$50.71 an hour in 2009 to \$66.69 in the latest estimate.<sup>41</sup> EPA also assumed that lawyers would need to assist trailer manufacturers in complying with the rule, but used hourly rates

of \$66 to \$138. In Clean Air Act litigation, EPA has stipulated to hourly rates in fee awards that far exceed those used in the Proposal.<sup>43</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.19]

EPA's analysis of the other cost categories is equally problematic. Without any real-world data, the agency assumed that a large trailer manufacturer would only spend about \$50,000 on the software, testing equipment, and other infrastructure needed to comply with the rule. This cost estimate appears to assume that manufacturers need to incur only start-up costs for trailer certification and labeling, but that ignores several categories of additional costs, including (1) the costs of owner's manuals, (2) the significant cost of developing training programs, and (3) the quality control procedures that must be developed and integrated into a manufacturer's compliance systems. [EPA-HQ-OAR-2014-0827-1242-A2 p.19]

In addition to these start-up costs, EPA grossly underestimated ongoing operations and maintenance costs. Perhaps the best illustration is that EPA calculated a \$3,000 total annual cost to prepare a certification application for each model year of trailer, including engineering fees, testing fees, and legal fees. In the engine and auto context, the cost of certification applications can range from \$25,000 for simple applications that build on existing testing to several hundred thousand dollars.

To provide EPA a sense of how much it underestimated costs, Wabash submits a *confidential* estimate of its compliance costs for the Phase 2 Proposal.<sup>46</sup> This estimate should be treated as confidential business information under 40 CFR Part 2 and 49 CFR Part 512 and *not* placed in the docket for the Proposal. Nonetheless, it will give EPA and OMB insight into the real-world costs of complying with the Phase 2 Proposed Rule and provide a basis for further due diligence on the agencies' part for investigating the true costs of compliance. [EPA-HQ-OAR-2014-0827-1242-A2 p.19]

#### **Response:**

For the final rule, the agencies updated the cost assumptions from the proposal, as discussed in Chapter 7.2.1.2 of the RIA and our Supporting Statement for the Information Collection Request (ICR) with this rulemaking.<sup>167</sup> In the NPRM, the agencies assumed \$1.2 million for testing, reporting, and capital costs for the trailer manufacturing industry. In the NPRM, these estimated costs were increased to \$7 million. The new compliance costs now include updated labor costs, increased initial capital costs that include computer software, labeling equipment, and infrastructure upgrades, and updated operational costs considering the information provided in this comment. These updates are summarized in the ICR, but we also refer the commenter to the calculations for our small business economic burden estimates.<sup>168</sup> The attached spreadsheet includes the cost estimates for both small and large manufacturers on which we based our ICR costs and general compliance costs.

**Organization:** Wabash National Corporation

### **XIII. EPA Must Ensure a Level Playing Field Between Domestic and Imported Trailers**

Wabash's strong domestic manufacturing presence depends on a level playing field with importers. Yet the rule only makes a single, passing reference to importers' obligation to follow the rule. The scant

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<sup>167</sup> Supporting Statement for Information Collection Request. EPA ICR Tracking Number 2394.05. Draft as of July 12, 2016. Docket EPA-HQ-OAR-2014-0827.

<sup>168</sup> Memorandum to Docket EPA-HQ-OAR-2014-0827. "Small Business Economic Burden Calculations for Trailer SISNOSE Analysis", July 2016.

attention paid to this issue is deeply disturbing because, as EPA knows, a flood of illegally imported engines and vehicles have been streaming into the U.S. since at least 2008. EPA must proactively engage on this import issue to prevent a pattern of similar violations from developing in the trailer industry. Otherwise, the ability of domestic manufacturers to fairly compete would be undermined. [EPA-HQ-OAR-2014-0827-1242-A2 p.23]

#### **A. The Final Rule Must Clearly and Unequivocally Cover Importers**

The final rule should make clear that imported trailers must comply with the Phase 2 emissions and fuel economy requirements. Despite stretching 629 pages, the Proposal makes only one indirect reference to the fact that imported trailers must comply with the rule.<sup>64</sup> The scant attention paid to the issue of imported trailers may lead some companies to misunderstand the rule's coverage of imports *or* seek to circumvent it. As a leading domestic manufacturer of trailers, Wabash depends on a level playing field with importers to ensure fair competition. To put to rest any argument about the scope of the rule, Wabash respectfully requests a few modest changes to the rule. [EPA-HQ-OAR-2014-0827-1242-A2 p.23-24]

First, it would be helpful to have the agencies discuss their authority to regulate emissions and fuel economy of imported trailers under the CAA and Energy Independence Security Act ("EISA"). Section 203(a) of the CAA prohibits the importation of new motor vehicles or engines unless covered by a valid emissions certificate of conformity. Likewise, the fuel economy requirements under EISA extend to importers of new motor vehicles. Explaining how these import provisions extend to trailers as motor vehicles would assist the regulated community in understanding its legal obligation to comply with the rule. [EPA-HQ-OAR-2014-0827-1242-A2 p.24]

Second, the definitions used in the text of the final rule should reflect the coverage of imported trailers. EPA's definition of "motor vehicle" should specifically reference that it includes trailers, particularly the proposed definitions found at 40 C.F.R. §§ 1037.801 and 85.1703. EPA's definition of "manufacturer" should be revised as follows: "*Manufacturer... covers includes* importers who import vehicles or vehicles for resale (**including trailers**) and entities that assemble glider kits." NHTSA's Proposal cross-references the statutory definitions of "manufacture" and "manufacturer" in EISA, which includes imports, but does not make specific reference to trailers. A regulatory definition of "manufacture" and "manufacturer" that includes "importers of heavy-duty trailers" would provide greater clarity to the regulated community. [EPA-HQ-OAR-2014-0827-1242-A2 p.24]

Third, EPA's Part 1068 rules on mobile source enforcement and compliance should mention trailers, including imported trailers. NHTSA's proposed fuel economy regulation expressly states that it "includ[es] trailers" as do EPA's Part 1037 regulations that set emissions standards for trailers. In contrast, EPA's Part 1068 enforcement rules make no specific mention of trailers, but instead contain broad cross-references to numerous other EPA rules, one of which—Part 1037—includes trailers. [EPA-HQ-OAR-2014-0827-1242-A2 p.24-25]

Wabash recommends that EPA amend Part 1068 in the following respects to make clear that it covers imported trailers:

- Reference trailers in the general applicability section of Part 1068. 40 C.F.R. § 1068.1(2), 80 Fed. Reg. at 40,714: "This part 1068 applies for **to** heavy-duty motor vehicles certified under 40 CFR part 1037, subject to the provisions of 40 CFR parts 85 and 1037., **including trailers subject to part 1037.**" [EPA-HQ-OAR-2014-0827-1242-A2 p.25]

- Add a definition of “trailer” in Part 1068 that incorporates the proposed definition in Part 1037. *See* 40 C.F.R. § 1068.30, 80 Fed. Reg. at 40,715; 40 C.F.R. § 1037.801, 80 Fed. Reg. at 40,665 (proposed definition of “trailer”). [EPA-HQ-OAR-2014-0827-1242-A2 p.25]
- Emphasize that each illegally imported trailer may result in a potential statutory maximum civil penalty of \$37,500 per trailer. [EPA-HQ-OAR-2014-0827-1242-A2 p.25]
- Reference trailers in other import provisions of Part 1068. *See* 40 C.F.R. § 1068.101(a)(1), 80 Fed. Reg. at 40,719-20 (“You may not sell, offer for sale, or introduce into commerce in the United States or import into the United States any new engine/equipment **(including trailers)** after emission standards take effect for the engine/equipment, unless it is covered by a valid certificate of conformity for its model year and has the required label or tag.”); 40 C.F.R. § 1068.101(a)(5), 80 Fed. Reg. at 40,7120 (“You may not import an uncertified engine or piece of equipment **(including trailers)** if it is defined to be new in the standard setting part with a model year for which emission standards applied.”); 40 C.F.R. § 1068.301, 80 Fed. Reg. at 40,7128 (“In general, engines/equipment **(including trailers)** that you import must be covered by a certificate of conformity unless they were built before emission standards started to apply.”).<sup>72</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.25]

## **B. Enforcement Is Critical for Imported Trailers**

In addition to these textual changes to the rule, Wabash supports a vigorous enforcement program for imported trailers to ensure that domestic trailer manufacturing remains an important source of good-paying jobs in our nation. Import violations are a chronic issue for EPA’s mobile source programs. As EPA has noted, “there has been a steady flow” of illegally imported engines and vehicles into the United States.<sup>73</sup> Nearly all of the mobile source civil settlements in 2015 involved import violations: importers failed to obtain valid certificates of conformity, install emission controls, or take other actions to comply with the CAA.<sup>74</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.25-26]

EPA’s mobile source enforcement against importers has been hampered by several factors. Importers have relied on falsified certificates of conformity for engines and vehicles, making detection of violations more difficult.<sup>75</sup> When violations have been discovered, EPA has frequently been unable to locate U.S. registered agents and assets.<sup>76</sup> Importers that have vehicles and engines seized at port “often change the port of entry for subsequent shipments.”<sup>77</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.26]

In light of ongoing compliance problems with imports, EPA should incorporate “Next Generation Compliance” into the final rule in order to enhance enforcement against import violations, particularly those involving trailers. EPA’s Strategic Plan on Next Generation Compliance takes advantage of new tools and strategies to leverage greater compliance, including electronic reporting, data transparency, and data analytics.<sup>78</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.26]

Consistent with these principles of Next Generation Compliance, the final rule should require declaration forms and other import documents to be electronically submitted and publicly available in an EPA-maintained database.<sup>79</sup> Access to electronic data on imports would allow agency staff and the public to better detect non-compliance patterns, identify repeat violators who shift from port-to-port, and deter fraud. Importers should also be required to electronically file annual reports certifying under oath compliance with the CAA for the past year, and disclosing the names of the test labs or consultants used to support the certificates of conformity for imported trailers. Certifying compliance would potentially provide an additional measure of deterrence for future violations, while disclosure of test labs would help validate that certificates of conformity resulted from legitimate testing. [EPA-HQ-OAR-2014-0827-1242-A2 p.26-27]

**Response:**

The agencies acknowledge that enforcement of emission standards for new trailers that are imported into the United States poses unique challenges at the point of entry, because new trailers may be carrying cargo and are therefore nearly indistinguishable from trailers that have already been imported or otherwise placed into service. We are not adopting any new or different compliance provisions in this rulemaking to address this; however, we intend to work cooperatively with Customs and Border Protection and other agencies to ensure that first-time state registration of new trailers includes verification that the trailer manufacturers have certified them to meet U.S. emission and fuel consumption standards. We expect this to be similar to the current system for ensuring that new, imported trailers meet NHTSA safety standards.

A related concern applies for foreign-based trailers traveling in the United States for importing or exporting cargo. Such trailers are not subject to emission and fuel consumption standards unless they are considered imported into the United States. U.S. cabotage law prohibits foreign truck drivers from carrying product from one point to another within the United States. Effective enforcement of this cabotage law will help prevent manufacturers of noncompliant foreign-produced trailers from gaining a competitive advantage over manufacturers of compliant domestic trailers.

EPA is revising the definition of “manufacturer” in 86 CFR 1037 and the applicability language in 86 CFR 1068.1 to reinforce that manufacturers that import trailers into the U.S. are covered by the trailer program.

## **5.7 Proposed Non-CO2 GHG Standards for Trailers**

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Non-CO2 GHG emissions from trailers**

The NPRM requests comment on the issue of HFCs refrigerant leakage from transport refrigeration units (TRU). U.S. EPA and NHTSA believe TRU refrigerant leakage is insignificant because they contend that trailer TRU owners have a strong incentive to limit this leakage in order to maintain the operability of the trailer’s refrigeration unit and avoid financial liability for damage to perishable freight due to failure to maintain the agreed-upon temperature and humidity conditions. Also, U.S. EPA and NHTSA believe that refrigerated van units represent a relatively small fraction of new trailers. U.S. EPA and NHTSA also asked for data on typical TRU charge capacity and the frequency of HFC leakage. [EPA-HQ-OAR-2014-0827-1265-A1 p.146-147]

Overall, CARB staff believes U.S. EPA and NHTSA are underestimating potential refrigerant leakage from TRUs. CARB staff recommends, as discussed further below, that 1) U.S. EPA and NHTSA establish an HFC refrigerant usage monitoring program for TRUs to inform future “cause and contribute findings” and decisions to regulate refrigerants used in TRUs, and 2) U.S. EPA and NHTSA provide incentive funding for zero- and near-zero-emission transport refrigerators, such as cryogenic transport refrigerators. [EPA-HQ-OAR-2014-0827-1265-A1 p.147]

CARB staff believes U.S. EPA and NHTSA may be overly optimistic when it comes to TRU owners proactively preventing and repairing refrigerant leaks. That may be partially true for the first generation owners, but many TRUs receive less maintenance as they age and their second, third, or fourth

generation owners are not financially able to pay for repairs. CARB staff believes that for a considerable number of TRU owners, repairs and maintenance issues are typically addressed only when there is a performance issue with the TRU. Excluding TRUs from leakage requirements shifts the responsibility for these systems to the users, leaving manufacturers free to develop systems that may be more prone to leakage. TRU manufacturers should be held accountable for manufacturing quality products that are not prone to leakage. CARB staff is not aware of any tracking programs for HFC usage to recharge leaky TRU systems or determine leakage frequency; but, those types of programs should be considered to provide the data that is needed to assess the impact on climate change due to TRU refrigerant leakage. [EPA-HQ-OAR-2014-0827-1265-A1 p.147]

TRU models that use open-drive refrigeration compressors are more susceptible to shaft seal leakage as they age. Many TRU models still use open-drive refrigeration compressors. Hermetically sealed refrigeration compressors do not have shaft seal refrigerant leakage issues because the electric drive motor is enclosed inside a housing with the refrigeration compressor. Unfortunately, hermetically sealed refrigeration compressors have not been incorporated into all TRU platforms. When used in conjunction with more energy efficient scroll compressors, GHG emissions are greatly reduced through a combination of lower fossil fuel use and the elimination of high-GWP refrigerant leakage from shaft seals. [EPA-HQ-OAR-2014-0827-1265-A1 p.147]

A quick review of current, on-line TRU specification sheets revealed refrigerant charge capacities are 13 to 16 lbs per trailer TRU. Previous to 2013, when both of the major TRU manufacturers re-designed and optimized their trailer TRU platforms, refrigerant charges averaged about 20 lbs per unit. This value is consistent with the value reported in Table S4 (page S8) of the *Supporting Information Document* for the article titled “High Global Warming Potential F-Gas Emissions in California: Comparison of Ambient-based versus Inventory-Based Emission Estimates, and Implications of Refined Estimates” by Glenn Gallagher, et al.<sup>54</sup> This document also includes average annual leakage rates for TRUs (18.3 percent). The data sources and methodology for TRU refrigerant emissions are explained on pages S19-S21. [EPA-HQ-OAR-2014-0827-1265-A1 p.148]

ACT Research estimates there are over 370,000 refrigerated trailers in the U.S. in 2015 and the average fleet age is 5.63 years.<sup>55</sup> This means that the total TRU refrigerant charge in the U.S. subject to potential leakage could range from 2,405 short tons to 3,700 short tons. [EPA-HQ-OAR-2014-0827-1265-A1 p.148]

Refrigerant emissions may be small compared to some other commercial and industrial sectors, but significant emission reductions in this sector can be achieved by adopting lower GWP refrigerants. CARB staff believes it is hard to rationalize refrigerant leaks on the basis of small sector numbers when the GWP is so high for currently used TRU refrigerants (R-404A, used in trailer TRUs, has a GWP of 3,922) and near “drop-in” refrigerants, such as R-452A, has a GWP of 2,141. [EPA-HQ-OAR-2014-0827-1265-A1 p.148]

Refrigerant R-452A is a blend of the hydrofluoro-olefin (HFO) R-1234yf that has a very low-GWP of 4 and higher GWP HFCs. Blends with greater R-1234yf cause reduced refrigeration capacity. Lost capacity could be offset by improvements in refrigeration system efficiency (requiring less energy) and more thermally efficient insulated cargo vans (requiring less refrigeration capacity). Integrated designs that balance these effects and produce net improvements in total equivalent warming impact are needed. [EPA-HQ-OAR-2014-0827-1265-A1 p.148]

In the long-term, natural refrigerants, such as CO<sub>2</sub>, may become viable if associated energy use rates can be reduced through continued design optimization. CO<sub>2</sub> systems have been demonstrated in Europe

for refrigerated shipping containers but industry has been slow to adopt them because costs are still high as a result of low production numbers and economies of scale. Incentive programs are needed to encourage adoption of existing CO2 refrigerant systems for shipping containers and to develop CO2 refrigerant systems for higher ambient temperature conditions and larger capacity systems needed for 53 foot trailer TRU applications. [EPA-HQ-OAR-2014-0827-1265-A1 p.149]

Cryogenic transport refrigerators also offer an alternative to vapor compression refrigeration systems that use high-GWP refrigerants. A cryogenic fluid, such as liquid nitrogen, liquid CO2 or liquid air, is used to provide cooling to the cargo space. There are some GHG emissions associated with the production of these cryogenic fluids. For liquid nitrogen, the most common type of cryogenic transport refrigerator, well-to-wheel (WTW) GHG emission reductions are 50 to 60 percent less than a conventional TRU. This technology, as well as other zero- and near-zero-emission technologies, is discussed in CARB's *Technology Assessment: Transport Refrigerators*.<sup>56</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.149]

In addition to establishing an HFC refrigerant usage monitoring program and providing incentive funding for zero- and near-zero-emission transport refrigerators, CARB staff also recommends that U.S. EPA use its SNAP program to phase out high-GWP refrigerants, such as R404A, as soon as it determines that viable alternative are available. [EPA-HQ-OAR-2014-0827-1265-A1 p.149]

### **Support Comment**

#### **Comment – Refrigerated Trailer Problems**

CARB staff agrees with U.S. EPA and NHTSA's statements: "Over time, refrigerated trailers can also develop problems that interfere with their ability to keep freight temperature-controlled. For example the insulating material inside a refrigerated trailer's walls can gradually lose its thermal capabilities due to aging or damage from forklift punctures. The door seals on a refrigerated trailer can also become damaged or loose with age, which greatly affects the insulating characteristics of the trailer." [EPA-HQ-OAR-2014-0827-1265-A1 p.150]

The refrigerated transport industry is well aware of the thermal performance degradation that insulated trailers go through as a result of blowing agent outgassing, moisture intrusion, insulation breakdown caused by road-induced vibration and panel flexing, forklift damage, tree side-swiping damage, and other normal wear-and-tear. Low permeability barriers can be used to slow down outgassing. Aluminum and stainless steel sheets, various types of polymeric films, laminated foil/plastic films, metalized films, fiberglass, glass mat, and composite liners are offered as options to prevent damage and subsequent moisture intrusion. Great Dane has published charts that show up to 40 percent degradation of insulation performance over several years and much slower degradation when various options are used to conserve insulation performance. [EPA-HQ-OAR-2014-0827-1265-A1 p.150]

There are no standards in the U.S. to ensure all refrigerated trailers meet minimum thermal performance standards when they are new. There are also no standards in the U.S. that measure thermal performance as an insulated trailer ages to ensure they are retired or delegated to less demanding service when thermal performance degrades. As this performance degrades, energy efficiency is compromised and TRU engines must run harder and longer to maintain temperature set points, resulting in greater GHG emissions. Market forces drive the thermal efficiency of refrigerated trailer designs in the U.S. [EPA-HQ-OAR-2014-0827-1265-A1 p.150]

CARB staff encourages U.S. EPA and NHTSA to look at the regulatory requirements that must be met in Europe regarding refrigerated van insulation. The 26 members of the European Union and 23 other European, former Soviet Union, North African and Middle Eastern countries have signed on as contracting parties to the United Nations Economic Commission for Europe's (UNECE) standards under the Agreement on the International Carriage of Perishable Foodstuffs and on Special Equipment to be Used on Such Carriage (ATP). ATP requires testing and certification of the insulation and cooling capacity of refrigerated transport equipment, and provides for separate testing of TRUs. France, Italy, Russia, and Spain apply ATP standards to domestic transportation within their borders. Although the U.S. is a contracting party to ATP, the U.S. made a declaration under article 10 of the International Carriage of Perishable Foodstuffs Act of 1982 and the implementing regulations at title 7 Code of Federal Registration (CFR) 3300, resulting in ATP standards being voluntary in the U.S. [EPA-HQ-OAR-2014-0827-1265-A1 p.150-151]

Under the ATP, samples of new-model insulated vans are tested to ensure they meet the appropriate overall heat transfer coefficient standard (K-value). Passing models are certified for six years. Certification of insulated vans may be renewed at six year intervals by inspecting and/or testing a sample of aged insulated vans to determine if they still meet the ATP K-value standard. [EPA-HQ-OAR-2014-0827-1265-A1 p.151]

In addition, market forces are at work in Europe, because diesel fuel typically costs two to three times more than U.S. fuel due to differences in government subsidies, taxes, and other influences. Greater thermal efficiency in truck and trailer vans makes legal and economic sense in the Europe, so insulation is generally thicker there (side walls are typically about four inches thick compared to two inches thick in the U.S.). [EPA-HQ-OAR-2014-0827-1265-A1 p.151]

The high cost of diesel fuel, the above-mentioned thermal efficiency standards, and greater prevalence of noise ordinances have also made European refrigerated fleets more open to trying new or alternative transport refrigeration technologies. For example, there is greater use of cryogenic transport refrigerators, all-electric, and hybrid electric TRUs with various range extender strategies in Europe. [EPA-HQ-OAR-2014-0827-1265-A1 p.151]

CARB staff recommends U.S. EPA and NHTSA continue to evaluate appropriate technologies and approaches that can achieve substantial emission reductions for TRUs and insulated trailers. CARB's *Technology Assessment: Transport Refrigerators*<sup>57</sup> provides information on zero- and near-zero-emission technologies and includes a discussion on energy efficiency for refrigeration systems and thermal efficiency for insulated cargo vans. Incentive programs are needed to transition these technologies to commercial readiness so they can be included in later phases of GHG rules. [EPA-HQ-OAR-2014-0827-1265-A1 p.151]

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<sup>54</sup> (Gallagher et al., 2014) Gallagher et al., "Supporting Information - High Global Warming Potential F-Gas Emissions in California: Comparison of Ambient-based versus Inventory-Based Emission Estimates, and Implications of Refined Estimates," *Environmental Science & Technology*. Available for download at: <http://pubs.acs.org/doi/suppl/10.1021/es403447v>.

<sup>55</sup> (ACT, 2014) Kenny Vieth (ACT Research), personal communication with Rodney Hill (California Air Resources Board), November 24, 2014, at ACT Research Co., LLC, U.S. Trailer Model, Reefer Van Population Outputs, 2014.



<sup>56</sup> (CARB, 2015d) California Air Resources Board, “Technology Assessment: Transport Refrigerators,” August 2015, <[http://www.arb.ca.gov/msprog/tech/techreport/tru\\_07292015.pdf](http://www.arb.ca.gov/msprog/tech/techreport/tru_07292015.pdf)>.

<sup>57</sup> (CARB, 2015d) California Air Resources Board, “Technology Assessment: Transport Refrigerators,” August 2015, <[http://www.arb.ca.gov/msprog/tech/techreport/tru\\_07292015.pdf](http://www.arb.ca.gov/msprog/tech/techreport/tru_07292015.pdf)>.

**Organization:** IdleAIR

## **ELECTRIFIED PARKING SPACES PROVIDE A CRITICAL NETWORK FOR ELECTRIFIED TRANSPORT REFRIGERATED UNITS AND ELECTRIC VEHICLE CHARGING INFRASTRUCTURE**

**Long range** Transport Refrigerated Units (TRUs) are cooled by unfiltered diesel compressors that idle 24-hours per day. IdleAir and other EPS providers are establishing a network for refrigerated fleets to be able to plug in and power down while the trailer is at rest. To the extent the TRU contains battery or solar, it can offset idling during drive time as well. Long Range TRU fleets are unlikely to abandon diesel backup, but more than 70% of TRU idling can be addressed with hybrid electric TRUs that can connect to our charging stations at the terminals of the largest refrigerated fleets in the country, their customer facilities, and public truck stops. The existing EPS network will prop up this nascent industry of TRU conversions to hybrid units, but only if EPS providers are in business long enough to reach the tipping point. [EPA-HQ-OAR-2014-0827-1250-A2 p.3]

### **Response:**

In addition to the impact of trailer design on the CO<sub>2</sub> emissions of tractor-trailer vehicles, EPA recognizes that refrigerated trailers can also be a source of emissions of HFCs. Specifically, HFC refrigerants that are used in transport refrigeration units (TRUs) have the potential to leak into the atmosphere. When powered by internal combustion engines, TRUs also emit criteria pollutants and CO<sub>2</sub> and consume fuel.

In their comments, CARB said they believe that EPA has underestimated the potential for TRU refrigerant leakage. However, CARB and other commenters did not provide sufficient information for EPA to introduce new regulatory requirements for TRUs at this time. EPA did not propose any action related to TRUs in this rule and does not take such action in the final program. In general, however, EPA will continue to monitor the state of TRU technology and operation, and may pursue appropriate action if warranted in the future. Similarly, regarding incentives for lower-emission TRUs, EPA is unaware of financial or regulatory mechanisms at this point that could be implanted to encourage such a market shift. We will continue to monitor both the potential need for and mechanisms for such incentives.

We also note that EPA has separately proposed a regulation under Title VI of the CAA, specifically section 608. See 80 FR 69457 (November 9, 2015). This proposal would extend existing regulations on ozone depleting refrigerants to many alternative refrigerants, such as HFCs, which are the most common refrigerants used in TRUs. If finalized as proposed, EPA would require that appliances like TRUs be subject to the applicable requirements of 40 CFR subpart F, including requirements for servicing by a certified technician using certified recovery equipment and for recordkeeping by technicians disposing of such appliances with a charge size between five and fifty pounds, which would include TRUs, to help ensure that the refrigerant is not vented.

In response to the comment about the phase-out of high-GWP refrigerants, under Section 612 of the Clean Air Act (CAA), EPA's Significant New Alternatives Policy (SNAP) program reviews substitutes within a comparative risk framework in the following industrial sectors: Adhesives, Coatings & Inks; Aerosols; Cleaning Solvents; Fire Suppression and Explosion Protection; Foam Blowing Agents; Refrigeration & Air Conditioning; Sterilants; and Tobacco Expansion. Section 612 also provides that EPA must prohibit the use of a substitute where EPA has determined that there are other available substitutes that pose less overall risk to human health and the environment. The SNAP program does not provide a static list of alternatives but instead, evolves the list as EPA makes decisions that are informed by its overall understanding of the environmental and human health impacts as well as its current knowledge about available substitutes. EPA will continue to review the availability of alternatives for the refrigerated transport end-use, including TRUs.

Finally regarding the CARB comment about the deterioration of insulating efficiency, the passage that they quote from the proposed rule was a general observation about factors contributing to trailer aging and replacement. We are not aware specific data relating to such impacts on TRU fuel use, and, regardless, are not addressing TRU emission or fuel consumption issues in this Phase 2 program.

## **5.8 Trailer-Specific Small Business Concerns**

**Organization:** Wabash National Corporation

### **Creating Exceptions for “Small” Trailer Manufacturers Discourages Innovation and Breaks from the Clean Air Act**

Pursuant to the Regulatory Flexibility Act, EPA convened a Small Business Advocacy Review Panel to evaluate the impact of the proposed Phase 2 emissions requirements on small businesses, including small trailer manufacturers. Based on the Panel Report, EPA proposes a one-year delay in the compliance deadlines for small manufacturers and invited comment on additional compliance delays.<sup>50</sup> In defining a “small” trailer manufacturer, EPA relied on a Small Business Administration (“SBA”) regulatory definition of a manufacturer with 500 or fewer employees.<sup>51</sup> [EPA-HQ-OAR-2014-0827-1242-A2 p.20-21]

#### **A. EPA's Proposed “Small” Trailer Manufacturer Exemptions Are Overly Broad and Punish Innovation**

EPA's proposed approach for small trailer manufacturers appears overly broad and creates disincentives for technological innovation to address climate change. Trailer manufacturing is far less labor-intensive than other segments of the heavy-duty sector such as engine manufacturing, cab chassis manufacturing, and other vehicle production.<sup>52</sup> As a result, over 80% of trailer manufacturers would qualify as small businesses under EPA's proposed definition.<sup>53</sup> Delaying compliance for most of the manufacturers in the trailer industry would unfairly punish Wabash and other forward-leaning companies that worked with EPA, NHTSA, and the technical community to improve fuel economy and reduce CO<sub>2</sub> emissions. As the agencies are well aware, Wabash has spent years of effort and devoted substantial resources to developing innovations in trailers, particularly industry-leading aerodynamic devices. EPA's Proposal ignores those efforts and would potentially distort the market in favor of companies that had neither the inclination, nor the resources, to move the industry forward. The Proposal therefore runs counter to EPA's longtime position that emissions standards under CAA Section 202 should encourage the development of new technologies in the motor vehicle industry. [EPA-HQ-OAR-2014-0827-1242-A2 p.21]

**Response:**

The agencies have provided a one-year delay for small businesses but have not established a small business trailer manufacturer exemption from the regulatory requirements for the remainder of the Phase 2 program. The agencies agree with Wabash that including small businesses in the regulation is important to the introduction of fuel efficiency improving trailer technologies. At the same time, we have heard from small businesses that they do not have the same resources available to become familiar with the regulations, make process and staffing changes, or evaluate and market new technologies as their larger counterparts. We believe a one-year delay provides sufficient time for small businesses to address these issues, without a large CO<sub>2</sub> and fuel consumption impact. The cumulative annual production of all of the small business box trailer manufacturers is estimated to be less than 15 percent of the industry's total production (Figure 1-3 of Chapter 1 in our RIA), which is significantly less than the annual production of the four largest manufacturers. We expect any diverted sales for this one year will be a small fraction of the large manufacturers' production and we are finalizing the one-year delay for all small business trailer manufacturers.

## **6 Class 2b-8 Vocational Vehicles**

### **6.1 General Comments**

#### **6.1.1 NOx from Idling Emissions**

Allison Transmission

#### **NOx Benefit from Stop-Start and Idle Reduction Technologies**

The agencies have requested comment regarding whether there may be a NOx co-benefit to Stop-Start idle reduction technologies, e-PTO, and neutral idle. [EPA-HQ-OAR-2014-0827-1284-A1 p.47]

With respect to such co-benefits, Allison has confirmed an engine Stop-Start system NOx and after treatment temperature co-benefit. During powertrain testing of a hybrid bus powertrain on the OCTA cycle, Allison documented an average 7% NOx decrease with engine Stop-Start vs. NOx baseline with no engine Stop-Start. The testing also showed an increase in average after treatment temperatures over the drive cycle and a slight increase in Fuel Economy. The following chart shows data taken from that testing. [EPA-HQ-OAR-2014-0827-1284-A1 p.47]

[Chart, 'Data summary average of samples', can be found on p.47 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

**Organization:** Odyne Systems LLC

Odyne believes co-benefits beyond fuel efficiency improvements and greenhouse gas reductions, like Odyne technologies' verified ability to reduce NOx emissions, should be valued in the Phase Two rulemaking, especially given potential future regulatory actions from EPA and current developments from CARB on NOx. Most of the benefits that Odyne achieved in the reduction of NOx came from the hybrid power take off (PTO) activities (stationary / work site). [EPA-HQ-OAR-2014-0827-1920-A2 p.12]

**Organization:** Daimler Trucks North America LLC

**NOx Emissions From Idling** – Note that all of our engines meet the ARB's 30 g NOx/hr idle level. [EPA-HQ-OAR-2014-0827-1164-A1 p.28]

**NOx Benefit from Stop-Start Technologies** - The agencies state a belief there may be a NOx co-benefit to stop-start idle reduction technologies, e-PTO, and possibly also to neutral idle. For this to be true, the benefits of reduced fuel consumption and retained aftertreatment temperature would have to outweigh any extra emissions due to re-starts. The agencies requested comments regarding this issue. DTNA is also investigating the potential for this technology in lighter classes of HDV applications as a measure to improve fuel efficiency. DTNA also recognizes and is investigating the potential for improving heat retention in the SCR system via stop-start but because of early stages of development cannot verify or quantify actual benefits. That said, EPA should allow manufacturers to demonstrate reduced NOx levels on transient FTP test procedures, from implementation of this technology. [EPA-HQ-OAR-2014-0827-1164-A1 p.29]

**Response:**

The agencies will retain this preliminary information provided by commenters on the relationship between NO<sub>x</sub> emissions from vocational vehicles and workday idle reduction technologies. The agencies also conducted independent NO<sub>x</sub> testing of engines at idle; however, the data are not conclusive enough for the agencies to quantify the NO<sub>x</sub> co-benefits of vocational workday idle reduction as part of this rulemaking. As part of the final Phase 2 program, NO<sub>x</sub> emissions will be measured and reported as a part of powertrain testing. This will allow EPA to monitor NO<sub>x</sub> performance. The information collected will also be used to inform EPA as to the merits of future rulemaking.

**6.1.2 Comments Generally Supporting Stronger Standards**

**Organization:** Natural Resources Defense Council (NRDC)

Increase the stringency of the standards. NRDC believes standards that achieve fuel consumption and emissions reductions of at least 24 percent by 2024 and at least 31 percent by 2027 relative to Phase 1 would meet the agency obligations for setting standards that are maximum feasible (for NHTSA) and appropriate (for EPA). Important areas where the Phase 2 program stringency can be improved significantly include the standards for tractor diesel engines and for vocational vehicles. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

**Organization:** Proterra

Proterra supports the proposed Phase 2 standards that, for vocational vehicles, would achieve up to 16% lower CO<sub>2</sub> emissions and fuel consumption compared to Phase 1 by the year 2027. [EPA-HQ-OAR-2014-0827-1160-A1 p.2]

**Organization:** Odyne Systems LLC

At a minimum, we would recommend the EPA increase full compliance fuel consumption and emission reductions for the vocational sector beyond the 16%, to at least 20% or higher – as recommended by groups like the Union of Concerned Scientists in their comments. [EPA-HQ-OAR-2014-0827-1239-A1 p.4-5] [[This comment can also be found in EPA-HQ-OAR-2014-08267-1372, pp.230-231.]]

**Organization:** Union of Concerned Scientists (UCS)

Vocational vehicles range from delivery vans to city buses and from bucket trucks to garbage trucks. This complexity makes it one of the most difficult segments to regulate. In Phase 1, the agencies chose to regulate these vehicles primarily through separate vocational engine standards. In Phase 2, the agencies have added significant complexity and identified a much broader array of viable fuel consumption reduction technologies in this sector. In the following sections, we focus on ways in which the agencies can strengthen the regulation, both with increased stringency and increased flexibility for manufacturers. The agencies' proposal must be 'technology-forcing' and achieve the 'maximum feasible' reductions in the timeframe of the rule. To do this, the agencies must strengthen Alternative 4 by: Increasing the stringency for gasoline-powered vocational vehicles by 7.8 percent and those for diesel-powered vocational vehicles by 3.6 percent in 2024 to fully reflect the ability for conventional technologies to reduce fuel use from this sector, while incentivizing the adoption of more advanced technologies where appropriate; [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

**Organization:** Environmental Defense Fund (EDF)

Class 2b-8 vocational trucks, which include a broad variety of trucks that have many different functions, consume about 20% of the fuel used by the heavy-duty vehicle sector. EPA and NTSA proposed vehicle standards that would result in about a 16% fuel consumption reduction from diesel-powered trucks and about a 13% reduction for gasoline-powered trucks, by 2027. The difference in stringency is explained by the fact that the agencies did not update standards for gasoline engines. In addition to finalizing a fuel neutral engine standard, the vehicle standards can also be strengthened. [EPA-HQ-OAR-2014-0827-1312-A1 p.37]

Weak standards for this segment send a negative signal to the emerging market for advanced technologies and discourage on-going investment and development. We strongly encourage the agencies to finalize more protective standards for vocational vehicles that include a meaningful role for advanced technologies such as hybrid and electric vehicles, and promote innovative companies that can provide high quality jobs. [EPA-HQ-OAR-2014-0827-1312-A1 p.38]

**Organization:** McNicols

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 271-272.]

Specifically, the sub-category for vocational vehicles and multiple route applications makes the regulations more clear and progress more easily identified.

However, regarding the vocational vehicles target improvements, the proposed requirement of 16 percent improvement may fall short of bringing about the necessary technologies to significantly impact this sector. With roughly 30 percent of the greenhouse gas pollutants coming from the vocational vehicle and medium and heavy duty pickup truck sector, a greater percentage should be considered to drive the innovation even higher.

**Organization:** Motiv Power Systems

We applaud the agencies for their commitment to work with manufacturers and craft the strongest standards to reduce fuel usage, save fleets money, and minimize the environmental impacts of the trucking sector. The agencies have taken some key first steps to build upon the success of Phase 1, and we look forward to working with EPA and NHTSA to ensure that the regulation adequately captures and incentivizes the levels of fuel consumption and emissions reductions we know can be achieved in this timeframe. [EPA-HQ-OAR-2014-0827-1184-A1 p.2-3]

**Organization:** California Air Resources Board (CARB)

CARB staff recommends that Alternative 4 be chosen, with the regulation proposing standards out to MY 2024 vehicles. CARB staff believes the proposed rule in its current framework is conservative and leaves obtainable emission benefits on the table. CARB staff does not believe that the current stringencies require the additional three years of lead time that is proposed in Alternate 3. Multiple manufacturers have made it clear to CARB staff that the proposed stringencies can easily be met in the MY 2024 compliance time frame. In the current Alternative 3 framework, most technologies do not see significant changes in penetration from MY 2024 to MY 2027.

The NPRM proposes an overall 16 percent CO<sub>2</sub> emission benefit for the final MY vocational vehicles. The additional stringencies recommended by CARB staff result in additional incremental CO<sub>2</sub> benefits of about 2.5 percent for vocational vehicles. CARB staff therefore recommends U.S. EPA and NHTSA

pursue Alternative 4 with a final stringency level of approximately 18.5 percent for vocational vehicles.<sup>26</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.56]

- Alternative 4 achieves greater emission benefits and greater net societal benefits than Alternative 3. As summarized in Table 10 below, Alternative 4 for vocational vehicles would achieve 33.5 more total MMT CO2 reductions and a \$5.2 billion greater total societal benefit nationally through MY 2029.
- The projected payback period for Alternative 4 is still acceptable and within the same year as the projected payback period for Alternative 3. [Table 10 can be found on p.54 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

**Organization:** CALSTART

As we shared at the Long Beach workshop, CALSTART recently published a report, titled “Higher Fuel Efficiency: Working for Fleets,” which assessed the business case for fleets from higher fuel efficiency trucks that might be driven by a new fuel economy rule. This report has highlighted two core issues: that there are achievable technologies that can provide higher efficiency on the rule timeline, and that these technologies on whole can be cost-effective and provide reasonable payback to fleets using them. [EPA-HQ-OAR-2014-0827-1190-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.152.]]

To understand the payback issue we took a different approach from the agencies. We worked with a cross section of fleets representing various applications and truck types nationwide to validate the key components of a fleet business case assessment model, collaborating with the NAFA Fleet Management Association and its fleets.

In developing the model, we also surveyed fleets on their support for and concerns about increased fuel efficiency.

- Interestingly, we found 87-percent of fleet managers responding supported rules driving higher fuel efficiency.
- Their primary concern was cost; though 89-percent said they would be willing to pay more up front for fuel efficient trucks if they knew they would pay back over their life.
- They also expressed concern about reliability and maintenance costs. This does have relevance for the rule duration.

We looked at different technology packages that were most applicable to each use profile, assembling packages that could achieve up to a 40 percent reduction of fuel use over 2010 baseline trucks. These packages, and their projected costs, were adapted from National Research Council and Transportation Research Board studies.

Our top level findings were these:

- We found there is a reasonable business case payback, based on fleet-validated cost assessment tools, for higher fuel economy trucks at levels proposed in the rules.

- The stringency levels we modeled in the report were, in most cases, actually higher than those proposed in the Alternative 3 language.

- We saw the potential for higher fuel economy targets than those proposed in several use profiles – particularly urban trucks, regional trucks and those vehicles with high work site idle time.

- The biggest variables for payback were utilization – the mileage and fuel used – and the upfront cost of the technology.

- Fleets have suggested that modeling payback sensitivity to maintenance cost would be helpful and we encourage the agencies to develop this information to address fleet concerns.

As mentioned, the report used different – and generally higher – assumptions for stringency than those recommended in the agencies’ preferred Alternative 3. Below we highlight the comparisons between the segments we studied, the corresponding segment in the rule (where there is one), and the stringency proposed in the draft rules compared with those studied in the report. [EPA-HQ-OAR-2014-0827-1190-A1 p.3]

[Table of segments studied and results can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1190-A1]

We are concerned that the vocational segments as proposed do not meet the same level of reduction path and we believe they could, while still providing fleet users with the functionality they need and a payback they can afford.

In shaping the final rule, we believe the agencies’ payback projections from efficiency are reasonable and real. Indeed, we see a strong case for higher efficiency targets than those currently called for particularly in several vocational segments. We also see the ability to further push improvements in engine technology than proposed while still making sure those engines are a component of a full vehicle strategy. [EPA-HQ-OAR-2014-0827-1190-A1 p.9] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.155-156.]]

We strongly support increasing the stringency requirements of these vocational segments, with a minimum target of 20% (though varied by different segment). In terms of the rule timeline, we remain sensitive to both OEM and fleet desires for a longer investment horizon and a more measured, stair-step regulatory approach to ensure quality product delivery. However, we believe any longer regulatory timeline (2027) would only make sense in the context of increased stringency, with some commensurate added flexibility.

**Response:**

We have carefully considered all the comments asking the agencies to adopt more stringent standards for vocational vehicles than proposed. Please see Section 8.2.1 for responses to comments related to the pace of phasing in the Phase 2 standards. See also Section 1.5 for responses to comments on the need for lead time for some technologies. In the sections below where we address specific comments on individual technologies, we describe the ways in which we have adjusted technology adoption rates and



effectiveness projections to form the basis for the final vocational vehicle standards that are more stringent than we proposed, but still afford sufficient lead time to achieve those standards.<sup>169</sup>

### **6.1.3 Other General Comments**

**Organization:** Truck & Engine Manufacturers Association (EMA)

The agencies should not proceed with the Proposed Phase 2 Standards for vocational vehicles for the many reasons previously noted. The agencies are proposing an inordinately complex, flawed and ultimately infeasible Phase 2 Program for vocational vehicles. As explained below, the agencies need to make fundamental changes to that proposal. Other reasons relating to the agencies' underlying assumptions regarding available technologies for vocational vehicles support this conclusion as well. [EPA-HQ-OAR-2014-0827-1269-A1 p.59]

The agencies' proposed segmentation of the vocational market, the assumed deployment and penetration rates of the envisioned GHG-related technologies, and the "normalization" process that the agencies are using to align the relative stringency of the various proposed vocational vehicle standards are all extremely problematic. The net result is an uncertain and unworkable proposal that fails to meet the basic requirements of an administrative rulemaking. Given this untenable situation, EMA recommends that the agencies consider the option of maintaining the Phase 1 program for vocational vehicle standards until such time as a better-reasoned and better-designed Phase 2 program can be developed. Deferring the Phase 2 standards for vocational vehicles will also allow manufacturers to focus their efforts on the successful implementation of the Phase 2 program for Class 7 and 8 tractors, the heavy-duty vehicles that represent more than 80% of the modeled benefits from the pending rulemaking. [EPA-HQ-OAR-2014-0827-1269-A1 p.4-5]

The net result is that the agencies' Proposed Phase 2 Standards for vocational vehicles are unworkable and infeasible in their current form. The applicable duty cycles, vehicle subcategory definitions and GEM "normalization" for vocational vehicles are all still moving parts in the agencies' still-evolving proposal. Moreover, given the agencies' announced schedule for finalizing the Phase 2 Standards, there is not enough time for manufacturers to develop detailed comments on how an appropriate, fully integrated Phase 2 program for vocational vehicles – a program based on more accurate methods, baseline assumptions and efficiency targets – should be structured and implemented. Rather, the agencies should consider the option of undertaking a new rulemaking process to craft that type of a fully integrated Phase 2 program for vocational vehicles. EMA is committed to cooperating with the agencies in such a supplemental rulemaking. [EPA-HQ-OAR-2014-0827-1269-A1 p.32]

In the interim, the agencies could maintain the Phase 1 program for vocational vehicles, with potential additions to the GHG technology drop-down menu to include a broader range of available GEM credits (broader than just tires) for features such as anti-idle technologies and improved transmissions. Simplifying the vocational vehicle program in this manner could allow manufactures to focus their nearer-term efforts on the successful implementation of the Phase 2 standards for line-haul vehicles, the vehicles that use more than 80% of the fuel consumed by the heavy-duty and medium-duty vehicle segments. [EPA-HQ-OAR-2014-0827-1269-A1 p.32]

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<sup>169</sup> However, we note an error in UCS' assertion that standards under CAA section 202 (a)(1) and (2) must be technology forcing. This is not correct, although standards adopted pursuant to this authority may permissibly be technology forcing (i.e. based on performance of technologies not yet on the market but available with sufficient lead time). See 76 FR 57129-130 (Sept. 15, 2011).

**Organization:** Truck & Engine Manufacturers Association (EMA)

**Remaining Fundamental Uncertainty Regarding the Vocational Vehicle Program**

The inclusion in the NODA of new data developed by the National Renewable Energy Laboratory (“NREL”) regarding vocational vehicle duty cycles still fails to sufficiently fill the significant gaps that continue to exist with respect to the Proposed Phase 2 Standards for vocational vehicles. The manner in which the agencies intend to divide and categorize vocational vehicles, the fuel efficiency technologies and percentage improvements that the agencies are ascribing to those different segments of vocational vehicles, the assumed respective penetration rates of those various technologies, and the derivation of potential unique “carveouts” from the vocational vehicle program (e.g., for certain custom chassis, such as cement mixers) are all still unknown, undefined, and unvalidated. The agencies have not articulated how vocational vehicles will be segmented under the Phase 2 Standards, what the Phase 2 Standards will be for those various vehicle segments, or how those standards were derived. GEM does not yet contain sufficiently certain inputs to conduct any assessment of the Phase 2 program for vocational vehicles, the stringency targets for which remain unknown. That makes it difficult for interested parties to provide meaningful comment on the agencies’ proposal for vocational vehicles, and calls into question whether the agencies have fulfilled the necessary requirements of the Administrative Procedures Act (“APA”) and Section 307 of the Clean Air Act (“CAA”). [EPA-HQ-OAR-2014-0827-1891-A1 p.2-3]

**Organization:** Association for the Work Truck Industry (NTEA)

**Regulatory Structure**

The NTEA supports the agencies’ structural approach to the rules. It is logical to separate out the four vehicle categories as they tend to be both built and utilized in different manners. Of the categories, vocational trucks will be the most diverse vehicle population, as noted by the possible chassis, body and equipment configurations available in the marketplace. This diversity also continues in the manufacture process. [EPA-HQ-OAR-2014-0827-1187-A1 p.2]

In order to complete a vocational truck, multiple manufacturing companies may be involved from the engine manufacturer, chassis manufacturer, intermediate stage manufacturers (perhaps adding axles) to the final stage manufacturer who completes the vehicle for final delivery. Also included in the manufacture chain are the body and equipment manufacturers who separately build products to be mounted on the vehicles for completion. Lastly, there can be what are known as “alterers” who work on completed (but neither titled nor sold yet at retail). Alterers, for instance, might take a completed pickup truck, remove the bed and replace it with another body type prior to the first retail sale. Another common alteration would be installation of a snow plow on an appropriate truck. [EPA-HQ-OAR-2014-0827-1187-A1 p.2]

The proposed regulatory structure recognizes the manufacturing complexity of vocational trucks and attempts to regulate in a less complex manner. [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

Due to the complexity of the vocational truck industry, longer lead times and regulatory consistency is valued. Having regulatory certainty to 2027 is helpful as would be a consistent, national program. [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

We do believe that some alterations to the proposed standards with regard to vocational trucks may be appropriate given the cost to industry and the stated benefits from increased fuel efficiency. [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

**Organization:** Navistar, Inc.

Some of Navistar's most significant concerns regarding the feasibility of the Proposed Rule itself are directly related to the provisions applicable to vocational vehicles. While Navistar supports the agencies' general intent to expand the reach of the GEM model to vocational vehicles, we have serious concerns that the Proposed Rule, as written, is simply not ready or feasible as it pertains to vocational vehicles. [EPA-HQ-OAR-2014-0827-1199-A1 p.31]

As we pointed out in our NPRM Comments, Navistar believes that the vocational regulations as proposed are not feasible or even fully conceptualized.<sup>2</sup> Vocational vehicles are an extremely complex and diverse portion of the heavy duty sector, while also small volume relative to tractors. This complexity and relatively small volume potentially magnifies the impact of any distortion created by the rules. The potential for tilting the playing field through an ill-conceived rule is very real and very concerning. With the NODA (as well as EPA documents contemporaneous in the docket but not in the NODA), the agencies have increased the risk of adverse impacts. In short, the new materials in the docket actually increase rather than reduce the uncertainty. [EPA-HQ-OAR-2014-0827-1919-A2 p.2]

Navistar's NPRM Comments stated that the "[t]he vocational vehicle standards must start from the actual baseline MY17 standards and must be simplified and revised throughout." Specifically Navistar felt like the vocational rule was not ready and needed significant work. The NODA included a revised Greenhouse Gas Emission Model ("GEM") and NREL report which will significantly impact the Vocational standards and technologies. [EPA-HQ-OAR-2014-0827-1919-A2 p.2]

**Organization:** Navistar, Inc.

Class 5-7 vehicles are in an averaging set with either no tractors or few tractors; therefore, it is critical that the Vocational regulations be achievable. Navistar had significant concerns with the NRPM technology penetrations and continues to be concerned as the agency have not shared any additional details of the structure, baseline, or standards for Vocational. We believe that the agencies must work with the industry to avoid all unintended consequences and for the agency to design a high quality rule that does not disrupt the market or force specifications inappropriate to the task a specific vehicle is to perform. Navistar is committed to helping develop a high quality rule, but we believe that agencies should take more time to do so and delay the inclusion of the vocational rule in the final rulemaking until these issues can be resolved adequately. [EPA-HQ-OAR-2014-0827-1919-A2 p.3]

**Organization:** Waste Management (WM)

WM has significant experience testing new technologies on our vocational refuse vehicles in the field. We have learned a great deal from those road tests, where we can evaluate equipment while operating in the various duty cycles that we use in serving our customers. Refuse vehicles are not typical of most vocational fleet vehicles. They are extremely heavy and have difficult duty cycles that place substantial demands on the vehicle. We have found that it is often necessary to test new technologies using a typical refuse duty cycle to assess whether they can achieve the advertised fuel or GHG reductions, or even operate properly in our work environment. We are very concerned that expediting the compliance schedule by three years would preclude much of the valuable field-testing time that we need to assure ourselves that we are purchasing vehicles and equipment that can serve our and our customer's needs. [EPA-HQ-OAR-2014-0827-1214-A2 p.6]

**Organization:** Daimler Trucks North America LLC

Of all of these problems we noted above, the biggest problem is that we are unable to repeat and verify the agencies' stringency analysis. Ideally, for us to do so, the agencies would provide an updated spreadsheet that outlines their assumptions for baseline setting and stringency setting vehicles (because the assumptions have changed since the NPRM). Unfortunately, we were only provided information about baseline vehicles on March 24, giving us too little time to do the analysis necessary to respond to the agencies. In particular, we have received only limited feedback from the agencies regarding our concerns about expected technology benefits and penetrations used for stringency setting in the NPRM. We therefore cannot yet conclude that the agencies' stringency analysis is correct or even reasonable. There may be significant errors, but we do not know. We will try to respond to the agencies promptly on GEM and the stringency analysis. [EPA-HQ-OAR-2014-0827-1918-A2 p.3]

**Organization:** Daimler Trucks North America LLC

**Alternative Vocational Vehicle Standards Considered** - The agencies request comment on risks or challenges associated with Alternative 4 for vocational vehicles. 80 FR 40289. Because some of the technologies on which the agencies premised the vocational standards are not yet developed to the level that is necessary for the heavy-duty vehicle industry, and because there is such a diverse array of vehicles for which technologies need to be developed and tested, we agree that Alternative 4 presents too grave a risk of unintended consequences such as unreliable performance of the new technologies. The agencies should follow a measured approach in forcing improvements only when it is clear that such improvements are 'achievable' (quoting the Clean Air Act's mandate to the EPA, CAA § 202(a)(3)(A)). [EPA-HQ-OAR-2014-0827-1164-A1 p.74]

**Organization:** Allison Transmission, Inc.

#### **Unique Characteristics of MD/HD Market Preclude Alternative 4**

The MD/HD vocational vehicle market is comprised of primarily vehicles that do work. Fleets in this market tend to be conservative with respect to the adoption of new technologies and they have a long memory for market failures. Prior to the widespread adoption of new technology, fleets will either test vehicles themselves in fleet operations, or require information from a third party or another fleet with whom they previously relied on for technology assessments. EPA's and NHTSA's Phase 2 rulemaking will not change these market dynamics. Instead the prime purchasers of new vehicles may be even more careful in verifying the performance and integration of multiple, new technologies and their suitability for the actual work demands that will be placed upon them. [EPA-HQ-OAR-2014-0827-1284-A1 p.10]

The Phase 2 proposal will require adoption of several new technologies across a wide variety of vehicle and engine components in order to achieve 16% lower CO<sub>2</sub> levels in 2027 compared with CO<sub>2</sub> emissions in the 2017 baseline. Given the aggressive nature of these requirements which are layered on top of GHG improvements made in the Phase 1 rule, Allison expects that the adoption of many new components to be viewed as a "high risk" by fleet operators. This becomes problematic for the assumed adoption rates since fleet operators have been historically concerned to keep the up-time (i.e., availability) of their vehicles at high levels. [EPA-HQ-OAR-2014-0827-1284-A1 p.10]

Second, the projected payback for incorporation of fuel efficient technologies is not until the 6th year. Many fleets turn trucks over in normal buying cycles of less than 6 years -- so they will either not realize a payback or not factor this payback into their initial purchase decisions. As a result, the long payback period (coupled with perceived technology risks) is likely to result in an increase of pre-buys and in delayed purchases to allow fleets to run existing trucks longer than originally projected. The 2010 NAS

Report (see Regulatory Impact Analysis (“RIA”) Section 8.4.2) also recognizes this dynamic in the MD/HD market. [EPA-HQ-OAR-2014-0827-1284-A1 p.10]

Overall, as compared with Alternative 3, Alternative 4 carries with it a much higher risk of market disruption. As noted above, under Alternative 4 there could be a surge in vocational truck sales, followed by a depressed market. Employment levels would follow suit. That is, employment levels would be increased to meet the pre-buy demand, only to rapidly fall due to an ensuing period of weak demand. In this situation, manufacturing companies who strive to manage cost and quality through stable production volumes and employment levels, would be negatively impacted. If the depressed demand were to be extended for a long time, then some businesses might not be able to continue operations. [EPA-HQ-OAR-2014-0827-1284-A1 p.11]

The RIA recognizes the possibility of a pre-buy, but the analysis concentrates only on what is viewed as favorable fuel costs and savings that will be recognized by vehicle owners. Specifically, the agencies “are not projecting a change in fleet turnover characteristics due to this regulation.”<sup>10</sup> Allison recommends a more thorough analysis of the market history to predict behaviors and economic impact due to the technology risks that are inherent in the proposed rule. Based on that analysis, changes in timing or stringency levels may have merit. For example, fuel costs per mile were calculated using EIA’s 2014 Annual Energy Outlook for diesel prices. Yet more recent EIA projections indicate a substantial decline.<sup>11</sup> This is significant since the agencies’ assumptions concerning “pre-buy” are that the value of saving money in future fuel purchases will outweigh the upfront additional costs of new vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.11]

**Organization:** Association for the Work Truck Industry (NTEA)

### **Fuel Efficiency Payback**

The NTEA requests that standards similar to those described as “Alternative 2” be considered for the vocational truck segment. [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

While we conceptually agree with the proposed application of the same general certification procedures for Phase 2 as are currently being used for certifying to the Phase 1 standards, we are concerned, about the expected payback period for vocational trucks using the “preferred” Alternative 3.

With regard to Alternative 3, in 2027 when the standard is fully phased in, heavy-duty vehicles across all classes would achieve up to 16 percent emissions and fuel use reductions for vocational vehicles when compared to Phase 1 standards. Further, the proposal calculates figures for expected payback periods based on the additional costs associated with the proposed standards and the economic savings based on the increased fuel efficiency expected with Alternative 3. The proposal estimates “Reasonable Payback Periods for the Trucking Industry In model year 2027,” for the buyer of a new vehicle. The notice states that the buyer would recoup the extra cost of technology used to achieve the standard (Alternative 3) within 6 years for vocational vehicles such as garbage trucks, buses and on-road construction trucks (e.g. cement mixers, dump trucks, etc.), which are typically used longer than vehicles in other heavy duty sectors.

The expected payback period of 6 years for vocational vehicles is not acceptable.

The NTEA surveyed over 40 vocational fleet companies with regard to fuel efficiency investment. More than 80% of the surveyed fleets said that a payback period beyond 6 years for 16% fuel efficiency gain that cost \$3,500 would not be acceptable.

More than 50% of the surveyed fleets found a 3 year payback period acceptable. Additionally, almost one-fourth of the respondents noted that the useful life of their Class 3-7 vocational trucks was less than 6 years. On the average, each of these fleets operated over 3,400 Class 3-7 vocational trucks.

The NTEA supports the overall regulatory structure of the proposed standards. We believe that the burden faced by vocational truck owners is out of proportion to their fuel use and the agencies should consider ways to reduce that burden such as provided by Alternative 2. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

**Organization:** National School Transportation Association (NSTA)

We understand that the proposal aims to establish a comprehensive Phase 2 Heavy-Duty National Program to reduce greenhouse gas emissions and fuel consumption for new on-road heavy-duty vehicles. In addition, we note that this program would phase in over the long-term, beginning in 2018 model year and culminating in standards for model year 2027. Our comments are specific to school buses, which fall under vocational vehicles, and do not speak to any of the other vehicles addressed in this proposal. [EPA-HQ-OAR-2014-0827-1301-A1 p.2]

NSTA is proud to be part of the largest and safest transportation system in the country. The nation's fleet of 480,000 yellow school buses provides safe, fuel-efficient and environmentally-friendly transportation to school children across the United States. [EPA-HQ-OAR-2014-0827-1301-A1 p.2]

NSTA members welcome efforts to improve fuel economy for school buses, but efforts to improve fuel economy should not come at the expense of reducing safety for school children riding the school bus. There can be no higher priority than protecting our precious cargo. While catastrophic school bus crashes have occurred, they are rare events. Most school bus crashes are minor, and in most crashes involving passenger cars and light trucks, the school bus has the advantage of its larger size and weight. That larger size and weight helps protect occupants, but may also exist at the expense of fuel economy. [EPA-HQ-OAR-2014-0827-1301-A1 p.2]

Yellow school buses are designed to protect students with special safety features not available on any other vehicle. These features include their recognizable color and size, height, reinforced sides, protective passenger seating, crash protected fuel systems, flashing red lights, cross view mirrors and crossing and stop sign arms to ensure children are protected and secure on and off the bus. School bus drivers also receive specialized training in student behavior management, loading and unloading security emergency medical procedures. Drivers receive driving record checks, criminal background checks and pre-employment and random drug and alcohol testing. [EPA-HQ-OAR-2014-0827-1301-A1 p.2]

The typical school bus is not only the safest vehicle on the road, but it also achieves significant fuel economy and emission reduction benefits. New diesel engine standards make today's buses 98% cleaner than buses manufactured two decades ago. Additionally, thousands of older buses have been modified with high-tech filters and catalysts to reduce emissions. In addition, school bus transportation eases the traffic congestion surrounding schools each morning and afternoon by keeping millions of cars off roads. Encouraging school bus use can achieve significant fuel economy and greenhouse gas reduction benefits. [EPA-HQ-OAR-2014-0827-1301-A1 p.2]

We are concerned, however, with the extremely aggressive timeline suggested by NHTSA and EPA in this proposal. We are aware that our manufacturer partners have significant concerns with meeting the requirements outlined in the proposal. We urge NHTSA and EPA to continue the dialogue on these requirements to ensure that the manufacturing industry can meet the requirements and not disrupt production in the process. To be effective, efficient and safe, school transportation is reliant upon the

availability of school buses. Any requirement which could potentially affect the availability of school buses could affect a provider's ability to secure enough vehicles to effectively manage their fleet. As currently proposed, we fear a significant effect on our ability to manage fleets and secure additional vehicles when needed. [EPA-HQ-OAR-2014-0827-1301-A1 p.2-3]

## **OshKosh**

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, pp.166-171.]

The Phase 2 plan mandates a 16 percent improvement for heavy vocational trucks, four percent of this coming from the engine. The remaining 12 percent is expected to come from applying seven technologies. Of these seven check the box technologies, none of them can be practically applied to most vocational applications.

The Phase 2 proposal requires that vocational vehicle manufacturers check these boxes on the seven technologies in order to show compliance. As we can see, these boxes either can't be checked, or if they are checked, doing so will not result in actual real world improvements. Besides being ineffectual, the checkbox approach creates an unfair hardship for those manufacturers whose only products are vocational in nature. Large truck manufacturers have the option to offset noncompliant vocational trucks with credits from line haul products. This is not possible if you only produce vocational products.

This dilemma deals a double whammy to business, vocational only manufacturers will be out of the business and new entrepreneurial ventures will be blocked. We propose the following solution. We suggest that the U.S. Congress and the EPA acknowledge the fact that the laws of physics simply do not allow heavy vocational work trucks the same potential for CO2 and fuel economy improvements as is possible for the higher speed line haul application. Slower speeds, low volumes, off road operation, complex duty cycles, lack of engine and transmission supplier market drivers, and the nature of the work being performed all work against the vocational product.

The Phase 2 regulations should, therefore, continue the current Phase 1 tire regulations as is and limit further mandates to whatever can be gleaned from the engine improvements alone.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The UAW recognizes and supports the high level of communication and collaboration between regulators, the industry, and other stakeholders in crafting a very complex standard. We urge all parties to continue working together to solve outstanding issues before regulations are finalized.

It is also critically important to have flexible and adaptable regulations for vocational vehicles. This is a complex and difficult task as this class of vehicles have a wide array of applications and have not previously been subject to stringent emission standards. This is why the viability of certain technologies on vocational vehicles needs to be carefully considered.

**Organization:** Autocar, LLC

**Autocar Requests an Extension of the NODA Comment Period and an Official Notice and Comment Period on the Memorandum.**

Autocar requests additional time to review and comment on the documents under the NODA and requests formal notice and opportunity to comment further on the Memorandum, as set forth in Appendix 2. [Appendix 2 can be found in docket number EPA-HQ-OAR-2014-0827-1885-A2][EPA-HQ-OAR-2014-0827-1885-A1 p.13]

Autocar requests that the agencies open a comment period with respect to EPA's February 12, 2016 memorandum entitled "Vocational Vehicle Technology Packages for Custom Chassis." EPA-HQ-OAR-2014-0827-1719. The memorandum purports to establish technology based packages and adoption rates for custom chassis vehicles. In response to comments from stakeholders indicating such standards were not currently feasible, the memorandum includes a "specific technical feasibility analysis ... for vehicles in seven vocations," including refuse trucks, which Autocar manufactures. However, the agencies have not provided a formal opportunity to comment on the memorandum or the information contained therein. [EPA-HQ-OAR-2014-0827-1869-A1 p.3]

Because this information (i) will likely affect the present rulemaking and (ii) is new, the public must be allowed an opportunity to provide substantive input. It is well settled that agencies must afford interested stakeholders the opportunity to comment on new data integral to a rulemaking. See generally *Kern County Farm Bureau v. Allen*, 450 F.3d 1072, 107677 (9th Cir. 2006); see also *Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1031 (D.C. Cir. 1978) ("[I]n this case, the Agency's final conclusions are far from the 'logical outgrowth' of the preceding notice and comment process and instead are the result of a complex mix of controversial and un-commented upon data and calculations. Given the lengths that the Agency must travel to justify its revisions between the interim and final stages, we cannot be sure that further and ultimately convincing public criticism of those changes would not have been forthcoming had it been invited by the Agency." (emphasis supplied) (citation omitted)); cf. *Crawford v. F.C.C.*, 417 F.3d 1289, 1295 (D.C. Cir. 2005) ("Whether the 'logical outgrowth' test is satisfied depends, in turn, on whether the affected party 'should have anticipated' the agency's final course in light of the initial notice."). [EPA-HQ-OAR-2014-0827-1869-A1 p.3]

Here the information included in EPA's February memorandum is highly technical, applies to a variety of vehicle types (while excluding others), and will likely have significant repercussions for various manufacturers including Autocar. Again, the agencies only provided this memorandum in February and have not invited comment upon it. To ensure that any final rule mandating technology packages for custom chassis complies with established administrative procedural requirements, Autocar and other stakeholders must be afforded the opportunity to respond to the technical and data-based analysis underlying and set forth in EPA's memorandum. [EPA-HQ-OAR-2014-0827-1869-A1 p.4]

As detailed in our October 1, 2015 comments, Autocar, LLC and Autocar Industries, LLC ('Autocar') are small, privately-owned Indiana vocational chassis assemblers producing specialized heavy-duty vocational trucks and tractors used in America to collect solid waste, sweep streets and shunt freight at warehouses, railroads and harbors. [EPA-HQ-OAR-2014-0827-1885-A1 p.1]

Autocar submits these supplemental comments to object to recent compliance proposals that appear to indicate that Autocar's small business impact comments have not been fully considered and that our request for extension will not be granted. We also request additional time to review and comment on the Memorandum and the underlying research set forth in documents included in the NODA. [EPA-HQ-OAR-2014-0827-1885-A1 p.2]

**Organization:** Volvo Group



Heavy-duty trucks are commercial vehicles purchased to enhance the profitability of a business. Purchasers must consider the initial cost (including Federal Excise Tax and state tax), operating and maintenance costs, plus any cost of vehicle downtime. Class 8 tractors, in particular, are generally purchased for regional or long-haul operation accumulating 100,000 or more miles annually. Most fleets require payback for efficiency technology in 18-24 months to cover the risk factors (actual efficiency delivered, maintenance and downtime costs, etc.), recoup their investment, and to provide a profit margin within their 4-5 year trade cycle. Fleets are particularly leery of complex new systems with unproven reliability and unknown maintenance cost. Rather than purchase such technology, fleets have delayed new purchases by extending the life of older equipment and/or pre-buying vehicles before such systems were forced into the market. This was amply demonstrated in 2007 when diesel particulate traps were forced into the market by PM emissions targets. Factories ran at full capacity at the end of 2006 only to nearly shut down for long periods in 2007. Production was then further curtailed by the severe recession in 2008. Vehicle manufacturers' and suppliers' employees suffered from lay-offs, pay reductions, and lack of work. One major supplier, Caterpillar, dropped out of the on-road engine business. Since 2010, the increased cost and complexity of emissions technology has spawned a booming business in trucks built from glider kits, a completely new truck chassis and body that is up-fitted with a rebuilt engine, driveline and axle, skirting emissions and efficiency regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.18]

We find a number of the technology assumptions in the NPRM are not justified because the technology is not demonstrated, does not deliver the assumed efficiency, or cannot be forced into the market at the agencies' assumed penetration rates. These include aerodynamic drag reduction, start/stop technology, neutral idle, low rolling resistance tires, 6x2 axles, new transmissions, idle shutdown, vehicle speed limiters, hybridization, "deep integration" of driveline, and vehicle weight reductions. [EPA-HQ-OAR-2014-0827-1290-A1 p.19]

**Response:**

In response to the above comments that express concern about expediting market adoption of technology as described in the proposed Alternative 4, the agencies have adjusted lead times and technology adoption rates to reflect the feasibility of developing technologies as described below in the sections for individual technologies. See Section 8 for further discussion of comments related to more stringent alternatives.

In response to the comments above that express concerns about the complexity of the vocational vehicle program and the standard-setting process, the agencies are adopting a final vocational vehicle program structure that is more straightforward than was proposed, as discussed in Section 6.2.2 below. Navistar noted particular concerns regarding the structure and feasibility of the vocational vehicle standards. Specific issues relating to duty cycle-based subcategorization are addressed in Section 6.1.4 below and in the Preamble at V.B.1.a. We appreciate that the medium heavy-duty averaging set has challenges distinct from HHD vehicles, and in addition to revisiting the technology adoption rates in response to comments (discussed in Section 6.3 below), we are adopting program flexibilities that should address Navistar's concerns with respect to transitioning from Phase 1 to Phase 2. Specifically, we are adopting extended credit life for LHD and MHD averaging sets so that all credits generated in these averaging sets in MY 2018 and later will last at least until MY 2027 (see Section 1.4.6 of this RTC and Section I.C.(1)(b)(i) of the Preamble). We note further that these are issues the agencies have analyzed carefully, and analyzed carefully with EMA members, including Navistar, as discussed in the next paragraph.

In response to the comments that express concerns about opportunity for notice and comment, the agencies conducted timely outreach to affected stakeholders. The agencies did so both during the public

comment period, and thereafter. These meetings including sharing interim information about program revisions being considered in response to the initial round of public comments.<sup>170</sup> As explained in detail in the meeting log in the docket, EPA and NHTSA staff met repeatedly with EMA representatives, and with representatives of EMA member companies (including Daimler and Navistar whose comments appear above), both before and after the proposal to discuss details of many aspects of the rulemaking, including potential standards for vocational vehicles.<sup>171</sup> We also spoke and met with Autocar on multiple occasions between August 2015 and June 2016.<sup>172</sup> Among the issues discussed with Autocar were the structure of the vocational vehicle program and feasible technologies for special-purpose vehicles. The agencies also provided public notice of potential changes from proposal in a Notice of Data Availability (81 FR 10824, March 2, 2016) which presented information, among other issues, of further modification to the GEM compliance tool (used for vocational vehicle standard compliance), and a draft report from NREL with analysis of drive cycles and segmentation recommendations. In addition, EPA held a web conference for chassis manufacturers on March 22, 2016 to discuss our evolved thinking with respect to several types of special-purpose vehicles.

In sum, many face-to-face meetings and telephone conferences were held during the deliberative phase, providing actual notice and opportunity for stakeholder feedback throughout this process. The commenters are therefore mistaken in asserting that the agencies provided inadequate notice and public comment opportunities. Meetings between EPA staff, EMA, Autocar and other significant stakeholders regarding the structure of the vocational vehicle standards continued up until a few weeks before promulgation. See Section 15.5 for further discussion of responses to comments related to public participation in the rulemaking process.

In response to comments requesting less stringent vocational vehicle standards with less upfront costs and a faster payback period, the agencies have made revisions to projections of technology adoption rates as well as incremental technology costs. These changes are described in more detail below in Section 6.3 for each technology, but in general the average vocational vehicle package costs have decreased slightly since proposal for vehicles certified as Urban and Multipurpose, and average package costs have increased slightly for vehicles certified as Regional. We anticipate that Regional vehicles would be those most likely to accumulate the most miles among the vocational fleet, while Urban and Multi-purpose vehicles are likely to accumulate fewer miles. Therefore we believe the revised average technology package costs should shift the payback period in a more favorable position for many vehicle owners. While the average payback is now projected to be closer to four years than six years as it was at proposal, vehicle owners may see different actual cost recovery periods, as payback periods are calculated on a hypothetical fleet-average vehicle. Moreover, payback is calculated assuming all vocational vehicles are certified under the primary program, a very conservative assumption. See Preamble Section V.C: “[u]sing this assumption, the vocational vehicle type with the shortest payback is intercity buses (less than one year), while most other vehicles (with the exception of school buses and motor homes) are projected to see paybacks in the fourth year or sooner. See Section 6.2.3 below for some ranges of estimated technology package costs for custom chassis. We expect that manufacturers will certify to the optional custom chassis standards where it is more cost-effective to do so; therefore, our analysis may be overly conservative where it indicates very long paybacks for some vocational vehicles.” See also the Preamble to this rule at Section IX.M, the RIA Chapter 7.2.4, and Section 11.13 of this response to comments document for further discussion of incremental costs and payback periods.

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<sup>170</sup> See Heavy-Duty Phase 2 Stakeholder Meeting Log, August 2016; see also Heavy-Duty Phase 2 FRM Phone and E-Mail Log.

<sup>171</sup> See Memo to Docket, “Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking,” August 2016

<sup>172</sup> See Emails between EPA and Autocar from August 2015 to June 2016.

## 6.1.4 Framework: Duty Cycles

### **Organization:** Volvo Group

Volvo's extensive database shows that NREL's study does not provide representative duty cycle weighting factors for Class 8 vehicles. We believe this is because of NREL's limited inclusion of representative Class 8 vocational vehicles. This has biased the data towards more low-speed operation not representative of typical Class 8 vocational duty cycles. [EPA-HQ-OAR-2014-0827-1928-A1 p.7]

As noted in the NREL report<sup>1</sup>, the population used for the NREL analysis was a total of 754 vocational vehicles comprising 10,765 daily drive cycles (see figure 1). Assuming an average of 200 miles per day the total mileage accumulation would be approximately 2.2 million miles for the Class 2b-8 vocational vehicle population. This results in an average of 2,855 miles of data per vehicle. In addition to the limited sample size for Class 8 vocational vehicles, NREL aggregated all weight classes in their determination of drive cycle weightings for each cluster (see figures 2 and 3). [EPA-HQ-OAR-2014-0827-1928-A1 p.7] [Figures 1-3 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1928-A1]<sup>2,3</sup>/1/ Duran, Phillips, Wood, Konan, Kelly, and Gonder, "The Development of Vocational Vehicle Drive Cycles and Segmentation" Draft, National Renewable Energy Laboratory, EPA Docket I.D. EPA-HQ-OAR-2014-0827-1621 /2/ It is not made clear in the NREL report what types of vehicles are represented by "N/A," though this author assumes they represent the 108 long-haul tractors in Figure 1. /3/ It is not made clear in the NREL report what weight classes distribution is represented by the "N/A" vehicles.

Volvo performed analysis utilizing data from over 12,000 in-fleet Class 8 vocational vehicles representing over 1.3 billion miles of operation, with an average data accumulation of approximately 110,000 miles per vehicle. The Volvo in-fleet vehicle data is represented by refuse trucks, vocational construction straight trucks (dumps, mixers, etc.), and vocational tractors. The data do not include transit buses or motor coaches; however, the volumes are so low as to have minimal impact on the resulting distribution. [EPA-HQ-OAR-2014-0827-1928-A1 p.9]

It is not entirely clear from the NREL report whether the results were based on the full Fleet DNA population, or the resampled population, but it is clear that, when compared to the large data set utilized by Volvo, Volvo's data is far more representative of Class 8 vocational vehicle operation. [EPA-HQ-OAR-2014-0827-1928-A1 p.9]

Volvo performed analysis based on two segmentation methods. First, as seen in Table 1, we performed segmentation as proposed in the NPRM (1037.510 (c)(2)). Second, as seen in table 2, we performed segmentation based on our understanding of our vehicle models and their applications and where we believed they would fall in the EPA's intended segmentation sub-categories. [EPA-HQ-OAR-2014-0827-1928-A1 p.9][Tables 1-2 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1928-A1]

The comparative results are shown in Table 3. Based on Volvo's two segmentation methods we believe that the NREL derived vocational duty cycle weightings in EPA's GEM P2v2.1 are more representative of vocational vehicle operation than the NPRM values, though we find that the proposal does not provide for sufficient 65 mph operation in multi-purpose and urban duty cycles. From this we conclude that the NREL result does not fully match real-world operational characteristics for Class 8 vocational vehicles, suggesting the need for HHD unique vocational duty-cycle weightings. In addition, we find limited differences in duty cycle weighting between the two segmentation methods used in Volvo's analysis. As such, we recommend finalization of vocational duty cycle weightings with either unique HHD

weightings, or additional distance at 65 mph as noted above. [EPA-HQ-OAR-2014-0827-1928-A1 p.9]  
[Table 3 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1928-A1]

- As with the newly proposed GEM P2V2.1 urban cycle weighting, Volvo does not believe the Refuse cycle is representative and needs additional high speed operation.

Volvo Group has been actively sharing Class 8 vehicle duty cycle information with EPA. We provided data on the operation of over 11,000 vocational trucks and motor coaches downloaded from the electronic control systems on our vehicles, spanning the full range of Class 8 vocational vehicles. This data showed that the actual vocational duty cycles for all segments included far less low speed transient and much more high speed operation (with a significant amount over 65 MPH) than the duty cycles proposed in the NPRM. In addition the in-use data showed higher idle time than the proposed duty cycles. Since the effectiveness of various efficiency technologies is highly dependent on duty cycles, it is essential that the regulatory duty cycles mirror actual vehicle usage as closely as possible. It is our understanding that the proposed vocational duty cycles are based on very limited data. Therefore, the agencies must take into account the submitted data to adjust the regulatory duty cycles, the technologies effectiveness, application rates, and standards for vocational vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.43]

The tractor duty cycles are the same as for the Phase 1 rule, except for the addition of grade to the highway portions that make up the bulk of the cycles. In addition, the speed targets and grades are expressed as a function of distance travelled. We support both of these changes since the addition of grade is essential to exercise the engine over its torque/speed range and the transmission shifting in response to steep grades. By using distance as the independent variable (rather than time), the simulation ensures that all vehicle cover the full distance even if the target speed is not always achieved. We do note that many tractors spend significant time above 65 MPH, which is the maximum speed in the regulatory cycles. However, we also note that NHTSA has stated their intention to promulgate a mandatory maximum road speed limit that would presumably limit speeds somewhere in the range just above 65 MPH. The final GHG/Efficiency rule should incorporate duty cycles with maximum speeds that correlate with the speed that NHTSA chooses for the mandatory limit. [EPA-HQ-OAR-2014-0827-1290-A1 p.43-44]

### **Motor Coach Duty Cycle**

Volvo Group has provided motor coach duty cycle data to EPA that shows these vehicles run predominantly highway duty cycles. 65% of the distance was run above 65 mph and 10% between 55 and 65 mph, with the balance (25%) below 55 mph. Idle time was 38%. These vehicles do most of their travel on interstate highways with some time in cities for tour groups or to access bus stations. Many of them are used for high-end motor homes with very limited time in cities. Extensive idling is done to maintain cabin comfort. Accessory loads are much higher due to air conditioning, electrical, and cooling fan loads (limited ram air available in rear engine configuration). Technologies such as stop-start and hybrid are not feasible. With motor coach volume quite limited, there is not a large staff available for product development, even though the vehicle requirements are quite unique from other commercial vehicles. The agencies should consider the unique requirements of this segment rather than lumping motor coaches in with other vocational vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.44]

We also note that motor coaches are an extremely efficient means of transporting people. The agencies should be encouraging this mode of travel and must be careful to avoid creating disincentives to coach travel. In particular, reliability problems and down-time are not tolerated by travelers, so complex systems that increase failure rates have a large negative impact. This is already a problem with the US10 criteria emissions technology. In fact, we request that EPA consider less rigorous requirements for motor coach

emissions systems that cause increased downtime, such as SCR inducements. [EPA-HQ-OAR-2014-0827-1290-A1 p.44]

### **Buses**

Urban buses have a unique duty cycles, but we have little detail data since Volvo buses in the US do not currently use Volvo powertrains and therefore are not part of our vehicle data collection system. We do note that this is the one heavy duty vehicle segment that has been utilizing some level of hybrid powertrains. But it is significant that we have not even certified our bus hybrid system under the Phase 1 rule due to the complexity and cost of coordinating testing of an engine and hybrid system from different suppliers, combined with the low sales volume. Unfortunately, one of the realities of the heavy duty market is that unique solutions are demanded for different market segments so this situation (low volume, multiple suppliers) means that few if any hybrid systems will ever be GHG certified. [EPA-HQ-OAR-2014-0827-1290-A1 p.44]

Buses offer the same opportunity for very efficiently transporting people as motor coaches and should also be incentivized in the larger scheme of reducing GHG emissions and fuel consumption. The same concerns are raised relative to complex systems reducing reliability, driving up cost, and resulting in rider dissatisfaction due to failures. As we did for motor coaches, we request that EPA consider less rigorous requirements for bus emissions systems that increase downtime, such as SCR inducements. [EPA-HQ-OAR-2014-0827-1290-A1 p.44-45]

**Organization:** Recreational Vehicle Industry Association (RVIA)

While actually driving, motorhome owners report that they spend about 53% of the time cruising at 55 mph and 32% of the time cruising at 65 mph.<sup>9</sup> Time spent idling is 16%. Given these numbers, we support putting motorhomes in the regional cycle. [EPA-HQ-OAR-2014-0827-1261-A1 p.9]

**Organization:** Effenco Hybrid Solutions

Our main concern regards the proposed composite cycle weightings for the three vocational vehicle duty-cycle-based subcategories: Urban, Multi-Purpose, and Regional. Indeed, the weighting of idle between 10 and 20% depending of the composite test cycles is very much lower than what can be observed with the publicly available data published by NREL ([http://www.nrel.gov/transportation/fleetttest\\_fleet\\_dna.html](http://www.nrel.gov/transportation/fleetttest_fleet_dna.html)) as well as with the data collected by Effenco over years of activities. In section 2.9.3.4 of the draft Regulatory Impact Analysis, it is however recognized that the data used to establish the proposed weightings are not representative of the national vocational vehicle fleet and that EPA has entered into an interagency agreement with NREL to further characterize workday idle among vocational vehicles. Still, it is mentioned that the preliminary range of daily idle operation per vehicle indicated by this work is about 18 to 33 percent when combining the data from all available vehicles. We reviewed the data published by NREL on the Fleet DNA webpage and summarized below the proportion of idle for different vocations. [EPA-HQ-OAR-2014-0827-1148-A1 p.2]

[Tables of NREL and EFFENCO data, 'Immobile Time as a Proportion of Operating Time', can be found on p.2-3 of docket number EPA-HQ-OAR-2014-0827-1148-A1]

Furthermore, the statistics above, coming from Effenco's own data base, suggest higher proportion at idle as well. As these numbers show, the daily idle operation per vehicle included in the Proposed Rules is far below what can be observed in real operating conditions for vocational vehicles. We suggest that the idle

weightings should rather be 35, 45 and 55% for the Regional, Multi-Purposes and Urban composite cycles, respectively. [EPA-HQ-OAR-2014-0827-1148-A1 p.3]

**Organization:** Motiv Power Systems

*Further Refine Duty Cycles to More Fully Capture Technology Benefits*

Despite significant improvement to the duty cycle, particularly for urban and multipurpose vehicles that spend much of the day parked or in transient operation, further improvements can be made to ensure that the broad spectrum of vocational vehicles is adequately represented and that the regulation drives the full spectrum of fuel consumption reduction technologies applicable to such a diverse fleet. Work trucks frequently experience idle time exceeding those of even the urban vehicle category, and emissions from such idle operations are not fully recognized. [EPA-HQ-OAR-2014-0827-1184-A1 p.2]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

The Phase 1 rule's segmentation of vocational trucks is based on weight class only and does not reflect vehicle use. Inadequate segmentation of vocational vehicle prevented the Phase 1 standards from promoting technologies that provide major benefits for only a subset of vocational duty cycles. ACEEE applauds the agencies' segmentation of vocational vehicles into nine subcategories in Phase 2, reflecting both weight and usage profile, together with the appropriate reweighting of cycles to capture these usage profiles. [EPA-HQ-OAR-2014-0827-1280-A1 p.19] We also support the agencies' proposal to include an idle cycle in vocational vehicle certification. The three cycles used in the Phase 1 program could not properly represent the operation of certain vocational vehicles in the real-world. Many vocational vehicles, including urban buses have average speed less than 10 miles per hour. Consequently, the transient cycle, with 15 mph average speed, and 55-mph and 65-mph constant speed cycles could not reproduce the appropriate average speed. Inclusion of an idle cycle will resolve this problem in Phase 2. [EPA-HQ-OAR-2014-0827-1280-A1 p.19]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

Recent information included in the docket provides additional research on the diversity of the vocational vehicle fleet and the real world behavior of these vehicles, many of which may be certified as incomplete. It is our assessment that this new information not only strengthens the case for increasing the stringency of the regulation of this class of vehicles but necessitates it in order to ensure the environmental benefits of a "maximum feasible" and "technology forcing" standard.

The National Renewable Energy Lab study utilizes its Fleet DNA database to show that vehicles largely fall into two classes of operation, high- and low-speed, with a much smaller fraction of vehicles bridging the two duty cycles.<sup>12</sup> The study finds that the high-speed vehicles spend a much higher fraction of time at cruise speeds above 55 mph than the weightings of the vocational regional category from the proposal, while all vehicles spend a much higher fraction of time at idle than the idle cycle weighting in the proposal.<sup>13</sup> [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

**Organization:** Isuzu Motors Limited

The duty cycles for Regional, Multi-Purpose, and Urban use are not accurate compared to real world data. Isuzu would like to work with the agencies and submit data to help generate more accurate duty cycles for the final rule.[EPA-HQ-OAR-2014-0827-1263-A1 p.3]

**Organization:** National Waste & Recycle Association

Route distance and number of stops: The distance a refuse truck travels in a day varies primarily by population density. In a densely populated urban area the truck can travel as little as 50 miles from the time it leaves the fleet yard to its return at the end of the day. In less densely populated suburban and rural areas, the daily route can be longer due to the longer distances between individual “stops.” [NHTSA-2014-0132-0071-A1 p.3]

More importantly, refuse trucks constantly stop and go while on-route in order to collect a load of waste or recyclables. This constant stopping and going has a major impact on fuel consumption. As an example of the number of daily stops, residential routes normally have somewhere between 800 and 1200 stops per day. Some automated collection routes, however, are capable of as many as 1500 stops in a day. Commercial routes tend to have fewer stops than residential routes, but can easily have well over 100 stops. Moreover, those stops often involve more backing up and maneuvering to obtain access to the container. [NHTSA-2014-0132-0071-A1 p.3]

**Organization:** United Parcel Service (UPS)

'Given the relationship between vehicle speed and technology benefits, it is imperative that EPA and NHTSA develop drive cycle weightings that are representative of real-world operating conditions. The agencies should contact the Federal Highway Administration and American Transportation Research Institute to determine how available data can be used to characterize the speeds at which trucks actually operate and incorporate this information into the speed weightings and technology assessments. [EPA-HQ-OAR-2014-0827-1262-A1 p.11-12]

**Organization:** CALSTART

Using the life cycle cost model we validated with fleets we assessed business cases in seven specific truck use profiles including Class 8 Regional Haul and three medium duty use profiles: Urban, rural/intra-city and work site support.

While structured before your draft rules were released, the categories are very similar to the three vocational segments you are proposing and which we do support. [EPA-HQ-OAR-2014-0827-1190-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

**Organization:** CALSTART

Coupled with the segmentation changes, we support as well changes to the test process that incorporate a larger component of transient operation, idle operation as well as the addition of an idle-only cycle. These changes to the regulatory test cycles better reflect the diversity of the vocational fleet and the duty cycles and general use profiles of end users, which will help identify the appropriate technology solutions for reducing fuel use from this sector. However, we believe that even the current draft cycles do not adequately reflect the percentage of driving idle time and are working with industry partners to share data they have that quantifies this. [EPA-HQ-OAR-2014-0827-1190-A1 p.5]

An important consideration around the idling and speed component, however, involves accounting for the transition to and from idling states. While we applaud the agencies' inclusion of more idling time and openness to expanding it as data justifies, simply adding in an idle element to the cycle is still misleading. By its very nature, idling occurs during a driving cycle, not in a vacuum – it is connected to the driving. This means there are deceleration and acceleration events surrounding them that have an impact on

average speed, engine transients, and fuel used that are important to the strategies to address them. Just “dropping” idle in and providing it with more time in the cycle is insufficient to understand its impacts. This is clearly most important to vocational cycles, though not unimportant to Class 8 tractors. [EPA-HQ-OAR-2014-0827-1190-A1 p.5]

Additionally, there is a separate category of idling we will call “work site idle” that carries a very different characteristic and duration that we do not believe is at all captured in the driving cycle but also may not be effectively captured by the “off-cycle” credit process. Work site idle is generally characterized by higher idle RPM and therefore higher fuel use as the engine is driving pumps or other devices to operate equipment or tool circuits. Examples include underground compressor trucks, overhead crane or boom trucks, and cement mixer vehicles. The duration of such high-idling is measured in minutes and hours, not seconds, in contrast with driving idle events. [EPA-HQ-OAR-2014-0827-1190-A1 p.5]

**Organization:** CALSTART

Segmentation and Duty Cycles. We support changes made relative to Phase 1 in the proposed Phase 2 regulation in providing additional market segmentation options for the vocational segment. Overall, we believe the agencies’ have reasonably captured a more useful description of the high level differences in how trucks are used in the vocational truck space while still keeping complexity to a minimum. While not perfect, it is sensitive to the multi-stage manufacturing nature of the vocational segment – OEMs do not always know exactly in what vocation a truck will end up. [EPA-HQ-OAR-2014-0827-1190-A1 p.4]

**Organization:** Union of Concerned Scientists (UCS)

Dividing vocational vehicles into three distinct duty cycles is a reasonable compromise with the complexity and diversity of real world duty cycles experienced by these vehicles, and it represents a substantial improvement over Phase 1. Acknowledging the diversity of vehicle operation and including cycles with a significantly higher fraction of low-speed, transient operation will help incentivize a broader selection of technologies. Furthermore, acknowledging the high fraction of idle with a separate idle cycle will similarly incentivize idle reduction technologies that reduce fuel usage and emissions from these vehicles. [EPA-HQ-OAR-2014-0827-1329-A2 p.23]

However, there are still classes of vehicle that are not necessarily well-represented by this characterization of the vocational vehicle sector, which may mean that the rules are not necessarily fully incentivizing all technologies applicable to the sector. Refuse trucks, for example, undergo extremely heavy stop-start operation beyond what is captured in the transient cycle and use a lot of fuel running the compactor from the PTO. Many other vehicles use a tremendous amount of fuel during worksite idling, which can be a high-speed idle that is not currently modeled by GEM. [EPA-HQ-OAR-2014-0827-1329-A2 p.23]

Work site usage is currently only captured under the hybrid PTO test procedure. While this will help incentivize technologies designed to reduce such usage, the agencies have not considered this in setting their stringency, and therefore they may also not be accurately assessing the fuel use from this sector, which would affect the total benefits of these regulations. [EPA-HQ-OAR-2014-0827-1329-A2 p.23-24]

**Organization:** Autocar, LLC

The NREL draft report is intended to support the final rulemaking with respect to vocational vehicle drive cycle weightings. However, Autocar has identified deficiencies in the study that warrant further analysis. For instance, the NREL report summarizes data collected from 57 refuse trucks. Autocar believes that it



has collected similar data sets from its trucks in the field, and that Autocar's data and resulting analysis differs significantly from what is reflected in the report. Thus, Autocar requests that the agencies provide the underlying refuse truck drive cycle data for review, and also take the opportunity to receive and review Autocar's data and analysis, to determine whether the agencies are using appropriate data and analysis as the basis for its rulemaking. Autocar plans to submit its readily available data in response to the NREL report later this week. Additional time will allow Autocar to provide other drive cycle data sets developed during the testing and development of hybrid drives for refuse trucks, which will be important in assessing the validity of the NREL data and the analysis of those data. [EPA-HQ-OAR-2014-0827-1869-A1 p.2-3]

### **Autocar's Data Contradicts the Limited Data Set Presented by the NREL Report.**

1.1 Autocar Has Identified Two Sources of Data on Refuse Truck Drive Cycles. As set forth in Autocar's request for an extension of time to review and comment on the Vocational Custom Chassis Memorandum (the 'Memorandum')<sup>2</sup> and the Notice of Data Availability (the 'NODA')<sup>3</sup> (see Section 4 of these comments, below), Autocar has data which contradicts the drive cycle data presented in the National Renewable Energy Laboratory report (the 'NREL Report').<sup>4</sup> Further, Autocar believes that the manufacturer of its hybrid-drive powertrain may be a source of additional data which accurately represents the drive cycle of refuse trucks. [EPA-HQ-OAR-2014-0827-1885-A1 p.4]

1.2 The Data in the NREL Report on Refuse Vehicle's Operational Duty Cycles Are Not Representative of Refuse Trucks. In Tables 3 and 4 of the NREL Report, the number of Mean Stops noted for refuse trucks indicates that the data were collected on urban and commercial, high-density routes, which does not reflect the diversity of refuse chassis' operation (city and suburban residential collection in particular). Additionally, while the NREL Report noted high average RPM relative to low speed, there is no mention of stational PTO<sup>5</sup> operation, a staple of virtually every refuse truck and a drive cycle factor that renders workday idle-reduction technologies useless. Finally, the performance of work trucks such as refuse trucks is measured in hours, not miles, and thus none of the 'per mile' metrics are relevant or informative. Autocar recognizes the difficulty of accurately plotting the drive cycle in heavy-duty refuse trucks but believes that ignoring these particular factors has led to an impossible proposed compliance requirement for refuse. In the limited time available for review and reaction to the NREL Report, Autocar assembled its own test data on drive cycle and offers the informative and analysis set forth in Appendix 1. [Appendix 1 can be found in docket number EPA-HQ-OAR-2014-0827-1885-A2] Autocar believes that this more representative data demonstrates that the drive cycles of refuse trucks in particular are so unique that they cannot be held to the same standards and compliance structure as other vocational and heavy-duty trucks. As set forth in the request for extension of the comment period on the NODA, Autocar welcomes the opportunity to review its data and analysis with the agencies, in an effort to ensure appropriate data is used as a basis for the regulations. [EPA-HQ-OAR-2014-0827-1885-A1 p.4]

Autocar footnotes: 2 Vocational Vehicle Technology Packages for Custom Chasses Memorandum, From Lauren Steele, EPA Environmental Engineer, OTAQ/ASD (Feb. 12, 2016), No. EPA-HQ-OAR-2014-0827-1719.

3 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 (the 'Proposed Regulations') - Notice of Data Availability, 81 Fed. Reg. 10822 (March 2, 2016).

4 National Renewable Energy Laboratory, The Development of Vocational Vehicle Drive Cycles and Segmentation, p.11 (Feb. 2016).

5 'PTO,' or power take-off, refers to drawing power from the engine to run auxiliary systems or functions such as compacting trash, dumping carts, loading and unloading roll-off containers or mixing or pumping concrete. The engine may operate at high RPMs during the PTO operation.

**Organization:** Navistar, Inc.

The agencies request comment on a National Renewable Energy Laboratory (“NREL”) study of vocational vehicle segmentation by drive cycle and weight.<sup>5</sup> A drive cycle is a data set that shows the speed versus time of a vehicle during its route, including stops. It is important here because the assumed drive cycles in GEM directly impact a vehicle’s GEM score. Apparently the agencies intend to use this data analysis to support “ongoing refinement” of the proposed rule and GEM, the sole means to determine a vehicle’s emission level. It does not appear that NREL collected new data for this study, but analyzed existing data. [EPA-HQ-OAR-2014-0827-1919-A2 p.3]

Navistar’s initial issue is whether the data used to generate the NREL study is representative. The NREL study is based on data from its Fleet DNA database, which appears to be based on voluntary submissions of data for the drive cycles for particular vehicles that happen to have been submitted to NREL by fleets and others. A primary concern is sample size. For example, in the NREL study the refuse truck population in Class 6/7 was a mere 2 trucks and only 55 in Class 8. The total refuse truck population has been estimated by EPA to be approximately 176,000.<sup>6</sup> For aggregated drive cycles to be minimally representative, they should at least reflect urban, suburban and rural conditions and flat, hilly and mountainous terrain and combinations of the foregoing. It is impossible for the agencies to have a truly representative sample from only two Class 6/7 refuse trucks driving their individual routes. Without accurate drive cycle data, the ultimate GEM-derived emission level could be wildly inaccurate based simply on differences between the way a vehicle is driven on real world routes and the assumptions built into GEM. [EPA-HQ-OAR-2014-0827-1919-A2 p.3-4]

It also appears that this data comes largely if not entirely from voluntary submissions from various fleets. This means that it is largely self-selected, coming from fleets and others that choose to provide information and do so accurately. Moreover, it seems likely that much of this data comes from multiple vehicles in one fleet. A fleet may very well operate in a limited geographical area and have similar drive cycles, which means that the representative nature of this data with respect to the national fleet may be highly suspect and could be skewed by only a few fleets that have chosen to contribute data. [EPA-HQ-OAR-2014-0827-1919-A2 p.4]

The agencies, nonetheless, propose significant changes from the original NPRM based on the data. EPA concluded from the NREL vehicle study that “[t]wo distinct clusters were identified: one with fewer stops and higher avg speeds, other with more stops and lower avg speeds. A third exhibits characteristics of each: multimodal vehicles.” Observations such as this from the NREL limited vehicle dataset have led the agencies to propose a very different weighting scheme for the vocational drive cycles. The major changes are significantly more idle time and a shift in the split for each category regarding % miles for 65, 55 and transient.<sup>7</sup> The new GEM on the docket provides results that are no longer comparable to anything included in the NPRM for vocational as the technology benefits are significantly revised. These changes are significant and require additional clarification with respect to the segmentation and standards in order to assess the impact. [EPA-HQ-OAR-2014-0827-1919-A2 p.4]

Unfortunately, the NREL study does not clarify the uncertainties with regard to the vocational portion of the proposed rule. We remain very concerned that the agencies do not have sufficient data to revise the rule in a manner that is not wholly arbitrary. Beyond that, as we discussed above related to the Memorandum, we know very little about how the agencies intend to use this data. As such, we reiterate

our request that the agencies postpone finalization of the vocational rule until they have an appropriate amount of real-world data. [EPA-HQ-OAR-2014-0827-1919-A2 p.4]

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2 NPRM Comments at 31.

<sup>5</sup> EPA-HQ-OAR-2014-0827-1621.

<sup>6</sup> Environmental Protection Agency, Population and Activity of On-road Vehicles in MOVES2014, EPA-420-R-16003a (March 2016). The MOVES2014 report does not break out vehicle class from the total 176,000. However, the total population in the NREL study was a sample of 57 to represent 176,000 vehicles, only .0003% of the actual population.

<sup>7</sup> Included with the docket entry referenced in the immediately preceding footnote was a document entitled “Vocational Strawman” in the form of a powerpoint presentation. It appears that this may be a rough outline of revisions to the proposed rule.

**Organization:** California Air Resources Board (CARB)

**Comment – Proposed composite test cycle weightings (in percent) for vocational vehicles**

The Composite Test Cycle is weighted based on the CARB transient cycle, 55 mph cruise with road grade cycle, and 65 mph cruise with road grade cycle. The idling portion is already included in those three cycles. But in the NPRM’s Table V-2, it appears that idling is additional to the three cycles. And if the percentages in each row in Table V-2 are added up, they sum to higher than 100 percent. For example, under urban conditions, the table indicates 94 percent CARB transient, 6 percent 55 mph cruise, and 20 percent idle. CARB staff recommends clarification on how these percentages will be used. [EPA-HQ-OAR-2014-0827-1265-A1 p.121-122]

**Allison Transmission:**

The agencies have requested comment regarding “the nature of vocational workday idle operation, including how much of it is in traffic and how much is while the vehicle is parked.” [EPA-HQ-OAR-2014-0827-1284-A1 p.42]

Allison is the largest supplier of transmissions for vocational vehicles in North America. We routinely capture and analyze actual work day duty cycles for numerous different vocations. In support of the Phase 2 GHG initiative, we randomly selected 240 North American duty cycles covering vocations such as Airport Refueler; Bus (Transit, Commuter, Shuttle, Tour Coach, School), City Delivery (Armored Car, Beverage, Van, Walk-In Van), Construction (Concrete Mixer, Dump, Snow Plow, Equipment Hauler), Farm, Straddle Carrier, Line Haul, Log Hauler, Oil Field (Draw Works, Pumping), Refuse (Landfill, No Landfill, Recycling, Transfer), Utility (Municipal Maintenance, Public Utility, Street Sweeper), Wrecker, and Dock Spotter. These duty cycles averaged 7.6 hours in length and generally represented a full workday of operation. The stop time data for a representative sample of the data are summarized below: [EPA-HQ-OAR-2014-0827-1284-A1 p.42]

[Tables of stop time data can be found on p.43 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

This data does not differentiate between stopped in traffic and parked. Knowing the ARB Transient cycle has 16% time at a stop and there is an idle cycle of various percentages, the agencies have proposed that the vocational weightings result in the following equivalent stop time percentage: [EPA-HQ-OAR-2014-0827-1284-A1 p.43]

With the exception of the concrete mixer vocation, the stop time percentages from the current EPA weightings appear reasonable and reflect Allison's own analysis of percentage stopped time for the cross section of the wide variety of vocational vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.43]

**Organization:** New Flyer of America Inc.

As an example of differences in the vocational driving cycles, the FTA requires transit bus manufactures to complete fuel economy testing. This test program is prescribed under the Safe, Accountable, Flexible, and Efficient Transportation Equity Act (SAFETEA-LU) under the Bus Test Program. [EPA-HQ-OAR-2014-0827-1306-A1 p.1]

There are three test phases to replicate the operating conditions of a transit bus: [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

1. A central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph.
2. An arterial phase of 2 miles with 2 stops per mile and a top speed of 40 mph
3. A commuter phase of 4 miles with 1 stop and a maximum speed of 40 mph.

Transit bus manufacturers optimize fuel economy performance to the FTA standard test procedures. These test results are commonly used by transit authorities during bus procurements for product performance comparisons. While it's quantitatively unknown the magnitude of GHG and fuel consumptions differences between the FTA driving cycle and the proposed vocational and fuel economy drive cycle, New Flyer is concerned the categorization of transit buses into the larger segment of vocational trucks may yield a further economic burden to bus manufacturers and transit agencies. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

**Organization:** Odyne Systems LLC

Odyne has found that our customers drive an average of 25 miles a day (1.5 hrs). Outside of the benefits that hybrids provide to the driving portion (MPG improvements), reductions in idling can be significant. Idle time is currently broken into two categories: traffic and parked. Odyne believes that the parked idle should also be broken down to normal and work (jobsite) idle. Normal idle occurs around 750RPM and work idle is typically much higher and can range from 800 to 2000RPM, which has a greater impact on fuel consumption and emissions. It is also important to account for the amount and type of work being done since that relates to work being done on the IC engine or replaced by the hybrid system. We have found that the typical duty cycle of the total time in work mode (PTO mode, work load) relative to the actual time running the application is around 20%. Based on our customers' workday we see an average of 1.6 hours just parked (non-PTO) and an additional 2.8 hours parked in the work mode (PTO, e-PTO). Fuel consumption during parked and work idle is also dramatically different. We have found that parked idle can consume up to 1 gals/hr, whereas work idle can consume as much as 2 gals/hr during high RPMs and load. [EPA-HQ-OAR-2014-0827-1239-A1 p.22-23]

This information comes from the fleet data we collected using our telematics. Based on this information Odyne feels that the percentage of idle time that is being proposed for the vocational drive cycles (Regional, Multi-purpose, Urban) is not high enough and is not weighted properly. The Urban drive cycle – proposed at 20% – would be used for our application, and our data shows that the percent idle time can be significantly higher. Using our daily averages we found a typical workday to be 6 hours (this doesn't account for other things like startup, shutdown and lunch). In general, we've found that driving is only 25% of the workday and time at the parked/jobsite accounts for the remaining 75%. Then when looking at idle time over the workday and breaking it down into each component, we've found the full workday to represent 3% idle while driving (11 min., transmission in drive, brake pedal applied, vehicle at 0 MPH), 26% idle while parked (1.6 hrs., parking brake on, in neutral, no PTO) and 46% idle (2.8 hrs., parking brake on, in neutral, and PTO engaged) while parked in work mode (e-PTO). [EPA-HQ-OAR-2014-0827-1920-A2 p.11-12]

Odyne strongly believes that it is important to account for the full workday vocational vehicle duty cycle: including driving, idling, and stationary operation of truck-mounted equipment through a Power Take-off (PTO). Then relative to idle it is very important to break it down into the three categories mentioned above and properly weight them. We believe that the worksite idle is the most important aspect of idle reduction and has the most benefit for vocational work truck applications. Since most of the vocational vehicles monitored were observed to spend most of their time at the jobsite in the work mode it should be weighted more heavily. For additional details you can reference our testimony at the public hearing in August at Chicago and our comments submitted for the main proposal under Docket ID No. EPA-HQ-OAR-2014-0827 in October. [EPA-HQ-OAR-2014-0827-1920-A2 p.16-17]

**Organization:** Odyne Systems LLC

**Comments on docket EPA-HQ-OAR-2014-0827-1621:**

The draft report entitled “The Development of Vocational Vehicle Drive Cycles and Segmentation” helps to advance the understanding of vocational vehicle duty cycles, an important aspect in developing appropriate Greenhouse Gas Emissions and Fuel Efficiency Standards for medium- and heavy-duty engines and vehicles. The report has helped to identify and characterize various vocational vehicle segments and the typical drive cycles for those segments. Odyne agrees it is very important to use appropriate drive cycles when evaluating vehicle performance, since there is such a wide range of applications for vocational medium and heavy duty vehicles. [EPA-HQ-OAR-2014-0827-1920-A2 p.4]

Based upon Odyne's work with the U.S. Department of Energy, the Electric Power Research Institute (EPRI) and various state agencies within California (SCAQMD, CEC and CARB), please see report: <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006566>, the company recommends that the entire duty cycle, not just the vehicle drive cycle, should be incorporated into future regulations and testing, especially for medium and heavy duty vocational vehicles. [EPA-HQ-OAR-2014-0827-1920-A2 p.4]

Odyne considers the “drive cycle” of a medium or heavy duty vehicle as the portion of vehicle operation that occurs when the vehicle utilizes propulsion to drive from location to location. The “drive cycle” includes the operation of the vehicle when it is moving and when it is stationary along the route, such as at a stop sign, stop light or in stop and go traffic. [EPA-HQ-OAR-2014-0827-1920-A2 p.4-5]

Odyne considers the entire duty cycle to include both the “drive cycle” and operation of the vehicle when it provides power during stationary activities (such as operation of the engine to power HVAC during delivery of goods or to power equipment often mounted to a vocational vehicle at a work site). The entire vehicle duty cycle may be composed of several modes of operation that create GHG emissions. Those modes include driving, engine idle while in drive (such as when at a stop sign or when in stop and go

traffic), engine idle while in neutral (such as when a vocational vehicle is stationary and operating engine powered HVAC and/or has continuing low voltage loads, such as warning lights that are on at a work site), and engine idle while using Power Take-off (PTO) (such as when operating the prime mover to power truck mounted hydraulic equipment). In some circumstances an additional vehicle mounted engine might also be consuming fuel, such as an independent engine powered electrical generator or engine powered a welder. The various types of engine idle in aggregate can compose a very significant percent of overall GHG emissions for vocational vehicles. [EPA-HQ-OAR-2014-0827-1920-A2 p.5]

Based upon testing performed at SwRI and CE-CERT, fuel consumption at idle can vary significantly depending on the operation of the stationary vehicle. Engine idle in neutral may consume less than one gallon of diesel fuel per hour, or the same engine may consume over 2 gallons per hour in a high idle mode when providing power to equipment through a PTO. Due to the significant variation in fuel consumption at idle, the large number of hours in idle per year and the large number of vehicles that idle, Odyne encourages the EPA to characterize non-propulsion operation of the engine carefully. [EPA-HQ-OAR-2014-0827-1920-A2 p.5-6]

Inaccurate test results may be produced if the testing was performed the same way for significantly different applications due to differences in duty cycles and fuel consumption. The NREL study helps to reinforce this point, especially in terms of drive cycles, but it was not clear that differences between driving and stationary (work / job site) impacts were adequately measured and segmented. Odyne recommends that testing be developed to accurately reflect the fuel consumption of vocational vehicles that occurs over the entire day, especially if vehicles typically operate engines for extended periods of time to power equipment at work sites. [EPA-HQ-OAR-2014-0827-1920-A2 p.6]

As an example, referring to Figure 1, page 8 of the report entitled “Vocational Strawman,” while Odyne supports the increase in the percent of time at zero mph (24%, 52% and 47%) for the possible composite test cycle revisions, because the higher percentages generally are supported by Odyne’s own 1 Hz telematics measurements of over 100 vocational vehicles in the field that show a high percent of stationary engine operation, Odyne has concerns about the type of idle that is incurred and what type of test will be used to assess various efficiency solutions. It is not clear to Odyne whether the increased idle time percentages in the possible composite test cycle revisions were incurred when the vehicle was in drive (such as when an engine is typically spinning a torque converter on an automatic transmission but the vehicle brakes keep the vehicle stationary at a stop light), or whether a significant amount of time was spent with very little load on the idling engine (such as during delivery of goods with the transmission in neutral and the parking brake applied) or whether the engine was under high load in idle with the PTO engaged. Odyne requests that the EPA specify if the idle time would be tested with the transmission in drive (which might favor an engine stop/start system or electrically powered de-fueling solution such as that described in U.S. patent 9,061,680), or if it would be tested with the transmission in neutral with the parking braking applied (which might favor an idle reduction system focused on HVAC and 12 volt power), or if it would be tested with the transmission in neutral with the parking brake applied and a significant load on the Power Take-off (PTO) (which might favor a hybrid, PHEV or ePTO solution that can power the PTO with the engine off). [EPA-HQ-OAR-2014-0827-1920-A2 p.6-7] [Figure 1 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1920-A2]

The population of vocational trucks that have a power take-off is very significant and often appears to be treated as a small minority of overall sales for testing and regulatory purposes. Odyne recommends making it easier for efficiency solutions that provide power to the PTO to gain credit for GHG reductions. Based upon work performed with input from the National Truck Equipment Association (NTEA), Odyne estimates that over 145,000 Power Take-off units (PTOs) are typically installed on medium and heavy duty trucks annually (please see the original Odyne submission for details and / or contact NTEA’s Director of market data and research, Steve Latin-Kasper at 248-489-8193 or via email at stevelk@ntea.com). Based upon the estimated number of class 4 – 8 straight truck chassis sales (box-off)

sold in 2015, which closely represents total medium and heavy duty vocational truck sales, PTO's may be installed on approximately 50% of vehicles within that range. [EPA-HQ-OAR-2014-0827-1920-A2 p.8-9]

Odyne encourages the EPA to include accurate PTO modeling in GEM and encourages the further characterization of entire duty cycles (both driving and stationary operation) for vocational vehicles. The modeling of hybrid and ePTO solutions should include a variety of factors in addition to inputs affecting propulsion efficiency already in the model, including: [EPA-HQ-OAR-2014-0827-1920-A2 p.9]

- Increase or decrease in fuel efficiency during driving due to work site efficiency solution
  - o Odyne has demonstrated increases in driving efficiency of over 40% during high charge deplete operation of plug-in hybrid systems that interface through the PTO with unmodified fully automatic transmissions (please see EPRI report: <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006566> for details). Those inputs should be recognized, but should also factor into worksite efficiency modeling. [EPA-HQ-OAR-2014-0827-1920-A2 p.9]

- o Certain ePTO systems that are designed to only provide electric power for equipment when the vehicle is stationary, actually reduce driving fuel efficiency. ePTO systems add weight to the vehicle without providing a propulsion benefit, decreasing driving efficiency, and may charge the ePTO battery system when the vehicle is in motion, further reducing driving efficiency. [EPA-HQ-OAR-2014-0827-1920-A2 p.9]

- Loads (power and energy) to be supplied during stationary operation of the vehicle by hybrid, ePTO or export power systems

- o Odyne recommends better characterization of the loads typically requiring power during stationary work site operations. Those loads may include power to operate electrical HVAC for the cab, low voltage loads including lights or small inverters for electronics, mechanical loads due to the operation of hydraulic pumps and air compressors, and electrical loads to provide 120V/240V power for tools or equipment. Overall power and energy should be characterized so that various efficiency solutions can be accurately tested. [EPA-HQ-OAR-2014-0827-1920-A2 p.10]

- o Capabilities of the hybrid, ePTO or other work site solution in terms of its ability to provide power and energy with the engine off. Battery size of various systems can differ, a smaller battery may result in greater engine operation at the work site. [EPA-HQ-OAR-2014-0827-1920-A2 p.10]

### *Testing and Verification*

Testing truck emissions requires a concise understanding of the full workday for all classes of trucks and vocation. For vocational vehicles, with their myriad of applications, this can be a difficult task. However, Odyne has been tracking full day duty cycles for Utility work trucks covering Aerial / Compressor / Digger / Underground applications for the past 5 years, alongside leading organizations including EPRI, DOE, CEC, and SCAQMD. Odyne appreciates the EPA's focus on the importance of accurate modeling here. We have also done testing at facilities like SWRI and CE-CERT to verify fuel economy and emission benefits. The EPA has done well in identifying the importance of the full workday (real world usage) and separating it into driving (traffic) and stationary (parked). Our system impacts both categories and needs to be accounted for appropriately since we are not just an idle reduction technology. Our understanding is that the EPA has chosen the HDT drive cycle for the transient portion of testing, and CARB has chosen the UDDS drive cycle; both drive cycles represent how our customers drive their vehicles. Odyne would highly suggest having a common drive cycle used by CARB and EPA (preferably the HDT cycle) to be used across all testing and it is important to evaluate this over a realistic period of time or distance instead of just the single drive cycle. [EPA-HQ-OAR-2014-0827-1239-A1 p.21-22]

Current regulations are focused on engine certification and some consideration for vehicle or powertrain testing under specific drive cycles. In Odyne's work truck applications, driving does occur, though this is a small portion of activity compared to the time spent at the jobsite idling at higher speeds and loads (in addition to normal idle when they are not working). So we feel it is very important to evaluate fuel consumption and emissions based on a full workday instead of only driving. Just as it is important to test driving conditions with the appropriate type of drive cycle it is also important to test the stationary with the appropriate cycle. The workday test cycle needs to account for the appropriate type of driving and stationary to have a better correlation to real world usage and impacts. [EPA-HQ-OAR-2014-0827-1239-A1 p.22]

**Response:**

The agencies are relying on work conducted by the U.S. Department of Energy at the National Renewable Energy Laboratory (NREL), as well as the duty cycle information provided in these public comments, in establishing the weighting factors for the test cycles to be used in the certification of heavy-duty vocational vehicles to the final Phase 2 standards. We disagree that we have not provided adequate notice of these cycles. At proposal we included analysis in the docket on the possible impact of an increased weighting of the idle cycle on vehicle emissions as represented in GEM.<sup>173</sup> Further, the NREL report released with the NODA was not a surprise, as we had signaled intent to rely on that work at the time of the proposal (80 FR 40288), and some manufacturers voluntarily shared data with NREL as part of this process. In any case, the NODA afforded opportunity to comment on the data, an opportunity of which commenters vigorously availed themselves.

Based on available fleet data, NREL identified three general clusters of vehicle behavior: one cluster of vehicles most often driving with slower speeds and frequent stops; one with higher average speeds and fewer stops; and one multi-modal cluster with vehicles that may operate similarly to either of the other clusters on any given day. In response to concerns expressed by some commenters that the vehicles from which NREL collected data for the cycle may not be representative of the overall vocational vehicle fleet, we are confident any discrepancies are sufficiently small to allow us to use the NREL work to establish weighting factors for three general driving patterns. NREL's Fleet DNA database contains millions of miles of historical real world drive cycle data captured from medium- and heavy vehicles operating across the United States.<sup>174</sup> The database encompasses data from existing DOE activities as well as contributions from valued industry stakeholder participants. The agencies consequently do not accept the criticism in comments that this database is arbitrarily self-selected. For the vocational vehicle project, NREL examined data drawn from the Fleet DNA database representing 913 unique vehicles comprising 16,250 days of operation. The Fleet DNA data used as a source for the NREL analysis has been collected from a total of 30 unique fleets/data providers operating across 22 unique geographic locations spread across the United States. This includes locations with topology ranging from the foothills of Denver, Colorado to the flats of Miami, Florida. The range of fleets, geographic locations, and total number of vehicles analyzed ensures results which include the influence of these factors. While no analysis will be perfect without unlimited resources and data, it is the researchers' understanding that the Fleet DNA database is the largest and most thorough publicly accessible vocational vehicle usage database currently in operation. Further, the NREL cluster analysis was performed on the data and the NREL staff examined the results along vocational and weight class parameters. As the analysis was focused on characterizing driving behavior independent of vehicle configuration, the results of the analysis and aggregation of the weight classes is representative of the vehicles demonstrating similar driving behavior regardless of weight

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<sup>173</sup> See Memo to Docket, "Analysis of Possible Vocational Vehicle Standards Based on Alternative Idle Cycle Weightings", May 8, 2015, <https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0827-0117>

<sup>174</sup> See [http://www.nrel.gov/transportation/fleettest\\_fleet\\_dna.html](http://www.nrel.gov/transportation/fleettest_fleet_dna.html)



class. NREL performed additional analysis attempting to subdivide the results into a greater number of clusters (see Chapter 2.3 of the NREL drive cycle report) and provided no superior findings.

Although the agencies have attempted to develop these factors to accurately represent average vehicle behavior, failure to do so would not necessarily make the cycles invalid. Just as the in-use effectiveness of engine technologies can be reasonably evaluated using testing that is limited to 68-86°F, the effectiveness of vehicle technologies could be reasonably evaluated using duty cycles that reflect operation different than the average vehicles. We believe the more relevant question is whether or not the final duty cycles exercise the technologies over enough of the range of in-use operation to effect in-use reductions. In this context, the weighting factors and duty-cycles are fully adequate as we now go on to discuss.

Public comments as well as the NREL work supported stronger weighting of idle in the test cycles. At proposal and even at the time of the NODA we had not yet received analysis from NREL on how to distinguish parked idle from driving idle operation. We have since conducted extensive outreach to affected stakeholders including interim releases of GEM, to provide opportunity for comment on the regulatory impacts of distinguishing parked idle from driving idle. Statistical summaries of vehicles in the three NREL clusters demonstrated that on average, vehicles in all three clusters operated between 22 and 28 percent of a work day in a parked idle state. As explained in Section 1.5 of the NREL report, one of the drive cycle metrics that was analyzed was percentage of operating time at zero speed. That statistical metric was identified for each cluster initially, which essentially represented a combination of both parked idle and drive idle conditions. NREL found that vehicles in the Multipurpose and Urban clusters statistically experience an engine-on zero-speed condition between 47 and 52 percent of a work day. Effenco's comments are corroborative of these data, where their comment suggested the range of total zero speed time might be between 35 and 55 percent. The further work to distinguish different types of zero speed operation (parked vs drive) is described in Section 5.5 of the NREL report. In response to compelling comments from Allison, time at zero speed during the ARB transient cycle is now accounted for when assigning weights to the drive idle cycle. By using these statistical targets along with the histograms of distance accumulated while operating within 2-mph speed bins, the agencies assigned weighting factors for each composite test cycle. We incorporated information from Volvo regarding percent of distance accumulated at speeds above 55 mph into the composite weighting factors for Multipurpose and Urban class 8 vocational vehicles. See discussion in the RIA Chapter 3.4.3.1. The Volvo information does show that the vehicles they produce with low cab forward configurations do accumulate more miles above 55 mph than those in NREL's dataset, and the vehicles they identify as VHD/GU designed for construction applications do accumulate more miles above 65 mph than those in NREL's dataset. Although both NREL and Volvo data showed vehicles whose behavior would logically be classified as Urban, accumulating some miles (from one to seven percent) in the 65 mph range, the agencies are applying a zero weighting factor to the 65 mph cycle for all Urban vehicles for certification purposes. The accumulated miles above 65 mph have instead been applied to the composite weighting of the 55 mph test cycle. This is because we believe it is important to have a test cycle available in the primary program for vehicles that may regularly drive on urban or local highways, but are not expected (or designed) to drive on rural highways. The final weighting factors of the composite test cycles are shown in Table 6-1.

The agencies do not agree with the comment that refuse vehicles are underrepresented in the NREL database. Indeed, because the full NREL database also contains over five percent refuse trucks and our MOVES model estimates that refuse trucks comprise only three percent of newly manufactured vocational vehicles each year, we directed NREL to remove excess refuse trucks from their final analysis, to avoid skewing the data by over-representing refuse trucks. We expect that manufacturers seeking to certify refuse trucks (in the primary program) that will have greater highway use than is represented by the Urban test cycle may certify in the Multipurpose subcategory. For refuse trucks certified to the

optional custom chassis standards, GEM will apply the Urban cycle weightings. Custom chassis manufacturers wishing to be recognized for applying cycle-dependent technologies such as driveline improvements may certify to the primary standards and select the most appropriate test cycle.

**Table 6-1 Composite Test Cycle Weightings (in Percent) for Vocational Vehicles**

|                         | ARB<br>Transient | 55 mph Cruise<br>with Road<br>Grade <sup>a</sup> | 65 mph Cruise<br>with Road<br>Grade <sup>a</sup> | Parked Idle | Drive Idle |
|-------------------------|------------------|--|--|-------------|------------|
| Regional                | 0.20             | 0.24   | 0.56   | 0.25        | 0.00       |
| Multi-Purpose (2b-7)    | 0.54             | 0.29   | 0.17   | 0.25        | 0.17       |
| Multi-Purpose (class 8) | 0.54             | 0.23   | 0.23   | 0.25        | 0.17       |
| Urban (2b-7)            | 0.92             | 0.08   | 0.00   | 0.25        | 0.15       |
| Urban (class 8)         | 0.90             | 0.10   | 0.00   | 0.25        | 0.15       |

When vocational vehicles are tested over the parked idle cycle, their emissions and fuel consumption will be measured while in a low idle state, without torque applied from an automatic transmission in gear, for example. During the drive idle test cycle, the transmission torque will be applied unless the transmission is a manual, AMT, or an automatic with a neutral idle feature activated. The parked idle cycle does not include high-idle PTO operation. Although we agree with the commenter from Odyne that this is a mode during which significant GHG emissions and fuel consumption can occur for some vocational vehicles, we do not agree that the standard test procedure needs to include this mode for all vocational vehicles. Our reasons for reaching this conclusion are outlined in the Preamble at Section V.C.1.c.iii. In our partnership with NREL, we have characterized the operation of utility vehicles with PTO, and the results are somewhat similar to those described by Odyne. Of over 1,500 work days analyzed for over 80 trucks, NREL observed the average fraction of a work day spent driving is 34 percent, with average 36 percent in PTO mode, and average 30 percent in low (parked) idle. The fraction of low parked idle is consistent with the fraction observed for other vocational vehicles and is consistent with the test cycle weightings in Table 6-1. Below in Section 6.3.6.3 we address comments requesting the agencies to recognize technologies that can reduce emissions during high-idle PTO mode operation. This is also addressed in the Preamble at Section V.C.1.c.iii.

The agencies have determined that it is impractical, from a regulatory perspective, to establish separate, unique test cycles for other vehicles such as transit buses, coach buses, or refuse trucks (although the optional custom chassis standards provide flexibilities consistent with these vehicles' duty cycles). In considering the challenges of such an undertaking, as well as the market structure of manufacturers who produce such vehicles, the agencies are instead adopting separate standards for transit buses and refuse trucks as part of the final Phase 2 program for custom vocational chassis, as described in Section 6.2.3. Further discussion of comments related to creation of separate regulatory subcategories for some vehicles is found below in Section 6.1.5.

In the final weeks before promulgation of the Phase 2 rules, the agencies received significant new comments from vehicle manufacturers, which suggest there is some uncertainty with respect to the three drive cycle structure being adopted. The agencies will continue to analyze this new information and any other new information we receive, and we will continue to actively engage with manufacturers and other stakeholders to determine if future revisions to the vocational vehicle program structure are warranted. In Chapter 2.2 of the NREL report, an alternate bi-modal clustering analysis is also presented, where instead of having a distinct middle cluster, vehicles with highly variable driving patterns are grouped as either

high speed or low speed. A preliminary update provided by NREL includes cycle weightings that correspond with this two cluster depiction of vehicle behavior.<sup>175</sup> Based on the NREL report and other information, the agencies believe it is appropriate to finalize a regulatory subcategory structure that includes a drive cycle appropriate for mixed use vehicles (a middle cluster); especially considering that the ultimate application of incomplete chassis is largely unknown at the time of certification. In other words, we are adopting a program structure that follows NREL's three cluster depiction of vehicle behavior, although the record shows that a two cluster structure could have been chosen for one or more vehicle weight classes. It is possible that further analysis of new data could lead us to consider proposing amendments to adopt the two cluster approach for one or more vehicle weight classes, or to consider amending the regulatory constraints limiting the choice of drive cycle subcategory that we are adopting to prevent potential adverse impacts of vehicle misclassification (See Section 6.5.1 below). However, at this time the final program structure will remain in place unless and until the agencies determine that revisions to the vocational vehicle program structure are warranted. See Section V.b.1.a of the Preamble for further discussion of this issue.

### **6.1.5 Framework: Regulatory Subcategories**

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

**Further vocational vehicle segments and more realistic test cycles.** The more extensive segmentation of vocational vehicles and the accompanying cycle re-weightings will better reflect these vehicles' operating characteristics. Test cycles will match vehicles' real-world duty cycles much better than they do in the Phase 1 program, especially with the addition of an idle cycle. Inclusion of road grade on the 55- and 65-mph steady-state cycles in Phase 2 will better reflect real-world driving. [EPA-HQ-OAR-2014-0827-1280-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.55-56.]]

**Organization:** BYD Motors

The agencies have made significant improvements compared to the MY2014-2018 standards, particularly in providing additional market segmentation options that reflect a larger share of transient operation as well as the addition of an idle-only cycle. These changes to the regulatory test cycles better reflect the diversity of the vocational fleet and the duty cycles of our customers and will help identify the appropriate technology solutions for reducing fuel use from this sector.[EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.227.]]

**Organization:** ABC Bus Companies, Inc.

Comments on proposed method of assigning vocational chassis to regulatory subcategories. A category for Passenger Carrier Vehicle, (PCV) could be defined. The GEM User Guide overview mentions Intercity Motorcoach operation should be classified under the Regional Duty Cycle. Given the nature of motorcoach designs as outlined in above comments, Fuel mapping, idling, ADA lift operations, etc. standards of these vehicles should have its own categories. The NREL should consider the PCV operation as described above to help define this vocational vehicle test cycle. [EPA-HQ-OAR-2014-0827-1430-A2 p.3-4]

**Organization:** PACCAR, Inc.

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<sup>175</sup> See memorandum dated July 2016 titled, "NREL Bi-Modal Vocational Vehicle Cluster Information."

PACCAR has evaluated and is still evaluating the Phase 2 vocational vehicle segmentation scheme that is in the NPRM. The early results of this analysis questions the value of the normalization approach that is used. Although it is included by the agencies to mitigate purposeful attempts by OEMs or customers to switch between segments, the normalization may not be needed to accomplish that task. [EPA-HQ-OAR-2014-0827-1204-A1 p.22]

The spec changes to move a vehicle from the middle of the Multi-purpose segment to Urban, for example, require significant changes to the rear axle ratio to the point that the vehicle will be rendered incapable of efficient operation in the intended application. [EPA-HQ-OAR-2014-0827-1204-A1 p.22]

PACCAR recommends that the agencies consider returning to a Phase 1-style program for vocational categories since emissions reduction opportunities are smaller than on tractors and the segmentation approach does not seem to be rendering the value that was expected. In addition, it seems that the segmentation may not provide substantial benefit, so one vocational category for each major weight class grouping may be sufficient. [EPA-HQ-OAR-2014-0827-1204-A1 p.22]

**Organization:** School Bus Manufacturers Technical Council

The School Bus Manufacturers Technical Council (SBMTC) applauds the joint efforts of NHTSA and the EPA to develop a Phase 2 Heavy-Duty (HD) National Program that will reduce greenhouse gas (GHG) emissions and fuel consumption for new on-road heavy-duty vehicles. We would also like to use the opportunity to comment on this regulation and point out how school buses are very different and unique from all other types of motor vehicles and how some of the proposed regulations may create significant challenges. [EPA-HQ-OAR-2014-0827-1287-A1 p.1]

**Organization:** National Automobile Dealers Association (NADA)

The duty cycles of vocational vehicles range from significant over-the-road operation, to periodic over-the-road operation, to stop and start low speed operation, to limited over-the-road and significant “at rest” operation, to off-road-operations, and to every combination thereof. The complexity of vocational truck design, production, and use makes it a challenge to set out categorical fuel use and GHG reduction strategies. [EPA-HQ-OAR-2014-0827-1309-A1 p.9]

**Organization:** New Flyer of America Inc.

With our sustained commitment towards GHG and fuel consumption reduction, New Flyer is respectfully requesting the EPA and NHTSA to reconsider the classification of transit buses as Vocational Vehicles with the proposed standards. Transit buses are currently grouped into a broad category of purpose built vocational trucks which includes delivery trucks, utility trucks, refuse haulers and cement and dump trucks. [EPA-HQ-OAR-2014-0827-1306-A1 p.1]

The applicable technologies and design requirements for transit buses differs significantly from the aforementioned commercial vehicles. Unlike the larger volume commercial truck market (where OEMs have a high percentage of proprietary engines and drivetrains, and dedicated organizations and resources equipped to support ongoing emissions and fuel economy testing), transit bus manufactures in North America assemble purchased drivetrain components, purchase diesel and gas engines from one industry supplier (Cummins Inc.), and have access to a limited number of commercially available transmissions and powertrain systems certified for the transit bus market segment. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

In our discussions with other transit bus manufacturers (including Gillig LLC) and the American Public Transit Association (APTA), we share aligned concerns on other aspects of the program which are related to vocational classification, including air conditioning leakage (transit buses have significantly larger and more complex air conditioning systems than trucks), and payload. New Flyer believes the differences in vehicle systems and the operating characteristics warrant distinctive classification. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

Similar to the standalone categorization proposed by the EPA and NHTSA for emergency type vehicles, New Flyer encourages the EPA/NHTSA to consider separate GHG and fuel consumption reduction requirements for transit buses by creating a separate categorization with simpler testing and compliance standards. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

New Flyer encourages further dialog between the EPA/NHTSA and APTA members (including OEMs, powertrain suppliers, and end-user transit agencies) to finalize the GHG and fuel consumption reduction standards that support the shared clean air and more fuel-efficient objectives for the transit bus vehicle segment. New Flyer is committed to participating and supporting these discussions and providing additional information to the EPA and NHTSA as needed. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

**Organization:** Allison Transmission, Inc.

### **EPA and NHTSA Should Adopt Subcategorization of Vocational Vehicles With Changes to Address Several Types of Vehicles**

The Proposed Rule contains nine different subcategories for vocational vehicles. These categories are intended to allow for the assignment of vehicles into categories based on use patterns; the proposed rule would utilize final drive ratios of vocational vehicles for this purpose. Subcategorization using the multi-purpose duty cycle would be presumed unless “some criteria were met that indicated either the Regional or Urban cycle could be more appropriate.” EPA and NHTSA have requested comment on the method for assigning vocational chassis to these regulatory subcategories. [EPA-HQ-OAR-2014-0827-1284-A1 p.39]

In general, Allison believes that EPA and NHTSA are proposing a reasonable approach to subcategorize vocational vehicles. We agree with the agencies that most vehicles should be classified as being Multi-Purpose and our analysis of the proposal indicates that this is likely to occur. As detailed below, however, we do have several issues concerning how the Proposed Rule would operate with respect to certain vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.39]

Allison Transmission

Our comments are based on a memorandum placed into the docket in connection with this NODA.<sup>1</sup> In this regard, Allison first commends EPA and NHTSA for the consideration of the small, custom chassis manufacturers in the Phase 2 rulemaking and generally supports the approach described in the memorandum.

#### **Table 1 Custom Chassis Types**

Allison recommends that EPA and NHTSA acknowledge that the custom chassis distinguishable features are not all-inclusive for each custom chassis listed and that the custom chassis definition is not limited to the narrow definition provided in Table 1. Instead, Allison would recommend that EPA and NHTSA provide additional vehicle uses as well as operational requirements for the vehicle classifications as noted in the attached table. For example, depending on the price range and whether they are built for comfort or

utility, everything from coach to RV to school bus chassis is used as the basis for an upfitted specialty vehicle, including entertainment travel, bookmobile, bloodmobile, mobile command station, etc. Yet the current Table 1 makes no mention of such vehicles. We would therefore suggest that a final Table 1 be supplemented and expanded as below: [EPA-HQ-OAR-2014-0827-1892-A1 p.3]

[Table 1 can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1892-A1]

**Organization:** Allison Transmission, Inc.

### **EPA and NHTSA Should Create Subcategory for Transit Buses**

Finally, EPA and NHTSA should address transit buses in the final rule apart from the presumptive classification based on gear ratio. That is, under the Proposed Rule, a typical transit bus configuration will result in a Multi-Purpose subcategorization, instead of Urban subcategorization. But changing the transmission from a 6 speed to a 4 speed would change this result and produce a classification of the transit bus as an Urban vehicle. Doing so, however, carries with it the downside of reducing fuel efficiency and increasing CO2 emissions. Therefore, in the final rule, EPA and NHTSA should avoid this “incentive” and instead treat all transit buses as Urban. This alternation is both rational – given the vehicle’s intended use and low prospects that it will be converted to other uses – and would avoid the unintended consequence of reduced transmission speeds to change the regulatory sub-classification. [EPA-HQ-OAR-2014-0827-1284-A1 p.41]

EPA and NHTSA should also consider a sub-category for transit buses. Transit buses operate in urban areas and have a duty cycle of frequent starts and stops, with no 65 mph operation and very limited 55 mph operation so the current vocational test cycle does not represent how they operate. Transit buses are manufactured by few companies and are purchased with public funds, typically through a bidding process. They do not have a secondary use for anything other than a transit bus. Transit buses have unique construction from other vocational vehicles and incorporate specialized accessories which result in different losses and efficiencies. They are also good candidates for future hybridization and electrification. Allison believes that these reasons warrant a separate sub-category in Phase 2. [EPA-HQ-OAR-2014-0827-1284-A1 p.41]

**Organization:** Allison Transmission, Inc.

### **EPA and NHTSA Should Incorporate Different Standards for Motor Homes**

Motor Homes (“MHs”) present different usage patterns than many other types of MD/HD vehicles primarily due to the fact that such vehicles are normally consumer-owned and not a vehicle that does vocational work. Therefore, EPA’s assumptions that underlie its estimation of the emissions output of such vehicles are incorrect since usage is intermittent. MHs are seldom driven over the course of a year; they tend to be stored over the winter, and then driven to various locations during the spring and summer months. MHs may also be parked for long periods of time and interstate driving, as a function of their overall use, is relatively small. MHs have a low number of idling events given their design elements to connect to the electric grid at campgrounds and other locations. Therefore, EPA and NHTSA should consider simplified compliance methods to MHs similar to those that may be applied to emergency vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.49]

**Organization:** Allison Transmission, Inc.

EPA and NHTSA should recognize that torque converter based ATs can launch with lower numerical axles than transmissions with clutch based launching systems. The lower numerical axles in conjunction with significant overdrives allow these vehicles to run lower engine speeds at the 65 and 55 mph cruise cycles – resulting in lower fuel consumption. The downside of the Proposed Rule subcategorization for vocational vehicles is that these configurations may be classified as Regional when the majority of their duty cycle is Multi-Purpose. Again, reducing the breakpoint from 75 to 70 would help to mitigate such concerns. [EPA-HQ-OAR-2014-0827-1284-A1 p.40]1137

**Organization:** CALSTART

That said, there may be some categories still worthy of customized approaches. Refuse may be one because of its extreme duty cycle and sufficient volumes to justify monitoring. The other is transit bus. The transit bus segment has traditionally been the launch point of advanced technologies for air quality and efficiency, including natural gas, hybrid, electric and now fuel cell systems. There are myriad reasons for this leadership, including the higher visibility of transit buses in urban centers, the federal funding process which underwrites 80 percent of the capital costs of new buses, and the operational profiles which have been conducive to controlled introduction and use of new fuels and technology. As a result, the segment could serve as a leader for the rest of the heavy-duty industry in terms of higher GHG reduction potential. It can also serve as a laboratory for credit structures supporting the introduction of low carbon technology. While we have no specific proposal to offer, we would request additional exploration of how to leverage the leadership of the transit segment in considerations of flexibility. Transit bus makers able to sell their credits to other HD OEMs for advanced bus over-compliance can be useful in paying for their investments, if stringency levels help create the need for such credits. [EPA-HQ-OAR-2014-0827-1190-A1 p.4]

**Organization:** GILLIG LLC

We have tried to address below two main areas of concern we have with the new rule. First, areas where we see a significant number of the underpinning assumptions for vocational vehicles in both the proposed GEM model and the Standards as not applicable to transit buses. Second, the business impacts associated with the certification process, limited compliance flexibility, burden of compliance, and the stockpiling rule. It is our belief that transit vehicles are designed, built and operated very differently from other vocational vehicles, and that the compliance process/burden has potentially devastating impacts for our business, employees and customers. GILLIG is very interested in pursuing a simplified compliance procedure and less stringent Phase 2 standards specific for transit buses and asks that the agencies consider establishing a separate subcategory for transit buses. [EPA-HQ-OAR-2014-0827-1156-A1 p.1-2]

GILLIG produces approximately 1800 MHD and HHD transit buses each year. These buses are configured with diesel, CNG and diesel/hybrid powertrains. Transit buses are purpose built, uniquely configured to each end users specific needs. Typical duty cycles are run in urban areas, and characterized by a significant number of stops and starts, high idle times, very low average speeds, limited operation above 55 mph, and a high percentage of the time run significantly under the fully loaded condition. The vast majority of these transit buses are sold to municipalities through a bidding process and are funded by federal (FTA), state and local governments with public tax dollars. We believe that significant differences between transit buses and the other vehicles in the vocational vehicle category necessitate a need for the agencies to consider establishing a separate subcategory for transit buses. [EPA-HQ-OAR-2014-0827-1156-A1 p.1]

GILLIG only produces HD transit buses. Annual volumes are approximately 1600 HHD transit buses and 200 MHD transit buses. The same engine models, hp, and fuel options (diesel, CNG, and diesel/hybrid)

are available in both weight classes. Our product line is so narrow that averaging does not provide much compliance flexibility. We request the agencies consider a separate subcategory for transit buses to address this. [EPA-HQ-OAR-2014-0827-1156-A1 p.4-5]

**Organization:** National Waste & Recycle Association

The National Waste & Recycling Association (NWRA) is the trade association representing private sector waste services companies. Our members collect municipal solid waste; own and operate waste transfer stations and landfills; collect and process recyclables; and collect and compost organic waste in cities and counties throughout the United States. We play an essential part in protecting America's public health and environment. [NHTSA-2014-0132-0071-A1 p.1]

Our industry has a vital stake in ensuring that the Phase 2 rules will result in trucks that allow us to continue to protect America's public health and environment as efficiently as possible. To manage America's solid waste stream, our industry has a fleet of more than 100,000 refuse, recycling and compost collection trucks. We are constantly looking for ways to lower fuel consumption. In fact, our desire to conserve energy and lower emissions has lead us to be the leading heavy-duty truck user of non-diesel, alternative fuel vehicles. [NHTSA-2014-0132-0071-A1 p.1]

We are disappointed that the two agencies continue to lump all the many kinds of vocational vehicles together instead of creating standards for each kind of vehicle. As we note in subsequent comments, refuse trucks are vastly different from other vocational vehicles, yet the agencies persist in treating all vocational vehicles as if they are the same. This unfortunate one-kind-fits-all approach will fail to achieve the results that uniquely-tailored standards would achieve. [NHTSA-2014-0132-0071-A1 p.1-2]

#### The solid waste industry truck fleet: overview

In order to manage America's solid waste, we are not just a public health industry. We also are a trucking industry with a large and highly diverse fleet of trucks that serve unique purposes and are different from each other in design and operation. The fleet includes, but is by no means limited to, garbage and recycling collection trucks, roll-off trucks, container delivery trucks and grapple trucks. These trucks are primarily Class 8 heavy-duty vocational vehicles. The industry also uses tractor trailers to haul solid waste from transfer stations to disposal facilities and pickups and similar lighter duty vehicles used by the industry. All of these trucks require off-road capability at some point. They are different in design and use, however, from the strictly off-road trucks used to manage waste at landfills. Most of the tractor trailers are owned and operated by contractors. [NHTSA-2014-0132-0071-A1 p.2]

#### The solid waste industry fleet: garbage and recycling collection trucks

The garbage and recycling collection trucks that stop at virtually every American house and business every week are the most recognized part of the solid waste fleet. Most Americans know a garbage truck when they see one. These are unique, highly specialized vehicles, almost all of which are classified in this regulatory proposal as heavy-duty vocational vehicles. They are totally unlike the other trucks in this subcategory in terms of their design, operation and function. Because garbage and recycling trucks are virtually identical in most respects, the generic term "refuse truck" will be used for both vehicles. Yard waste can be collected by either type of truck. [NHTSA-2014-0132-0071-A1 p.2]

Fuel consumption is determined by a variety of factors including the truck's total weight, the use of compaction equipment, structural needs, route distance, the extraordinarily high number of stops and starts a truck makes in a day (and a week and a month and a year) and the extensive use of power take-off



units while the truck is stopped, but is still working. Virtually all refuse trucks use an automatic transmission. [NHTSA-2014-0132-0071-A1 p.2-3]

Loading and compaction: A refuse truck can be loaded manually or automatically in its front, rear or side, depending on the truck. Automatic loading can be accomplished by the use of an automated arm on side loaders, a cart tipper at the rear or side of a truck or a set of automated forks on its front. In the latter case, the forks go into sleeves on the sides of a container and then lift the container up and over the truck and deposit its contents into the truck's hopper. Fuel is used to power the loading equipment. At some point, the material is compacted by a moving blade that presses against the wall of the hopper. Compaction is used because it allows the truck to compress garbage and thus, collect more. This lowers the numbers of trucks on the road. The truck is stopped while the material is being loaded. Compaction can occur while the truck is stopped or moving. [NHTSA-2014-0132-0071-A1 p.3]

#### The solid waste industry fleet: roll-off container and other trucks

A roll-off container truck is a heavy heavy-duty vocational vehicle designed to take empty "detachable containers" to waste generator sites. When those containers are full, they will be replaced with an empty container. The full container will be taken to a disposal facility, unloaded, and returned to the fleet yard to be cleaned and placed at another generator's site. These are large containers, usually ranging in size from 10 to 40 cubic yards, primarily used at factories, construction and demolition sites and large commercial accounts such as shopping malls. They can hold a variety of materials, ranging from lightweight pallets generated at a factory to concrete generated at a construction or demolition site. [NHTSA-2014-0132-0071-A1 p.4]

The truck will raise its hydraulically operated bed allowing the empty container to roll off the bed and be lowered by means of a cable or hook lift. When the container is full, the process is reversed and the container is placed back on the truck. These trucks are subject to the same weight limits as are refuse trucks. When the truck is stopped and moving a container on or off its bed, the truck is still consuming fuel. These trucks often drive down alleys and go off-road, especially at construction sites. [NHTSA-2014-0132-0071-A1 p.4]

The solid waste industry also has other specialized equipment such as grapple trucks and container delivery trucks. Grapple trucks use specially mounted grapples to lift bulky waste such as logs, yard waste or debris and place them into a container on the truck. Container delivery trucks are used to deliver small containers to a commercial customer such as a gas station or restaurant, when a container needs to be repaired or when service is terminated. These vehicles are subject to the constraints of truck weight laws. [NHTSA-2014-0132-0071-A1 p.4]

The trucks used by our industry are in the "vocational vehicle" category in both the Phase 1 rule and the Phase 2 proposal. As they did with the Phase 1 proposal, EPA and NHTSA continue to ignore the advice of the National Academies of Science (NAS). In its study, "Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-duty Vehicles" (2010), NAS highlighted the wide differences between different types of vocational vehicles. In the press release accompanying the release of the study, NAS pointed out that "NHTSA will need to establish standards tied to the task associated with a particular type of vehicle; garbage trucks might be held to a different standard than transit buses, for example." The failure of the agencies to heed that advice and to instead lump all vocational vehicles together with only minimal differences in regulatory approach, results in a proposal that fails to recognize their differences and that will accomplish far less than an approach tailored to each different kind of vocational vehicle. [NHTSA-2014-0132-0071-A1 p.6]

Phase 2, nonetheless, is a slight improvement over Phase 1 because it divides groups of vocational vehicle chassis into subcategories based on vehicle use patterns in which CO2 emissions and fuel efficiency standards vary. We appreciate that the agencies recognize this distinction. However we are concerned that the very example supplied in the discussion of the test cycles for these proposed subcategories (see page 40288, second column, first paragraph) does not understand the operational realities affecting “a neighborhood collection refuse truck” and a “roll-off straight/dump truck that makes daily highway trips to a landfill.” The agencies discussion implies that these are significant differences between the two types of trucks. In reality many “neighborhood collection refuse trucks” make daily trips on highways to either transfer stations or landfills. Many roll-off and dump trucks never go directly to a landfill. Yet the agencies are proposing to require manufacturers to classify the intended test cycles without knowing where or how the purchasers of their trucks will use those vehicles. As a result, we suspect those manufacturers will opt for the “multi-purpose” cycle as a compromise between “urban” and “regional.” [NHTSA-2014-0132-0071-A1 p.6]

The agencies have chosen to cover all medium- and heavy-duty trucks in this regulatory proposal. We understand their reasoning as applied to most pickup and tractor trailers. We do not, however, understand this logic as applied to the tremendous diversity among vocational vehicles. Unlike pickup trucks and tractor trailers, vocational vehicles come in an extraordinary array of design, sizes, functions, configurations, weights, and duties. Instead of recognizing this diversity and crafting regulations that distinguish among, for instance, refuse trucks, fire trucks, septic tank trucks and motor coaches, EPA and NHTSA continue to support a procrustean, “one size fits all” approach for vocational vehicles. In effect, the agencies are proposing rules for a truck that does not exist. If that truck existed, it would not resemble any truck used by the waste services industry. [NHTSA-2014-0132-0071-A1 p.7]

We look forward to working closely with EPA and NHTSA as they proceed with this rulemaking and with further regulatory actions in this area. As we stated in the beginning of our comments, our industry is constantly looking for ways to lower fuel consumption. We are a public health industry. We support lowering greenhouse gas emissions. We also believe that the public is best served by regulations that will reduce fuel consumption and greenhouse gases in the real world, not in a computer simulation that ignores the real world realities created by Federal and state truck weight limits [NHTSA-2014-0132-0071-A1 p.7-8]

**Organization:** Oshkosh Corporation

Vocational Vehicle Duty Cycles Vary Dramatically - Vocational vehicle duty cycles vary considerably, both between vocations, and within the same vocation. The most important factor to consider is that most vocational vehicles do not perform the majority of their work by transporting cargo, rather they perform work at a job sight, an emergency scene, or on the roadway. Consider the following examples: [EPA-HQ-OAR-2014-0827-1162-A2 p.2]

Utility Bucket Trucks - The cargo carried by a utility truck is typically limited to lineman’s tools. Once on site, the bucket truck will idle just to run the hydraulics that operate the bucket while the lineman performs his/her work on the overhead lines. Mechanics Trucks Mechanics trucks carry tools, spare parts, and lubricants for repairing equipment in the field. The truck may idle to keep it warm during cold weather. [EPA-HQ-OAR-2014-0827-1162-A2 p.2]

Recovery Vehicle - Recovery vehicles, or “wreckers” will spend some amount of time on the road towing disabled vehicles, and some time operating the recovery equipment (winches, cranes, and towing devices). [EPA-HQ-OAR-2014-0827-1162-A2 p.2]

Concrete Placement - Ready mix concrete trucks spend approximately half their time driving to the delivery site, and half their time dispensing the load. Part of this time will be spent waiting for the crew to be ready for the pour, and the other portion of time is spent pouring concrete. If the pour is a remote site, the concrete may be moved from the truck to the site via wheelbarrows or other means. In this case the wait time will be considerable. [EPA-HQ-OAR-2014-0827-1162-A2 p.2]

We do not envision Table V-17 through V-19 representing an attainable regulation for vocations such as Ready-Mix Concrete trucks. As evident from the following comparison, even assuming that tire improvements are possible and practical, the actual improvements are limited to not much more than whatever can be accomplished with engine improvements alone. [EPA-HQ-OAR-2014-0827-1162-A2 p.5] [Table can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1162-A2]

Refuse Truck - Refuse trucks come in a variety of configurations. Roll-on-Roll-off vehicles will pick up a single container and haul it to the land fill. Type T container haulers will pick up loads from many containers. A large type T container can take 10 minutes to empty with the truck at high idle most of the time. Residential trucks will have aggressive stop-drive cycles while loading, and then some period of mixed urban and country driving to reach the land fill. [EPA-HQ-OAR-2014-0827-1162-A2 p.2]

Snow Plows - The snow plow may carry a load of sand or salt while plowing at the same time. Some of the engine power goes into hauling the load, but a significant amount of power is consumed pushing the snow. [EPA-HQ-OAR-2014-0827-1162-A2 p.3]

Communications Vehicles - Electronic news gathering and incident command vehicles carry communications transmission equipment as well as audio and video processing capability. These vehicles become on-site production or emergency response offices that idle for long periods of time to provide power and climate control for the occupants. [EPA-HQ-OAR-2014-0827-1162-A2 p.3]

Tree Trimming - Similarly to utility trucks, the tree-trimming industry uses bucket trucks to obtain overhead access to their work. Tree trucks will spend most of the day logging no road miles, but running the truck engine for hydraulic power to operate the bucket. [EPA-HQ-OAR-2014-0827-1162-A2 p.3]

Fire Apparatus - Fire apparatus typically drive a short distance and then run at the scene to pump water, generate power, or operate aerial devices. [EPA-HQ-OAR-2014-0827-1162-A2 p.3]

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 166]

Heavy vocational trucks are characterized by niche applications, low volumes, and special purpose designs. Example segments include dump, plows, utility, refuse, fire, and concrete delivery. Within each segment, there are often widely varying vehicle types. There are, for instance, seven unique types of refuse collection vehicles as one example. This extreme variability and complexity renders a design prescriptive regulation untenable.

**Response:**

We are keeping the phase 1 subcategory boundaries of vehicle weight class, with three groups in ranges of GVWR. Applying the three general duty cycles described above in Section 6.1.4 to these three weight class groups, we have created nine vehicle subcategories in the primary program. We believe that this additional level of segmentation with different duty cycles is necessary to recognize the vehicle technologies that are duty cycle dependent, especially transmission technologies and idle reduction.

This structure enables the technologies that perform best at highway speeds and those that perform best in urban driving to each be fairly recognized over appropriate test cycles, while avoiding the unintended consequence of forcing vocational vehicles that are designed to serve in different applications to be measured against a single baseline. The agencies believe these three duty cycle groups balance the competing pressures to recognize the varying performance of technologies, serve the varying needs of customers, and maintain reasonable regulatory simplicity.

We recognize that by adopting a few meaningful duty cycles that “bound” how vocational vehicles are generally used, we cannot perfectly match how every vocational vehicle is actually used. We agree with commenters that there are some vehicle applications for which these general cycles are likely to be poorly representative, and for which unique chassis characteristics are unlike those in the reference GEM vehicles used to establish the subcategory baselines. The agencies have determined that it is impractical, from a regulatory perspective, to establish separate, unique test cycles for all the vocational vehicle applications for which commenters requested separate treatment. In order to determine an appropriate path, we spoke with stakeholders and obtained information about many businesses that produce the chassis mentioned in the comments as well as other purpose-built chassis produced in low sales volumes.

In considering whether to create additional subcategories, the agencies have taken into account the fact that many manufacturers of chassis for which special consideration has been requested do not have diversified products. For manufacturers offering a narrow range of products, averaging is not of practical value as a compliance flexibility, and there are not large sales volumes over which to distribute technology development costs. Based on the comments received and extensive stakeholder outreach, the agencies have identified over a dozen chassis manufacturers serving the U.S. vocational market who produce a narrow spectrum of vehicles for which many technologies underlying the primary standards will either be less effective than projected, or are infeasible. We do not believe it is warranted to force any of these specialized manufacturers to certify their narrow product line of vehicles to the primary standards, where stringency is premised on performance of some technologies unsuited for their specialized type of vehicle. Thus, the agencies have developed optional standards derived using separate subcategories tailored for seven chassis types we are describing as custom chassis. Further discussion of the optional program for custom vocational chassis can be found below in Section 6.2.3.

## **6.2 Vocational Vehicle Standards for CO<sub>2</sub> and Fuel Consumption**

### **6.2.1 Baselines**

**Organization:** Isuzu Motors Limited

Isuzu has several issues with the proposed rulemaking, specifically with vocational vehicles which is the primary vehicle segment Isuzu participates in North America. These potential issues could affect our future product offerings and potentially limit the applications that we could certify. While Isuzu believes the GEM model is capable of accurately representing our vehicles, we note that it has several technically significant limitations and inaccuracies due to the fact that the user-defined parameters are limited. [EPA-HQ-OAR-2014-0827-1263-A1 p.2]

**Organization:** GILLIG LLC

The standard engine for GILLIG MHD and HHD transit buses is an 8.9L 280 hp diesel engine. A diesel-electric hybrid is the only configuration, MHD or HHD, where a 6.7L 280 hp diesel engine is used. We are concerned that differences in the fuel maps between these transit specific engines and the urban duty cycle engines used to establish the baseline vocational vehicles used to create the standards may make it

appreciably more difficult for transit buses to meet the Phase 2 standards. We feel the best way to address this is with a unique subcategory for transit buses. [EPA-HQ-OAR-2014-0827-1156-A1 p.3]

In the GEM HHD and MHD predefined modeling parameters, the payload figures are high relative to what a typical Class 7 or 8 transit bus normally carry. A typical 40' Class 8 transit bus total passenger capacity is around 73 people, and a typical 30' Class 7 transit bus passenger capacity is around 48 people. Feedback from some end users have placed the operating time at full capacity at less than 5%. Transit bus payload is very transient throughout the service day and much different than other vocational vehicles. [EPA-HQ-OAR-2014-0827-1156-A1 p.2]

In the GEM predefined modeling parameters for all vocational vehicles electrical power draw is modeled at 300W. In comparison, the vast majority of our transit buses are capable of producing 14kW to power lights, air conditioning fans, information systems, electric engine cooling fans, etc. Additionally, mechanical losses are modeled in GEM at 1000W, but on transit buses refrigerant compressors *can* pull 18kW and on buses with hydraulic engine cooling fan systems the pump can pull 37kW. Transit buses have significantly different system losses compared to other vocational vehicles. [EPA-HQ-OAR-2014-0827-1156-A1 p.2]

**Organization:** Daimler Trucks North America LLC

**Simulating Axles for Vehicle Certification** - Whether this pre-specified efficiency is reasonable. (Fixed axle ratio energy efficiency of 95.5 %). The proposed fixed axle ratio is reasonable at the baseline with the option of the truck manufacturer to input its own value if superior to the baseline. 80 FR 40185. [EPA-HQ-OAR-2014-0827-1164-A1 p.62]

**Organization:** Navistar, Inc

Navistar feels the following are key areas the agencies must address: The vocational vehicle standards must start from the actual MY17 standards as the baseline and must be simplified and revised throughout. [NHTSA-2014-0132-0094-A1 p.2]

**Organization:** Allison Transmission, Inc.

For vocational vehicles, the 1.3kW constant power accessory load is unrealistically low and unrealistically constant. Further, to use this accessory load for engines of all sizes is an oversimplification. The Allison best practice for estimating engine accessory loads is the following: [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

- Fan power is 6.5% of peak engine power at peak engine power speed and varies cubically with engine speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

- Air compressor power is 0.5% of peak engine power and is constant. [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

- Alternator/generator power is 1.0% of peak engine power at peak engine power speed and varies proportionally with engine speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

- Steering pump power is 1.0% of peak engine power at peak engine power speed and varies proportionally with engine speed. [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

Although Allison includes a few vocationally specific exceptions, this is the general characterization used to estimate engine accessories. The figure below shows the Allison estimated accessory loads for the EPA sample engines, in contrast with the EPA estimated accessory loads. [EPA-HQ-OAR-2014-0827-1284-A1 p.28]

[Charts, plotting speed against power for Allison estimated accessory loads versus EPA estimated accessory loads, can be found on p.28 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

Revising the load upwards would be more consistent with EPA and NHTSA's generally conservative approach to estimation of the GHG and fuel efficiency benefits of this rulemaking. Such a revision, coupled with the corresponding stringency adjustments, would better characterize accessory losses and more accurately demonstrate the impact of engine downspeeding. Therefore, Allison recommends GEM utilize a higher and variable power accessory load which is scaled to each engine in the manner described above. [EPA-HQ-OAR-2014-0827-1284-A1 p.29]

Allison recognizes the need to simplify the quantity of pre-defined modeling parameter sets; however, there are some discrepancies in the typical configurations EPA has defined in Table 8. Specifically: [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

- In the case of Coach Bus: HHD Regional, the transmission forward gear ratios shown are "wide" ratio, and a bus would have a "close" ratio set. A better definition would be 3.51, 1.91, 1.43, 1.00, 0.74, 0.64. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

- In the case of Transit, Refuse, Mixer, Emergency: HHD Urban, the ratios shown are "wide" ratio which would not be used for a transit bus. The "close" ratios used in a bus would be 3.51, 1.91, 1.43, 1.00, 0.74. It should also be noted that this collection of vehicle types would not all be 5-speeds. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

**Organization:** Autocar, LLC

The agencies' proposed baselines and standards are not suitable for Low-speed/Frequent-stop Vehicles. Autocar does not have the ability to comment on the agencies' proposed baselines and GHG and fuel consumption standards, but the Company believes a fundamental disconnect exists with respect to the baselines and standards applied to Low-speed/Frequent-stop Vehicles: The agencies propose to measure CO2 emissions in grams per ton-mile and fuel consumption in gallons per ton-mile for these trucks, and yet recognize these types of trucks generally are low-mileage vehicles (80 Fed. Reg. 40286). The refuse and sweeper industries appropriately track fuel consumption in gallons per hour. The extreme variation in payload that refuse vehicles carry throughout a day (from zero load to full, one or more cycles per day),<sup>4</sup> and the relatively low number of miles per unit of work for these vehicles, makes any ton-mile metric inappropriate for trying to measure fuel efficiency and GHG emissions per unit of work. Refuse vehicles can travel as little as 50 miles in an entire day on a collection route, and such vehicles expend fuel even while stationary to power compaction and loading mechanisms that run on engine power from a PTO. Thus, gallons per hour is the only logical and appropriate measure of fuel efficiency, and the current proposed standards – measured in grams per ton-mile and gallons per ton-mile – are not appropriate for Low-speed/Frequent-stop Vehicles.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1233-A1 p.8-9]

**Organization:** Volvo Group

When setting stringencies the agencies have made errors in their assumptions regarding transmission applicability and penetrations, most egregiously in assuming the baseline vocational vehicles in all but the

HHD Regional subcategories are equipped with automatic transmissions (AT) and that there is no penetration of other transmission types (reference Preamble Section V.C.2.a). Chapters 2 and 4 of the RIA and Section V of the Preamble make no mention of why these subcategories utilized an AT as the baseline with an assumed 100% penetration. The results of this assumption are over-inflated baselines and stringencies. [EPA-HQ-OAR-2014-0827-1290-A1 p.25]

Volvo Group finds this error to be large and the assumption unsubstantiated. For Volvo Group N.A. production for the years 2013 and 2014 (the first two full years of production for Phase 1) the Volvo Group built more than 20,000 units of the Mack Granite, Titan, and TerraPro and Volvo VHD HHD vocational models. These truck models are designed and optimized solely as vocational vehicles for either on/off-road or refuse operation. Of these trucks, just over 60% were equipped with ATs, while just under 40% were equipped with manual transmissions (MT). This does not include volumes of AT and MT in other highway optimized models that are sold into vocational applications where the volumes of AT are very low in favor of MT or automated manual transmissions (AMT). [EPA-HQ-OAR-2014-0827-1290-A1 p.25]

Additionally, ATs increase heat rejection requirements on HHD vocational vehicles. In many cases it is necessary to restrict AT offerings on vehicles with specific packaging constraints or with high torque engines due to the inability to package additional cooling capacity. These constraints would primarily impact vehicles performing more shifts and/or operating at a higher percentage of time at heavier load, such as an increased percentage of transient operation. Thus, the assumption of 100% penetration of automatic transmissions in the agencies' proposed Urban and Multipurpose subcategories is not justified. [EPA-HQ-OAR-2014-0827-1290-A1 p.25-26]

**Response:**

In response to comments on the chassis specifications for the baseline GEM configurations, the agencies have revised many vehicle characteristics since the NPRM. In response to comments from manufacturers of LHD vocational chassis including Isuzu, the agencies have revised downward the default aerodynamic drag area for all LHD vocational vehicles. In response to comments from transmission suppliers and engine manufacturers noting that unloaded idle speeds were too low, we have revised upward the default mechanical and electrical accessory loads for vocational vehicles in all subcategories. Other changes made in response to comment include the gears of the transmissions on coach buses and transit buses and the axle ratios and tire revs/mi of LHD and MHD vehicles.<sup>176</sup> The most significant changes to the HHD baselines are in establishing blended baselines for HHD Regional and Multipurpose vehicles. These blended baselines have been created in response to information received during meetings with EMA using a weighted average of the GEM performance of two very different vehicles: one with a 10-speed manual transmission and one with a 6-speed automatic transmission.<sup>177</sup> See RIA Chapter 2.9.2. We believe that these changes enable the final Phase 2 program to better measure the improvements in fleet performance beyond that being achieved by today's vehicles.

In response to comments that the metric of the standard, grams per ton-mile and gallons per ton-mile, is inappropriate for some vehicles, we have determined that the simplification of a single metric for all vehicles is warranted. In Phase 1 the agencies considered other metrics, in view of the fact that not all

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<sup>176</sup> See memorandum dated July 2016 titled, "Summary of Comments on Vocational Vehicle Baselines."

<sup>177</sup> See Memo to Docket, "Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking," August 2016.

vehicles have a primary purpose to haul freight.<sup>178</sup> Some vehicles carry passengers and others conduct work while in stationary mode sometimes operating a device through use of a PTO. Nonetheless, we are adopting Phase 2 standards using the same metrics we adopted in Phase 1. Based on NAS's recommendation and feedback from the heavy-duty truck industry, NHTSA and EPA are adopting standards for vocational vehicles that are expressed in terms of moving a ton of payload over one mile. Thus, NHTSA's final fuel consumption standards for these trucks are represented as gallons of fuel used to move one ton of payload one thousand miles, or gal/1,000 ton-mile. EPA's final CO<sub>2</sub> vehicle standards are represented as grams of CO<sub>2</sub> per ton-mile. The agencies note that the commenter claims that a payload-based metric is not appropriate for all types of vocational vehicles, specifically buses and waste haulers. The agencies recognize that a payload-based approach may not be the most representative of an individual vocational application; however, it best represents the broad vocational category, and is appropriate for this phase of standards. Furthermore, by creating two new idle cycles with emissions and fuel consumption measured per hour over those cycles, we are in essence incorporating an alternate metric as part of the standard-setting process. Furthermore, a more differentiated metric would not affect the technology choices for vocational vehicles. Thus, the agencies are adopting the proposed metric, but will revisit the issue of metrics in any future action, if required, depending on the breadth of each standard.

## **6.2.2 Comments on the Standard-Setting Process**

**Organization:** Truck & Engine Manufacturers Association (EMA)

In developing their multi-subcategory approach, the agencies apparently became concerned that the differing proposed standards for the different vehicle subcategories might incentivize vehicle manufacturers to certify their vehicles in certain categories over others. For example, if the relative stringency and cost of the proposed standards for the heavy-duty Urban subcategory are deemed more onerous than for the Regional and Multi-Purpose subcategories (given the differing underlying assumptions, including those regarding hybrid penetration rates and other factors), there is a perceived risk that manufacturers might try to avoid having to certify vehicles within that subcategory. This prospect for potential "gaming" of the proposed regulatory scheme – in itself, an unrealistic concern – has led the agencies to introduce a "normalization" process that is overly-complex and fundamentally problematic – in effect, resulting in an unreasonable "solution" to an unlikely problem. [EPA-HQ-OAR-2014-0827-1269-A1 p.29-30]

In their "normalization" process – ostensibly designed to help ensure that all of the proposed vocational standards reflect the same relative stringency – the agencies have assumed that a certain percentage of vehicles in each weight category will fall into each of the three cycle-based subcategories. For example, the agencies have assumed that the medium heavy-duty category is comprised of 25% Regional vehicles, 50% Multi-Purpose vehicles, and 25% Urban vehicles. The agencies then used that assumed mix of cycle-based categories to derive GHG/FE targets for where the Proposed Phase 2 Standards should be set, again premised on assumptions regarding available technologies and forecasted penetration rates. However, the agencies' multistage layering of multiple assumptions has created significant risks of error at each stage of the assumption-building process. [EPA-HQ-OAR-2014-0827-1269-A1 p.30]

Beyond the likelihood of incorrect baseline assumptions about the nine vehicle subcategories, the numeric output of the agencies' "normalization" process – which according to the agencies' own admissions is

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<sup>178</sup> Responses to comments on the metric of the Phase 1 standard may be found beginning on page 230 of the Phase 1 response to comments document, available at <https://www3.epa.gov/otaq/climate/documents/420r11004.pdf>



still subject to substantial revision – is fundamentally incorrect as well. For example, the GEM-based output for determining where the Phase 2 Standard should be set for the heavy heavy-duty Urban vehicle subcategory is 219 g CO<sub>2</sub>/ton-mile. That is the result obtained if the full GHG technology mix as predicted by the agencies is fully deployed for heavy heavy-duty Urban vocational vehicles. However, the “normalized” output for determining the Phase 2 Standards for that same type of vehicle is 209 g CO<sub>2</sub>/ton-mile, a result that is more stringent than the GEM-based approach, and thus, on its face inherently infeasible. A manufacturer cannot be expected to achieve a Phase 2 GHG/FE result that is better than the fully optimized GEM-based result. Consequently, a “normalization” process that makes achieving the Urban-cycle-based Phase 2 standards even less feasible will not reduce manufacturers’ incentives to avoid the Urban category; it will increase them. [EPA-HQ-OAR-2014-0827-1269-A1 p.30]

It is fundamentally insufficient and unreasonable for the agencies to try to rely on potential future averaging, banking and trading (“AB&T”) credits in support of infeasible vocational vehicle standards. In that regard, the agencies state as follows at page 40308 of the NPRM: [EPA-HQ-OAR-2014-0827-1269-A1 p.30]

“We are aware that in this approach, some of the projected technology packages would not provide a direct path to compliance for manufacturers, such as in the example of the MHD Regional vehicle. Using the technologies adopted at projected rates, it would still fall short of the standard by 1.5 percent. The agencies believe that the Phase 2 program has enough regulatory flexibility (averaging, banking and trading provisions in particular) to enable such a vehicle to be certified.” (80 FR at 40308). [EPA-HQ-OAR-2014-0827-1269-A1 p.30]

That rationale cannot sustain an infeasible rulemaking. AB&T provisions are not a substitute for the logical and transparent development of well-reasoned and feasible standards. Moreover, AB&T credits are inherently dependent upon achieving product mixes and over-compliance capabilities that may not occur. Consequently, while the agencies may “believe” that their Phase 2 vocational vehicle standards are feasible, that belief, divorced from the necessary real-world demonstration, cannot sustain a federal rulemaking. [EPA-HQ-OAR-2014-0827-1269-A1 p.31]

**Organization:** Truck & Engine Manufacturers Association (EMA)

As noted, one fundamental problem with the NRPM is that the Proposed Phase 2 Standards for vocational vehicles are still subject to ongoing revision as the agencies are continuing to modify the “normalization” process that they are using to try to “align” the relative stringency of the proposed standards, as assessed under the proposed Urban, Multi-Purpose and Regional test cycles. Apparently, the agencies are endeavoring to “normalize” the results obtained from GEM, and thus the relative stringency of the proposed standards, under each of the Urban, Multi-Purpose and Regional cycles, so manufacturers are not incentivized to classify their vocational vehicles as one type over another. For example, if it is perceived to be harder for a vocational vehicle tested under the Urban test cycle to meet its targeted standards than it is for a vehicle tested under the Multi-Purpose cycle, manufacturers may skew their vocational vehicle subcategories accordingly. [EPA-HQ-OAR-2014-0827-1269-A1 p.40]

The problem is that the agencies’ “normalization” process is not complete. Nor is it transparent or logical. In fact, it seems that the agencies are still trying to figure out how best to “balance” the different results obtained from the different vocational test cycles. Consequently, manufacturers are being forced to comment on the stringency of standards that remain subject to change as a result of “normalization.” That is neither fair nor in accordance with requisite rulemaking procedure. If the Proposed Phase 2 Standards for vocational vehicles were still subject to further internal review and modification by the agencies, promulgation of the NPRM as it pertains to those vehicles should have awaited completion of the pending

“normalization” process. Simply stated, manufacturers should not be required to assess and comment on moving regulatory targets. [EPA-HQ-OAR-2014-0827-1269-A1 p.40]

It is not a sufficient answer for the agencies to claim that changes to the GEM-based determination of “normalized” GHG/FE standards would not amount to changes to the stringency of the proposed standards. They would, and they are. Manufacturers must have the ability to assess compliance with fixed numeric standards in order to determine whether their available and projected technology packages, along with their unique product mixes within the proposed subcategories of vocational vehicles, can meet those fixed numeric standards. Otherwise, any feasibility assessment becomes a theoretical exercise divorced from the certainty required under a proper notice-and-comment rulemaking process. In sum, in the absence of fully fixed vocational vehicle standards, manufacturers cannot properly assess the potential infeasibility of those standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.40]

Moreover, the agencies’ assumptions regarding the percentages of vocational vehicles that would fall into each category are dramatically different from the percentages based on manufacturers’ experience, which indicates additional fundamental errors in the agencies’ “normalization” process. On top of that, the applicable vocational duty cycles are not yet settled. Those cycles are integral to determining the potential GHG/FE impacts of available technologies and the appropriate stringency of the Phase 2 Standards.

**Organization:** Daimler Trucks North America LLC

**Normalization and Equalization Must Be Eliminated** - The agencies discuss additional vocational vehicle categories and the manner for baselining then request comment on whether the proposed configurations adequately represent a reasonable range of vocational chassis configurations likely to be manufactured in the implementation years of the Phase 2 program. 80 FR 40308. We comment elsewhere on the additional categories. As we have discussed in meetings with the agencies, we think that the baselines and the normalization/equalization processes are inappropriate. In particular, with the baselines, we find that the agencies’ technology packages do not meet the emission standards and FE requirements because of these normalization and equalization processes. In other words, the processes make otherwise feasible technologies incapable of meeting the standards. That is not appropriate. The agencies should choose categories of vehicles correctly and should eliminated normalization and equalization. [EPA-HQ-OAR-2014-0827-1164-A1 p.74-75]

Further, we are unable to provide any meaningful input to the agencies on the vocational vehicle portion of the program, even at this late stage in the rulemaking. The agencies have not yet clarified (for example) how vehicles will be categorized and how problems like normalization and equalization will be eliminated. We understand from discussions with the agencies that the NPRM’s proposal for a “deep integration” benefit, which (as we explained in our response to the NPRM) was unclear and (as far as we can tell) not related to an actual facet of vehicle engineering, and which would have required onerous powertrain testing, has been eliminated from the proposal—a correct choice. And we understand that the agencies’ analysis of drive cycles for vocational vehicles shows a much greater value of idle-reduction technologies, which seems consistent with real-world data we have seen. Beyond this, we are unable to actually model our vocational vehicles in GEM to provide any meaningful comments to the agencies on their proposed regulations. With regard to the agencies’ investigation of the benefit of hybrid technology we like to point out that there is a difference between the energy that could potentially recuperated and the energy that can actually be recuperated. Once actual conversion efficiencies and other system limitations (i.e. how fast can the battery absorb and discharge energy) come into play, hybrids should be expected to perform significantly worse than the agencies expected. That is why we strongly urge the agencies to incorporate these considerations into any projection of potential hybrid savings. Otherwise this will lead

to an inaccurate assessment of hybrid benefits and unrealistic expectations of CO2 reductions that cannot be met in the real world. [EPA-HQ-OAR-2014-0827-1918-A2 p.2]

**Organization:** Navistar, Inc.

As briefly noted above, the NPRM contains a proposal for vocational vehicles that has been developed with a “normalization” process utilized to adjust the MY2017 standard baseline and thus adjust the current standards accordingly. [EPA-HQ-OAR-2014-0827-1199-A1 p.31]

The NPRM contains only a reference to the RIA, which contains only one paragraph and a table that explains this process. The process sets out a set of assumptions that the agencies applied to “normalize” across vocational vehicle categories to adjust the baseline. [EPA-HQ-OAR-2014-0827-1199-A1 p.31]

The process uses assumed populations for various classifications, including urban, regional and multipurpose, to which apparently arbitrary population percentages are then applied. The resulting proportions are then applied to the 2017 emission baseline (the 2017 standard), resulting in modified beginning points. As a result, the starting point is not where it should be, the MY2017 vehicle emission standards, but instead reflects some adjusted standard. No significant explanation is given as to why certain numbers were chosen, including the percentage of vehicles assigned to various cycles. [EPA-HQ-OAR-2014-0827-1199-A1 p.31]

It is difficult if not impossible to adequately comment on this portion of the proposal. From what we can tell, the proposal uses arbitrary populations and adjustments and cites no actual data in support of its percentages. It also appears that this proposal seriously misrepresents the actual classification of vehicles. This results in a seriously skewed starting point, since the assumptions that an emission limit can be met are based on assumptions about penetration rates for new technologies in various vehicle classifications. If those assumptions are wrong, the bases for the emission standards are wrong and, therefore, the standards themselves are wrong. [EPA-HQ-OAR-2014-0827-1199-A1 p.31]

In particular, we think the normalization incorrectly stated the populations. Currently, we think that the percentages are off as much as 20% in some categories. This will inappropriately penalize some manufacturers and benefit others, based on their particular mix. Some manufacturers, because of this mix, may adopt all of the technologies assumed in the RIA yet still not reach compliant levels because of the arbitrary normalization, which skews the actual emissions goals based on incorrect assumptions of the current product mix for the industry. [EPA-HQ-OAR-2014-0827-1199-A1 p.31-32]

Normalization or equalization could benefit one manufacturer over another based on their mix. It is likely that the unknown elements of the regulation could translate into a rule that drives customers to the incorrect specification for their application or to avoid upgrading their vehicles entirely.<sup>4</sup> This normalization should be eliminated from the rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.32]

**Organization:** Volvo Group

In setting stringencies for the Phase 2 regulation the agencies have included technologies, penetration rates and processes such as “normalization” that, by their own admission (see below), result in targets that are not attainable even using the proposed technology packages and penetration rates. Volvo Group agrees that the Averaging, Banking and Trading (AB&T) flexibility provision is necessary to help meet individual customer needs and to offset any one OEM’s product mix and market share in each segment. However, we also believe that stringencies for any one market segment must not be based on the

expectation that credits can be transferred from another market segment, since this creates an unlevelled playing field based on OEM market mix. [EPA-HQ-OAR-2014-0827-1290-A1 p.30]

This is best illustrated within the vocational vehicle subcategories, where the agencies have set stringencies that cannot be attained with their own technology packages, let alone after accounting for realistic penetration rates. One example of this is the normalization process that the agencies used, supposedly to avoid an incentive to certify vocational vehicles in a less stringent subcategory. The agencies state in Section V.C.2.b of the Preamble that they “are aware that in this approach, some of the projected technology packages would not provide a direct path to compliance for manufacturers...Using the technologies adopted at projected rates, it would fall short of the standard,” but that the “Agencies believe that the Phase 2 program has enough regulatory flexibility (averaging, banking, and trading provisions in particular) to enable such a vehicle to be certified.”[EPA-HQ-OAR-2014-0827-1290-A1 p.30-31]

Indeed, any vehicle can be certified regardless of its performance when compared to the standard. However, it is completely unacceptable that the Agencies promulgate a regulation where an entire class (regulatory subcategory) of vehicles is known and intentionally targeted beforehand to be incapable of meeting the standard for that subcategory when utilizing the full technology package and the expected penetration rates used to set the standard. [EPA-HQ-OAR-2014-0827-1290-A1 p.31]

Another example of this is found in the very first paragraph of the aforementioned section of the Preamble where the Agencies state “the proposed standard stringency does reflect, to some extent, the ability of manufacturers to utilize credits. For example, we project that hybrid vehicles would generally be certified in the urban subcategory and would generate emission credits that would most likely be used in the other subcategories within the weight class group.” This is compounded by the Agencies’ inclusion of the same 18% penetration rate of hybrids in the vocational Multi-purpose subcategory as they have assumed in the urban subcategory, even with the aforementioned statement around their projection of most hybrids being certified in the urban subcategory. [EPA-HQ-OAR-2014-0827-1290-A1 p.31]

The Agencies’ position leaves OEMs susceptible to non-compliance if they cannot offset a negative balance of credits within three years. This will, given the Agencies’ position, put OEMs at the mercy of their product mix and market strength across the vehicle subcategories. Per the Agencies’ example in the referenced section if an OEM is dominant in the MHD Regional subcategory in MY2021 and had little participation in the other MHD vocational subcategories then that OEM would have no way to accrue an average positive credit. The only way an OEM can meet the normalized standards given the Agencies technology packages and penetration rates is to match the 25%-50%-25% vocational product mix in the Regional, Multipurpose, and Urban subcategories respectively, or to over-comply, which few, if any, OEMs will be able to do. Volvo Group’s sales do not match this assumed mix, nor have the Agencies provided any data to support their assertion that the general market matches this mix. [EPA-HQ-OAR-2014-0827-1290-A1 p.31]

As requested elsewhere in this document and within the EMA comments, we request that the standards set for each regulatory subcategory be set based on the ability to meet the standard for that regulatory subcategory with a reasonable penetration of technically and commercially feasible technologies for that subcategory, and that subcategory alone, in the timeframe of the regulation and its’ individual stringency steps. [EPA-HQ-OAR-2014-0827-1290-A1 p.31]

**Organization:** California Air Resources Board (CARB)

CARB staff recommends that U.S. EPA and NHTSA re-examine the weighting procedure used to set equivalent standards for the three subcategories of vocational vehicles in the NPRM. CARB staff agrees it is important to set the standards so manufacturers do not have an incentive to purposely “misclassify” their vehicles. However, CARB staff is concerned that the method described on page 40308 of the NPRM may inadvertently present just such an incentive. [EPA-HQ-OAR-2014-0827-1265-A1 p.52]

In the example on page 40308, the NPRM explains that for one technology that would provide a 5 percent benefit for regional vehicles, 7 percent for multipurpose vehicles, and 8 percent for urban vehicles, when setting the proposed standards, they weighted the reductions and assumed 6.6 percent benefit for all three subcategories. CARB staff is concerned that a manufacturer using such a technology would have an incentive to classify their vehicle as urban (to show an 8 percent benefit) even if their vehicle actually would fit more appropriately in the regional or multipurpose subcategories (where the device would show only a 5 to 7 percent benefit). CARB staff encourages U.S. EPA and NHTSA to re-examine whether it may be more appropriate to set differing standards for the differing vocational vehicle subcategories, to remove this potential incentive for misclassification. [EPA-HQ-OAR-2014-0827-1265-A1 p.52-53]

**Response:**

At proposal our standard-setting process included a process described as ‘normalizing’, where the GEM-derived baseline values were adjusted prior to applying improvements, as well as an equalization process where subcategory-specific technology-based improvements were averaged before applying reductions to the adjusted baselines. The agencies have carefully considered all comments and we have reconsidered our standard-setting process. Now that we have revised our baselines in response to comment (as described above in section 6.2.1), we are more confident that we are reasonably representing the MY 2018 vocational vehicle fleet without needing to “normalize” the baseline GEM values. We also have revised our standard setting process to no longer include equalization. The stringency of the final standard for each of the subcategories is derived directly from the final technology package found to be feasible in each subcategory, without any fleet mix assumptions (i.e. equalizing assumptions) baked into the equation. We agree with comments noting that the equalization approach at proposal could have inappropriately benefitted one manufacturer over another based on their product mix. We also note that the equalization process as proposed would have made the standards for the Regional vehicles unattainable using the technology pathway identified by the agencies, thus motivating manufacturers to select less appropriate test cycles for vehicles that are designed for Regional service.

In comparing our relative stringencies in each subcategory with each respective baseline, the Regional vehicles are generally able to achieve the smallest percent improvement from the lowest (cleanest) baseline. By contrast, the Urban vehicles are generally able to achieve the greatest percent improvement from the highest (dirtiest) baseline.

The proposed normalization/equalization approach was motivated in part by a legitimate desire to avoid inappropriate subcategorization. In the final process to establish numerical standards, we conclude we have found a way to prevent enabling reasonably efficient vehicles in today’s fleet from avoiding installing any technology simply by certifying in an inappropriate subcategory. We do so by specifying certain equipment-related constraints – if a vocational vehicle is equipped with certain equipment then it cannot certify in a specified subcategory. The constraints we are adopting on selection of subcategory at the time of certification are discussed below in Section 6.5.1. Preamble Section V.C also discusses recent information relating to program structure and constraints on choice of duty-cycle and the agencies’ intention to continue discussions on these issues.

**6.2.3 General Comments on Custom Chassis Standards**

**Organization:** Oshkosh Corporation

### **Custom Chassis Manufacturer Issues**

Beginning on page 40294 of the NPRM, EPA recognizes the dilemma caused by smaller manufacturers who produce vehicles on their own chassis. The flexibility inherent in the Phase II regulations are not available to small volume manufactures as they do not have other categories of vehicles to average over. EPA suggests setting less stringent targets, or providing additional time to meet the targets, would be a way of addressing this dilemma. They also suggest limiting the volume over which this relief would be provided. [EPA-HQ-OAR-2014-0827-1162-A2 p.6]

The dilemma here is caused, not by the size or method of manufacturing, but by the almost certain fact that vocational vehicles cannot be designed to practically comply with the proposed regulations. If a large manufacture can produce a compliant truck for a specific vocation, then a small manufacturer can do the same. In anticipating the problem custom chassis manufacturers will have in meeting the Phase II criteria, EPA is essentially admitting that the criteria is unlikely to be attainable without the averaging component of the regulation. Large manufactures will not make compliant vocational vehicles, they will simply rely on credits from their high production models make up the difference. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

We suggest that the Phase II regulations must limit mandates to realistic and practical improvements that can be met for each vocation, and then applied equally to all manufacturers. The NRPM has two suggested solutions: [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

- 1) Provide relief through less stringent regulation of low volume vocational vehicles, but place a limit on the sales volume. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]
- 2) Provide extra time to meet the more stringent regulations. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

We believe that both of these approaches are flawed. If more stringent regulations are impractical and cannot be met, then less stringent regulations on a limited production volume stifles a custom chassis manufacturers' opportunity to grow their business. Providing extra time to meet an impossible target simply delays the inevitable. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

It is an inherent fact that most efficiency related innovations in heavy vehicle components come first on high volume applications. This is natural because the large fleets who purchase high volume trucks are most sensitive to fuel economy improvements, and component suppliers have a greater incentive to invest in new product development when the potential sales volume is greater. Vocational vehicle manufactures are therefore not in a position to influence components such as engines, transmissions, axles, tires, wheels, drivelines, etc... where the EPA is presuming the majority of efficiency improvements will come from. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

While not part of the NODA, an agency memorandum on alternative approaches to certifying specialty vocational vehicles, or custom chassis, has recently been added to the docket.<sup>16</sup> The two approaches are a simplified model of GEM similar to Phase 1 and a minimum applied technology package. The vehicles that these could be applied to are motor homes, intercity coaches, school buses, transit buses, refuse trucks, cement mixers, and emergency vehicles. These vehicles together represent around 20 percent of

vocational vehicle sales, with motor homes being the largest contingent. [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

The standard for these vehicles proposed in the memorandum is significantly weaker than the proposal for every single class of vehicle, by an average of between 5 and 7 percent.<sup>17</sup> This means that if manufacturers take advantage of this approach for the 20 percent of the fleet that is eligible, the vocational vehicle standard would need to be strengthened by more than 1 percent, on average, to offset the application of these standards and maintain the environmental benefits of the proposal. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

If manufacturers are able to identify these specialized classes of vehicle as would be required to take advantage of this proposal, then they should also then be able to take advantage of the most appropriate fuel-saving technologies for that unique duty cycle (e.g., aerodynamic improvements for motorcoaches that spend extensive time at high speed cruise). The ability for manufacturers to identify these applications should therefore result in a more stringent vocational vehicle target for these custom chassis, not less. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

Furthermore, the simplified compliance pathway eliminates incentives for technologies directly applicable to these vehicles, including transmission improvements and hybridization. This is especially concerning for intercity buses, school buses, and refuse trucks, all of which are ideal applications for powertrain improvements that would not be captured or incentivized under this approach. This could significantly undermine the vocational vehicle target and erode benefits of the rule. [EPA-HQ-OAR-2014-0827-1896-A1 p.6]

Simulating the technology packages identified in the memo with GEM P2v1.1 resulted in a shortfall for the vehicles ranging from 3 to 17 percent, which yielded an approximate sales-weighted average of 7 percent. Accounting for the reweighted drive cycles would reduce this average to 5 percent, with only motor homes having a standard that is as strong as the proposed vocational vehicle target for its class.

**Organization:** Autocar, LLC

### **EPA's Memorandum Proposes an Ineffective and Costly Compliance Scheme.**

Simplified GEM Misses the Mark. Autocar disagrees with EPA's conclusions and compliance suggestions in the Memorandum and is seeking an opportunity to provide formal comments to this substantive rule proposal that appears to be largely based on the data in the NODA. Although Autocar appreciates EPA's attempt to provide a more manageable compliance construct for vocational custom chassis manufacturers, the diversity of the applications, and the unique characteristics of refuse drive cycles and payload needs in particular, render the data and the proposed technologies unusable, as set forth in this section. [EPA-HQ-OAR-2014-0827-1885-A1 p.5]

If Adopted, EPA's Proposal Will Require Autocar to Certify Some of its Vocational Chassis to the Full Greenhouse Gas Emissions Model ('GEM'), while Refuse Chassis Will Have only Limited Variables to Certify to in Simplified GEM. Autocar acknowledges that EPA is attempting to address certain of Autocar's concerns set forth in its October 1, 2015 Comments, incorporated herein,<sup>6</sup> in proposing an alternative compliance scheme to full GEM certification. In particular, Autocar appreciates EPA's willingness to develop separate standards for vocational vehicles manufactured as custom chassis, and EPA's recognition in the Memorandum that certain manufacturers in these vocational segments will not be able to avail themselves of banking and averaging credits to comply with the Proposed Regulations.<sup>7</sup> However, Autocar respectfully notes that some of the suggestions in the Memorandum, while well-

intended toward small-volume manufacturers like Autocar, have certain negative unintended consequences. [EPA-HQ-OAR-2014-0827-1885-A1 p.5] /6/ Comment submitted by James M. Johnston, President, Autocar, LLC and Autocar Industries, LLC, No. EPA-HQ-OAR-2014\_0827-1233. /7/ Memorandum at pp. 1, 3, and 4.

EPA's Proposal for Simplified GEM as a Compliance Path Does Not Include Conventional Refuse Trucks, Street Sweepers, Concrete Pumpers or Other Vocational Custom Chassis. If Simplified GEM is available only for Autocar's refuse chassis, and not for its chassis that are final-stage manufactured into street sweepers, asphalt patchers, stripers and blasters, concrete pumpers and conveyers, aircraft deicers, refuelers and stockers and sewage suction trucks, then Autocar will still be burdened with full GEM compliance obligations, for these highly customized and low-volume chassis applications.<sup>8</sup> Assuming this bifurcated compliance structure was not intended, the agencies have no basis to exclude these applications as vehicle types covered by the Memorandum because these other vocational applications have operating characteristics that are similar to some of the vehicle types covered by the Memorandum (i.e., low-speed/frequent-stop PTO usage). Had the NREL Report mapped these applications' drive cycles, it would have provided an adequate basis for crafting standards and determining compliance technologies for these vehicle types (see Section 1.2 for further discussion of this issue). [EPA-HQ-OAR-2014-0827-1885-A1 p.5-6] /8/ All of these applications together constitute less than 130 annual chassis sales for Autocar.

EPA's Proposal for Simplified GEM Allows Refuse Trucks Merely Seven Input Variables, Only Two of Which May Be Useful in the Refuse Segment. Tables 4-6 of the Memorandum indicate that refuse custom chassis will have to comply with Phase 2 through certification in Simplified GEM and specific adoption rates of five technology packages. Table 3 of the Memorandum suggests GEM inputs for Simplified GEM, and allows refuse chassis only seven technology package inputs, while the most significant fuel-efficient and emission-reducing technologies - certified engines and transmissions - are made a default (requirement), with no credit toward GEM compliance. Of the technology packages listed, only two are arguably useful in refuse truck applications: Low Rolling Resistance ('LRR') Tires, and Tire Pressure Monitoring.

As noted in Figure 1, whether LRR tires can successfully reduce fuel consumption, and whether weight reduction can be achieved, are largely dependent upon the truck owner and the body builder, respectively, neither of whom are subject to the regulations. Other than engine and transmission producers, body builders may have the greatest potential for reducing GHG emissions by improving or changing PTO performance (PTOs are generally specified, procured and installed by body builders) and reducing weight, but there is no allowance for that possibility in the instant proposal. And with respect to vocational customers, who are likely to enjoy much less fuel-cost savings with these proposed technology packages than their long-haul tractor-trailer colleagues gain with their compliance requirements, they will not likely voluntarily seek these features. This puts Autocar in the position of having to market any components the agencies may compel, and that reduces its ability to comply because it cannot average, bank and trade credits. The agencies should consider the need to communicate the requirements for the proposed technologies to customers and additionally take measures to prohibit their removal or disabling after purchase. [Figure 1 can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1885-A1]

2.2.5 Compliance Efforts for Refuse Trucks May Be Futile. Using the information in the Memorandum and additional guidance<sup>9</sup> provided by its author, Lauren Steele, but without the benefit of reviewing an actual Simplified GEM file (see Appendix 2 for Autocar's request for extension), Autocar attempted a refuse truck GEM simulation, using the defaults provided in Table 8<sup>10</sup> and the proposed technologies listed in Tables 4-6 of the Memorandum. [Appendix 2 can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1885-A2] TPMS and ATIS were not available in the model. 'Neutral at Idle' provided only a 2.8% improvement in emissions and consumption. 'Low Rolling Resistance Tires' provided only a



1.4% improvement in emissions and consumption. Even with the addition of either (but not both) TPMS or ATIS, the only remaining technologies available, it appears that any attempt to reach the required fuel savings and tailpipe GHG emissions reductions under the proposed compliance scheme is futile.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1885-A1 p.8] /9/ This additional guidance was provided in the form of a sample input file for use with the Phase 2 GEM, where certain rows indicated the types of vehicle configurations the agencies anticipate using to set the baseline 2018 performance levels for regular vocational vehicles using the full GEM program, and other rows indicated the types of vehicle configurations the agencies anticipate using to set the baseline 2018 performance levels for custom vocational vehicles using Simplified GEM. /10/ Although notably, the default engine in Table 8 is not available for Autocar's refuse trucks. /11/ The apparent impossibility of compliance under the Simplified GEM with the available proposed technologies may result from the non-representative drive cycle data and inappropriate defaults. Autocar believes it is similarly impossible to have default engines, transmissions, weight and payload for such diverse vocational vehicles.

2.3 With the Instant Proposal, Autocar Has Little Control Of Its Destiny. Regulations requiring the integration of certain technologies make Autocar entirely dependent on third party suppliers for compliance. This is a particularly precarious position for a small, low-volume business, subjecting it to the mercy of the suppliers with regard to lead time and pricing. Autocar is not vertically integrated and only installs suppliers' components; thus, Autocar does not enjoy the real flexibility EPA likely intended with technology-based packages. Also, refuse truck customers almost always specify desired components and may resist purchasing them at the adoption rates EPA suggested in Tables 4-6 of the Memorandum. In fact, specifying adoption rates less than 50% for certain technologies virtually assures the failure of this compliance scheme, as Autocar will be forced to market and sell to some customers more expensive and payload-displacing components, in order to obtain the required averages. Larger, more diversified chassis manufacturers could achieve these levels using credits from other vehicles, creating a lopsided market incentive. Unless all custom chassis makers are required to install the mandated technology packages on all vocational trucks, the agencies will have created a commercial imbalance in which a certain number of Autocar refuse customers, for example, will have to choose between buying a more expensive and component-laden Autocar chassis, or a non-compliant, but cheaper and lighter, competitive brand. [EPA-HQ-OAR-2014-0827-1885-A1 p.8-9]

3.5 Some Small Businesses Received Greater Flexibilities. In the Memorandum, EPA exempted manufacturers of emergency vehicles and cement mixers from compliance with Phase 2, requiring only that they install LRR tires on their vehicles. Manufacturers of recreational vehicles also have a lesser compliance burden than other vocational vehicle types. Neither the Memorandum nor the documents included in the NODA explain why emergency vehicles, cement mixers and recreational vehicles should be exempt, but not refuse vehicles. Moreover, Autocar and other small volume manufacturers assemble custom chassis in other heavy-duty vocational applications that are not addressed in the Memorandum, such as conventional (non-cab-over-engine) refuse trucks, concrete pumpers, street sweepers, tank trucks and sewer cleaners. Without explanation, these similar applications have been excluded from the proposed Simplified compliance scheme, and presumably require full GEM certification. This bifurcated approach will further unnecessarily burden small businesses. [EPA-HQ-OAR-2014-0827-1885-A1 p.12]

3.6 If EPA's Proposal is Used, It Must Not Allow Any Refuse Trucks to be Sold Without the Proposed Technologies. Given the questionable effectiveness of the proposed technologies to provide fuel savings to refuse truck owners (see Section 2.2.2 above), if the final regulations reflect the compliance scheme described in the Memorandum, then it is imperative that every vehicle of the same vehicle type be required to be sold with the same proposed technologies; meaning, the adoption rate of the proposed technologies must be 100%. If a customer knows it can purchase a vocational vehicle without ATIS, for example, it will find a manufacturer who will sell the truck without ATIS. That means that larger

manufacturers will have an advantage over small manufacturers, who cannot average, bank or trade credits, and that must be prevented. [EPA-HQ-OAR-2014-0827-1885-A1 p.12]

**Organization:** Daimler Trucks North America LLC

We are unable to provide meaningful input to the agencies on the proposal to allow a stripped-down GEM or to allow certification without use of GEM at all for certain types of vocational vehicles classified as “custom chassis.” The reduced procedural requirements may be beneficial to certain small or unsophisticated custom chassis manufacturers. But the primary issues are 1) whether all manufacturers, small or large, sophisticated or not, get to use the procedures and 2) what the substance of the program is, specifically, the actual emission standards. Regarding the first issue, we recommend that the agencies not create inequity in custom chassis markets by allowing some manufacturers of a type of vehicle to use a simplified procedure or meet a relaxed standard, while requiring other manufacturers of the same type of vehicle to play by other rules. Rather, it should be the type of vehicle, and not the type of manufacturer, that determines the rules that apply. Regarding the second issue, in proposing the reduced procedural burdens (e.g., at a webinar on March 22), the agencies described example standards a manufacturer might have to meet if it opted for the reduced procedural burdens (e.g., a set tire rolling resistance, Crr). It was not clear whether those standards are meant only as examples or as the actual standards, nor was it clear whether those standards are achievable by the various types of custom chassis. For example, the Crr’s were considerably lower than those on vocational vehicles built today, and it is not clear that new tire technology is being developed that will allow vocational operation while meeting the agencies’ proposed Crr’s. [EPA-HQ-OAR-2014-0827-1918-A2 p.3]

**Organization:** Navistar, Inc.

In a memorandum posted to the docket in February 2016, but not included in the NODA,<sup>3</sup> (“Vocational Memorandum”) EPA is proposing a regulatory scheme that is completely new and appears to carve out a less stringent rule for some vehicles based on the identity of the manufacturer. Even so, the proposal is only very roughly sketched out, and inadequate for meaningful comment. The NODA was an opportunity for EPA to share additional information on this portion of the rule, but the baseline, segmentation, structure, standards, and other key elements are still unknown. Although the GEM includes the technologies, it is uncertain what EPA’s stringency will be for any category, as GEM and the duty cycle weightings have changed so substantially since the NPRM. The Vocational rule covers an extremely diverse group of vehicles with hundreds of downstream equipment manufacturers. It is important that this portion of the regulation be structured correctly to ensure no adverse consequences. The custom program with a simplified GEM could provide an unlevel playing field for manufacturers.

Another key element is missing, as there is virtually no additional examination of costs as a result of this major potential change to the original proposal. The entire examination of costs is one sentence, in which EPA concludes that the average cost for custom vehicles would be less than the average for the rest of the vocational sector (presumably regulated by the proposal in the NPRM) under the scheme set out in the Vocational Memorandum. No explanation is given as to why this is the case or how this analysis was conducted. More distressingly, no explanation is given as to why this should be the case. No basis is given for dividing vocational vehicles into sectors with resultant differing manufacturing costs. As near as we can tell, the difference appears to be based on whether a company is diversified or not, although no meaningful explanation is given as to the basis for that division or any justification for the division. It appears to be a completely arbitrary distinction, between different vehicles presumably based on certain undefined aspects of the company that manufactured them, rather than the vehicles themselves. Navistar objects to such an arbitrary reclassification. This clearly has the potential to cause significant disruption in

this portion of the industry and to arbitrarily advantage some manufacturers over others. [EPA-HQ-OAR-2014-0827-1919-A2 p.2-3]

Navistar is also concerned with that the NODA did not call attention to these potentially major changes. The Memorandum, dated February 12, 2016, discussing the custom chassis was not listed in the NODA as something for which the agencies are seeking comment. It appeared in the docket on February 25, 2016, which likely means there was sufficient time for it to be listed for additional comment in the NODA. As such, it appears that the agencies are contemplating a wholesale restructuring of the vocational program, and yet not seeking comment on the key document. While the NODA did seek comment on vocational segmentation in one document, this statement by EPA itself was not highlighted. [EPA-HQ-OAR-2014-0827-1919-A2 p.3]

3 Memorandum, Vocational Vehicle Technology Packages for Custom Chassis, February 12, 2016. EPA-HQ-OAR-2014-1719. We would also note that some level of customization is extremely common among all manufacturers, diverse or not.

**Organization:** Truck & Engine Manufacturers Association (EMA)

The agencies' proposal to create separate Phase 2 Standards for seven categories of custom-chassis vehicles could result in an unlevel regulatory playing field for larger integrated manufacturers that provide non-custom chassis for the targeted vehicle applications (e.g., school buses). The agencies need to provide more details regarding this proposal to enable meaningful public comment. [EPA-HQ-OAR-2014-0827-1891-A1 p.4]

**Organization:** Volvo Group

### **Technology Packages for Custom Chassis – EPA-HQ-OAR-2014-827-1719**

#### **Volvo's Opposition To The Custom Chassis Optional Standard**

Based on the limited information available at present about the vocational vehicle program, the Volvo Group does not believe that an optional standard is warranted for small manufacturers, even if it is extended to larger OEMs. To the contrary, Volvo believes that the base vocational vehicle standards should be set such that all manufacturers can comply. This approach would also limit compliance burden, as well as provide for a level playing field. [EPA-HQ-OAR-2014-0827-1928-A1 p.12]

Under "Industry Characterization" on page 2 of the Custom Chassis document the agencies note that "it would be likely that the single-type (non-diversified) manufacturers would be able to certify their products as custom vocational vehicles, while only some of the multiple-type manufacturers (diversified) would have sufficient knowledge about, or control over, the intended use of their products to certify one or more types as custom vocational vehicles." [EPA-HQ-OAR-2014-0827-1928-A1 p.12]

This explicitly states the agencies' belief that most large OEMs would not be able to certify their vehicles to the simplified and less stringent standard, thus creating an un-level playing field that would give smaller manufacturers the ability to produce less technically complex, more reliable, and less expensive options for end-users. For this reason, the Volvo Group finds this provision completely unacceptable in its current form. [EPA-HQ-OAR-2014-0827-1928-A1 p.12]

#### **A Manufacturer's Ability To Comply Is Subject To Its Supplier's Offering**

The agencies' purpose for the custom chassis flexibility is to allow small manufacturers who cannot average over a larger mix of vehicle types the ability to meet the requirements of the Phase II GHG regulation without the need for credit averaging, banking and trading. This approach allows these manufacturers the ability to meet a simplified set of requirements, according to the agencies; however, it is not entirely clear whether this will actually be the case, as none of the targeted manufacturers produce their own components and, therefore, their ability to comply is subject to the product offering provided by their supplier base. As noted in the following section, this may result in an inability to provide a reliable and durable stop-start engine offering. [EPA-HQ-OAR-2014-0827-1928-A1 p.12]

**Response:**

At proposal the only type of vocational vehicle for which we proposed any less stringent standard was emergency vehicles. Although we asked for comments that could lead us to adopt separate standards for other vehicle types (80 FR 40294), the proposal on its face would have held all non-emergency and non-exempt vocational vehicles to the proposed standards that were predicated in part on significant adoption of a large menu of technologies that, on average, could improve the fuel efficiency of the U.S. vocational vehicle fleet by 12 to 16 percent. Thus, at proposal, we gave notice that we could finalize standards with that level of stringency and those associated costs for nearly all vehicles. If we had done so, any business that could not reasonably have applied a set of cost-effective technologies at adoption rates leading to compliance for any reason would have either had to purchase credits from a competitor or accrue a credit deficit.

During the course of the comment period and subsequent months of stakeholder outreach, we became aware that this outcome could be realized for some non-diversified manufacturers and we began to develop options with intent to prevent this. Upon careful consideration of all the comments related to vocational vehicle chassis manufacturers who produce non-diversified products, we are adopting optional standards for seven applications of vocational vehicles that we are calling custom chassis.

Although we had received informed comment regarding which technologies would not be cost-effective for each of these custom chassis in response to notice of what could be thought of as a worst-case scenario (higher costs and stronger technology packages than we intended to finalize), we decided to provide actual notice to manufacturers who build and certify chassis for these vocational applications, in the form of a memorandum to the docket along with a public web conference.<sup>179</sup> By doing so, we offered another opportunity for affected manufacturers to weigh in on the reasonableness of the direction we were moving as we responded to previous comments. Commenters are correct that the memorandum provided only draft technology packages with adoption rates, without technology-specific effectiveness values or costs. The technology effectiveness and cost values were the same as those used in the proposed rules. Using this available information, preliminary package costs and stringencies for custom chassis could have been easily estimated by stakeholders. We thus disagree with Navistar that the memorandum was inadequate for meaningful comment. In fact, as evidenced by the detailed comments from UCS and other stakeholders found in the administrative record, we received ample comment and have been able to further refine the program in response.

We agree with the commenter that if manufacturers are able to identify that a chassis will be finished as one of the vehicle applications that are eligible to certify under the custom chassis program, then they

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<sup>179</sup> See record of Webinar on Vocational Custom Chassis, March 2016, Docket ID EPA-HQ-OAR-2014-0827-1944; see also memorandum dated February 2016 on Vocational Vehicle Technology Packages for Custom Chassis, Docket ID EPA-HQ-OAR-2014-0827-1719.

should also be able to take advantage of the most appropriate fuel-saving technologies for that unique duty cycle. The optional standards for custom chassis are predicated on that exact premise.

Although the memorandum indicated that we were exploring adoption of three levels of standards with the same implementation years as the primary program (MYs 2021, 2024, 2027), we are not adopting any MY 2024 custom chassis standards in the final rules. Our reasons for this are related to regulatory stability and incremental technology improvements. First, for those small businesses that may begin in MY 2022, having a new standard in MY 2024 would only provide two years of stability between sets of standards. Second, as presented in the Preamble Section V.B.2.b.ii, there are relatively small incremental changes between MY 2021 and MY 2027 standards in terms of technologies that are within the control of the vehicle manufacturer. We appreciate the comments from OshKosh and Volvo emphasizing the point that the ability of a custom chassis manufacturer to comply is subject to the product offering provided by its supplier base. Considering that the custom chassis user inputs exclude engine data, we have established the numerical standards for both model years using default engines that meet the MY 2027 engine standard. This promotes better transparency because the incremental difference between the MY 2021 and MY 2027 numerical standard for each custom chassis subcategory is due solely to vehicle-level technologies. By comparing the values in Preamble Tables V-12 or V-13, manufacturers choosing to certify emergency vehicles, concrete mixers, motor homes, or coach buses under this optional path will see that the incremental difference in stringency between MY 2021 and MY 2027 is two percent or less, excluding the engine. Manufacturers choosing to certify transit buses or refuse trucks under this optional path will see that the incremental difference in stringency between MY 2021 and MY 2027 is five percent or less, excluding the engine. Manufacturers choosing to certify school buses under this optional path will see that the incremental difference in stringency between MY 2021 and MY 2027 is less than seven percent, excluding the engine.

Given that the GEM-based numerical standard is a target for manufacturers to meet on average, it thus does not appear worth the extra programmatic complexity to set an intermediate target with a very small incremental improvement. Even for school buses, where the incremental improvement is the largest, it does not appear to be worth the extra programmatic complexity to have one custom chassis subcategory with a MY 2024 standard where others do not.

As requested by commenters, we have estimated ranges of package costs for each of the custom chassis, and simplified cost summaries are presented in Table 7 in the Executive Summary of the RIA. The values shown below in Table 6-2 are taken from those tables. The ranges represent variations in cost that are relative to different vehicle and engine weight classes.

**Table 6-2 Incremental Costs for Custom Chassis Technology Packages**

| Regulatory Subcategory | Average Incremental Cost per Custom Chassis Vehicle Relative to Phase 1 Costs in Model Year 2021 <sup>a</sup> | Average Incremental Cost of Comparable Subcategories in MY 2021 | Average Incremental Cost per Custom Chassis Vehicle Relative to Phase 1 Costs in Model Year 2027 <sup>a</sup> | Average Incremental Cost of Comparable Subcategories in MY 2027 |
|------------------------|---|---|---|---|
| Coach Bus              | 700-900   | 900-2,600   | 1,100-1,400   | 1,500-5,700   |
| Motor Home             | 600-800   | 900-2,600   | 800-1,000   | 1,500-5,700   |
| School Bus             | 700-1,000   | 1,100-1,300   | 1,300-1,800   | 2,500-4,200   |
| Transit                | 800-1,000   | 1,100-1,300   | 1,400-1,800   | 2,500-4,200   |
| Refuse                 | 600-700   | 1,100-1,300   | 1,000-1,300   | 2,500-4,200   |
| Mixer                  | 300   | 1,100-1,300   | 600   | 2,500-4,200   |
| Emergency              | 300-400   | 1,100-1,300   | 500-600   | 2,500-4,200   |

Note:

<sup>a</sup> Diesel engine costs are included in average vehicle costs. These costs are based on our projected market adoption rates of various technologies and these costs include indirect costs via markups along with learning impacts. For a description of the markups and learning impacts considered in this analysis and how it impacts technology costs for other years, refer to Chapter 2 of the RIA (see RIA 2.11).

In response to the comment about whether the technology packages for custom chassis are feasible, we note that this comment is from Daimler, which provided sufficient information in its MY 2014 production report for the agencies to identify different vocational applications including motor homes. We have determined from these reports that of the nearly 6,000 class 6-8 motor homes certified by Daimler in 2014, they have an average drive and steer tire CRR of 6.1 kg/ton. Thus, it is reasonable that we predicate the MY 2021 Phase 2 motor home standards on adoption of LRR tires with CRR of 6.1 kg/ton and MY 2027 standards that are based on CRR improvements even slightly beyond that level.

In response to Volvo’s comment against offering an optional standard for a selection of vocational applications even if it is extended to larger OEMs, and setting a standard “such that all manufacturers can comply,” we interpret this comment to mean that the mandatory standards for all vocational vehicles should have a stringency on the order of the proposed Alternative 2. In that alternative, no transmission-related technologies would have been considered, instead the standards would have been predicated on adoption of lower rolling resistance tires, neutral idle, and axle lubricants. See Section 8.4 for responses to comments on consideration of less stringent alternatives.

In the final Phase 2 program, simplified GEM means that for some subcategories the full Phase 2 GEM is run with some input fields populated with agency defaults instead of user inputs. These defaults include the engine maps, transmission, drive axle ratio, tire revs/mile, and aerodynamic drag area improvement. In response to comments from Autocar and others, the available inputs for custom chassis have been expanded since release of the docket memo and the accompanying stakeholder outreach. In particular, manufacturers certifying vehicles to the optional custom chassis standards may now enter inputs in GEM for vehicle speed limiters, improvements over the separate hybrid PTO test, and electrified accessories, in addition to automatic engine shutdown that has since become available to all manufacturers. The simplified GEM has far more user inputs than the Phase 1 GEM, and allows for fair and reasonable

recognition of many feasible vehicle technologies with a lower certification burden than with use of full Phase 2 GEM.

We disagree with Autocar that the custom chassis standards are not achievable. With the standards being predicated on use of a different set of technologies than the standards of the primary program, the stringency is adjusted accordingly. For example, the refuse truck stringency in MY 2027 is 12 percent below the 2017 baseline, which includes a certified engine plus about six percent reductions attributable to vehicle technologies beyond the engine improvements. With the final drive cycle weightings in GEM and the characteristics of refuse truck baselines, applying neutral idle would result in reduced emissions in GEM of about 5 percent. If TPMS were added with a defined improvement of 0.9 percent, this could easily represent a path to compliance for a custom chassis refuse truck. Autocar is mistaken that the final rule mandates use of any particular technologies for custom chassis (or, indeed, any vocational vehicle), and we are not inclined to agree with their comment requesting that we mandate specific technologies on vehicles. The agencies have been promulgating performance-based standards for decades, and have found that this offers many benefits over a design-based approach, especially with respect to product variability and opportunity for manufacturer innovation. Even with excellent input from manufacturers and suppliers, we are not equipped to mandate specific technologies to be installed on any subcategory of vocational vehicles for the next decade or more. There are multiple feasible pathways for custom chassis manufacturers to attain the performance standards, even with a default driveline in GEM.

Furthermore, we disagree with Autocar that having a default driveline creates any sort of disadvantage. On the contrary, with a default driveline, vocational vehicles within a subcategory may be compared solely on the basis of the allowed user inputs, which facilitates a level playing field where some applications necessarily have features needed for vehicle utility that do not improve fuel efficiency in GEM. For example, the driveline gearing on a refuse truck may be such that its emissions over the Urban cycle could be higher than that of a typical urban work truck (See comments from Allison at EPA-HQ-OAR-2014-0827-1284-A1 p.45), putting it at a disadvantage in terms of the amount of additional technology needed to comply. In this case, having an optional standard where refuse trucks are compared on the basis of tire rolling resistance, workday idle reduction, and tire pressure systems (excluding engine, axle and transmission) minimizes any disadvantage associated with the driveline. If a manufacturer decides that the most cost-effective pathway to complying with Phase 2 is by certifying to the primary program where engine and driveline technologies may be recognized, that is an option for any refuse vehicle family in any year, for any manufacturer. Finally, the entire Phase 1 program is structured with default engines, transmissions, weight and payload where each subcategory of vocational vehicles is compared solely on the basis of tire rolling resistance. The use of defaults does not mean that vehicles are actually built similarly; rather, it provides freedom to build widely varying products without affecting regulatory status.

Use of simplified GEM as an optional certification tool is most easily justified in cases where either the typical duty cycle of the vocational application is poorly represented by any of the three final test cycles, or where we find that the default GEM vehicle characteristics are so different from real world characteristics (for example engine power to vehicle weight ratio) that use of full GEM with active simulation of actual driveline parameters would not reasonably test the effectiveness of applied technologies. Furthermore, use of a simplified GEM as an optional certification tool can also be justified where the certifying manufacturer produces small volumes of vocational chassis using a non-integrated business model where driveline optimization is not feasible and other transmission improvements would either be ineffective or not cost-effective. See Section 6.4.1 for responses to specific comments related to this issue.

In response to the comment requesting clarification on our reasons for adopting a non-GEM design standard option for motor homes, cement mixers, and emergency vehicle chassis, this is because we have

determined these vehicles have the least number of feasible technologies that can be applied in Phase 2. Emergency vehicles and concrete mixers have been determined by the agencies to essentially need only to apply low rolling resistance tires in addition to certified engines and low leakage air conditioning (i.e. stringency of the custom chassis standard for these vehicles is predicated on use of only these technologies). Motor homes have been determined to apply these technologies as well as tire pressure systems. Where a manufacturer of these vehicles is able to apply the same technology on all of its production without averaging, we offer the non-GEM option as a compliance flexibility to avoid the certification burden associated with running GEM. We were unable to identify other custom chassis technology packages that we believed could be applied at a 100 percent adoption rate; thus, averaging (and use of GEM) was deemed necessary for other vehicles.

We disagree with commenters that we need to explicitly include a large list of miscellaneous vocational vehicles in the custom chassis program. First, we have crafted definitions in the regulations that allow vehicles of similar characteristics to be reasonably certified to the custom chassis standards. For example, we would allow a bookmobile built on a motor home chassis to be certified as a motor home. Further, we believe that many of the low speed/off-road vehicles described in the above comments would likely be eligible for exclusion from vehicle-level GHG requirements pursuant to 40 CFR 1037.631. However, we agree with commenters that some of the vehicles described in the comments may legitimately have a need to travel at highway speeds or may need to conduct work that does not require an affixed component designed for doing off-road work. In response, the agencies have adopted additional flexibility whereby a vehicle partly meeting the criteria may optionally certify to the custom chassis standard established for concrete mixers.<sup>180</sup> This approach does not allow such vehicles to be excluded from applying any vehicle-level technologies, but does not require use of the full GEM certification path for vehicles where the full suite of technologies is not feasible. See Section 6.4.2 for further responses to comments on issues related to low speed/off road vehicles. Please see Section 6.4.1 below for more detailed responses to comments related to small volume manufacturers and small businesses.

In response to comments expressing concerns about the Phase 2 creating an unlevel playing field, we believe that forcing non-diversified manufacturers to certify to the primary standards that are predicated in part on use of technologies that are not universally feasible would create a disruptively unlevel playing field and potentially infeasible standards. By providing an optional path to compliance for those types of vocational vehicles that are either poorly represented by our regulatory baselines or for which reasonable technology options are severely limited, the agencies have created a regime allowing these specialized vehicles to certify based on standards most likely to result in real world benefits by setting appropriate standards. In addition, by creating this type of potential compliance path for the non-diversified manufacturers and permitting diversified manufacturers to choose this option where the end use of the vehicle is known at the time of certification, we believe we have structured Phase 2 to minimize the potential market disruptions due to this program.

#### *Technology-Specific Comments*

We believe that some custom chassis manufacturers are better positioned than others to adopt transmission technology to improve fuel efficiency. Most have little or no in-house research capacity, and purchase off-the-shelf transmissions. We agree with commenters that businesses that purchase components such as transmissions in the hundreds instead of thousands have less leveraging power and tend to pay higher prices. Some, such as Gillig and Autocar, have partnered with suppliers to successfully implement hybrids on their vehicles. Some bus chassis manufacturers are exploring the benefits of applying transmissions with additional gears. In real world driving, vehicles with a lot of transient

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<sup>180</sup> Vehicles must meet either 40 CFR 1037.631(a)(1) or 1037.631(a)(2) but need not meet both.



operation including custom chassis with urban driving patterns, can see real fuel savings from adoption of improved transmissions, including those with more efficient gears and advanced shift strategies. We expect that suppliers will continue to develop improved transmissions for vocational vehicles including some custom chassis, and that manufacturers will continue to select transmissions that deliver reliable products to fuel-conscious customers. Specifically, we believe that bus manufacturers will continue to have choices of competing products that offer performance characteristics that improve over time. However, we believe that a final Phase 2 program that is impartial to these transmission-based improvements for custom chassis will avoid adverse unintended consequences for reasons similar to those given in response to Allison's refuse example above.

Because we agree with commenters that motorcoach buses and school buses can reasonably apply transmissions with a higher number of gears (with wider spread of gear ratios), we have revised the regulations applicable to manufacturers opting to use simplified GEM to permit recognition of this technology in a simplified manner. Below in Section 6.3.3 we explain how we have addressed comments specifically related to adoption and effectiveness of transmission technologies on custom chassis.

We disagree with commenters that locking out the driveline inhibits adoption of hybrids for custom chassis. In fact, we believe it may offer an incentive in some cases. In the final Phase 2 program, all hybrid systems certified with full GEM must undergo the complete set of tests for engine mapping (including powertrain testing as applicable) and must meet OBD requirements as well. However, manufacturers certifying hybrid vehicles with simplified GEM need not undergo such testing, and where the certified configuration does not rely on functioning of the hybrid system to comply, it need not meet the hybrid OBD requirements of 40 CFR 86.010-18(q). Further, where the hybrid system includes a stop-start function, the manufacturer may select "Yes" as a GEM input for this feature and obtain reduction emissions in GEM as determined by the default engine. As a result, custom chassis manufacturers have a pathway to sell vehicles with hybrids that is similar in many ways to current practice under Phase 1, with opportunity for stop-start emissions credit without an unduly high certification burden.

We disagree with commenters that there is no allowance for weight reduction at the body builder level. The intended path to credit weight reduction is the table of lookup values for chassis components using preapproved values. However, the off-cycle approach is available for manufacturers who are able to demonstrate a lightweighting improvement over a baseline value, either on a component-specific basis or a system basis as approved. If the lightweighting for which certification credit is sought will be completed by a downstream manufacturer, the delegated assembly provisions may apply. See Section 6.3.9 for discussion of other comments on weight reduction, and Section 1.4.4 for discussion of comments on delegated assembly.

We disagree with commenters that the simplified GEM must recognize aerodynamic improvements for custom chassis. Although motorcoach buses do operate frequently at speeds where aerodynamic drag forces are strong, those vehicle bodies are so different from typical freight trucks that to improve the aerodynamics from buses, a very different set of technologies would need to be considered than the bolt-on fairings reviewed by the agencies in these rules. We imagine that some improvements could possibly be made through streamlining mirrors and redesigning frontal areas, however we have no information on the availability, cost or effectiveness of any such technologies. Thus, we have not identified any technologies likely to provide in-use benefit to coach buses, even in the primary program with full GEM. The types of aerodynamic technologies listed by the agencies as available for non-custom vocational vehicles are bolt-on fairings for which an improvement value may be entered in GEM to reduce the default drag area. Further, the default drag area in our baselines may not be reasonably similar to the drag area of a coach bus. If a coach bus or motor home chassis manufacturer were to conduct A to B testing pursuant to the test procedures of 40 CFR 1037.527, it may obtain an improvement value under the

primary program. Below in Section 6.3.10 we explain how we have addressed comments specifically related to adoption and effectiveness of aerodynamic technologies on vocational vehicles.

We disagree with claims made by commenters expressing concerns with respect to a shortfall or gap in emissions reductions between the primary vocational vehicle program and the custom chassis program. Some commenters have attempted to quantify a difference in stringency by comparing select technology packages for custom chassis described in a February 2016 memorandum with the proposed technology packages for comparable subcategories. Because most of the baseline configurations for the custom chassis are tailored for each vocational vehicle, the only vehicle types where this comparison is straightforward is school buses and motor homes. In comparing the MY 2027 stringency of the medium heavy-duty Urban subcategory with the optional MY 2027 standard for school buses, for example, it can be seen that diesel vehicles in the primary program are projected to achieve 22 percent improvement on average, while school buses are expected to achieve 18 percent improvement on average. This is nowhere near the gap posited by the commenter. The differences are due to the documented different projections of technology feasibility, which are discussed in more detail in the Preamble Section V and below in Section 6.3.

This comparison is not straightforward for motorcoaches and other custom chassis types, however, because the baselines are different and the vehicle attributes are not similar. For example, our baseline configuration for coach buses includes a 350 hp 11-liter engine with a 6-speed automatic transmission. However, the primary program includes a baseline for heavy heavy-duty Regional vehicles that is a weighted average of 95% with 455 hp 15-liter engine with 10-speed manual transmission and 5% with a 350 hp 11-liter engine with a 6-speed automatic transmission. As an example of a technology difference, we have determined that regular HHD\_R chassis may reasonably apply AES on average at a rate of 90 percent by MY 2027, whereas we find that AES is not feasible at all for a conventional coach bus. A diversified manufacturer choosing to certify a coach bus in the HHD\_R subcategory with full GEM is likely to need credits from other types of vehicles to meet the standard on average. A non-diversified coach bus manufacturer would be unlikely to achieve the HHD\_R primary program standard unless some very advanced technology is applied. Therefore we do not believe it is accurate to draw a comparison between the HHD\_R primary program stringency of 16 percent and the coach bus MY 2027 stringency of 11 percent.

#### **6.2.3.1 UCS Custom Chassis Recommendations**

**Organization:** Union of Concerned Scientists (UCS)

On May 9, 2016, UCS emailed a 15-page document to EPA with recommendations regarding the custom chassis program, with the following introductory paragraph; “Our analysis of the proposal indicates that in the form outlined in the memo included in the docket, this provision would significantly undermine the vocational vehicle program under the medium- and heavy-duty vehicle standards. Furthermore, our analysis of the technology available to these vehicle classes indicates that even these specialized vehicles would be capable of achieving the average vocational vehicle standard by 2027. Therefore, we recommend that any provision focused on custom chassis be focused on small business considerations with an appropriate volume cap, preserving the integrity of rule while recognizing the complexity of the vocational vehicle market.” This comment document is available in the docket.<sup>181</sup>

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<sup>181</sup> See UCS Custom Chassis Recommendations, May 2016

**Response:**

We appreciate the thoughtful comments from UCS on custom chassis. While we have several areas of disagreement, the industry characterization with respect to manufacturers, vehicle miles traveled, and sales volumes are significant contributions to the record for this rule. We are not directly responding to the aspects of this comment document where UCS estimated percent reductions, emissions in grams per ton-mile and metric tons, or perceived “shortfalls” (other than select examples above). This is because the final Phase 2 GEM, including duty cycles, final technology packages, and other program revisions since the time of the NODA have rendered such comparisons no longer relevant. We appreciate that UCS offers these comments in the spirit of helping to answer the questions of what a reasonable cost-effective technology package might be, and whether market constraints prevent companies from competing effectively where some lack an ability to average (UCS page 1). Although we have strengthened the custom chassis program in many ways in response to compelling comment, we have not seen persuasive evidence that any of these vehicle types should be excluded from the custom chassis program.

*School Buses*

- We agree with UCS on stop-start. The 30% adoption rate on which the final (optional) standard is predicated is what UCS recommended and is more than the 15% penetration rate set out in the memo. Custom chassis may select ‘Yes’ in GEM for neutral idle where a DCT is installed. Also, we are including a 70% adoption pathway of AES.
- We disagree on aero. NREL found that operating patterns associated with school buses have low average speeds with frequent stops and high amounts of zero speed time, which is not consistent with driving patterns associated with vehicles likely to benefit from aerodynamic improvements. This is noted by UCS in its comment on page 4. If a bus OEM has a customer that intends to use these in a regional driving pattern and wants to get credit for aero they may elect to certify to the primary program.
- We disagree on weight. The bus OEMs submitted comment cautioning us against predicating the standard on weight reduction due to constraints of safety standards. If a bus OEM uses lightweight wheels, this may be included as part of a compliance strategy.
- We partially agree on transmissions:
  - Although we disagree that we should predicate the standard on use of DCT, one of the benefits of current MHD DCT is the wide gear spread offered by 7 forward gears. We have finalized a path to partially recognize the benefit of transmissions with additional gears, using a fixed technology improvement and an adoption rate of 15%.
  - We disagree that shift strategy/integration is feasible for these. Sales volume is not a sufficient criterion for deciding if this is feasible. It would take a business partnership between the engine OEM and transmission supplier to develop the integrated product, who would then sell it to the independent chassis manufacturer. Although these buses may seem to be high volume compared to some other types of custom chassis, this is still a niche market.
- We disagree with the suggestion to predicate the standard on use of natural gas or downsized engines. We did not even predicate the primary vocational vehicle standards on either of these technologies. See Section 12 for responses to comments on natural gas. See Sections 3 and 4 for discussion of downspeeding for engines and tractors.
- Although we have several areas of disagreement with UCS, we have made the final standards for school buses more stringent than first presented in response to compelling comment, including a simplified method for recognizing transmission technology, increasing adoption of stop-start in

the projected compliance pathway, and including 70% adoption of AES. These buses now have the most stringent of all the custom chassis standards.

#### *Transit Buses*

- We partially disagree on idle. Although we are applying an adoption rate of stop-start at 30% in the FRM (less than the 50% requested), this is the same as in the primary program for MHD-Urban and is more stringent than the 20% in HHD-Urban. Transit bus is the only subcategory where adoption of drive idle reduction technologies (neutral idle plus stop-start) add up to 100%.
- We partially agree on weight. We disagree that the package should be 2,000-3,000 lbs. That would involve components beyond the chassis for which we do not have data. The same lightweighting package that is considered as part of the primary program standards is now applied for transit buses in the final rules. Where a bus OEM wishes to gain credit for lightweighting a component that is not listed in our regulations, it may apply for off-cycle credit.
- We disagree that we should predicate the standard on use of 10-speed automated manual transmissions. AMT are generally not suited for urban applications, and as noted above, most transit buses service urban routes. Express commuter buses may drive in regional patterns; however, the bus OEM's have told us that they do not design buses differently for these applications (essentially most are designed to be multi-purpose) because transit authorities may re-assign any bus on any day to a different route.
- We have altered the axle configuration in the baseline as recommended by UCS, so that transit buses in the custom chassis program will have their performance measured against a reference vehicle with a 4x2 axle configuration, rather than a 6x4 axle (UCS Note 16, page 5).
- We note with interest that commenter does not recommend including hybrids in the stringency of the standard for transit buses. We support this conclusion, although from a pure cost effectiveness perspective, hybrids appear equivalent to lightweighting. According to the source that UCS cites (TIAX 2009), the cost of UCS' recommended 3,000-lb lightweighting package is on the order of \$30,000.<sup>182</sup> TIAX estimates this could provide three percent fuel efficiency benefit. TIAX also reports that unsubsidized costs of hybrid systems for transit buses are on the order of \$200,000, likely providing at least 20% fuel efficiency. Both of these technologies thus fall in the range of \$10,000 per percent improvement. By contrast, none of the technologies projected as part of the compliance pathway in the final rules for the primary Phase 2 vocational vehicle program exceed \$3,000 per percent improvement.
- We disagree with the UCS claim that a sales cap of 200 vehicles per year would cover 80 percent of this market. Gillig certified over 1,700 class 6-8 vehicles in MY 2014.
- Although we have several areas of disagreement with UCS, we have strengthened the transit bus standards in response to compelling comment, including addition of modest weight reduction and defining a more representative baseline. With the improved baseline and more stringent standards, the opportunity for windfall credits is reduced.

#### *Coach Buses*

- Although we disagree that we should predicate the standard on use of AMT, commenters provide compelling evidence that applying transmissions with more than 6 gears can be a cost-effective

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<sup>182</sup> See Table 3-7 of TIAX 2009, indicating a cost of \$10/lb for lightweighting packages over 2,000 lb.

technology for these vehicles. We have finalized a path to partially recognize the benefit of transmissions with additional gears, using a fixed technology improvement and an adoption rate of 15%.

- Although coach buses do have regional driving patterns, as noted earlier in this response, we are not convinced that the bolt-on technologies identified for box trucks could be feasible for buses. If a coach bus manufacturer wants to get credit for aero, it may elect to certify to the primary program and conduct A to B testing to demonstrate a fuel efficiency improvement.
- We partially agree on axles:
  - We have altered our baseline as recommended by UCS, so that coach buses in the custom chassis program will have their performance measured against a reference vehicle with a 6x2 axle configuration, rather than a 6x4 axle (UCS page 7).
  - We disagree that we should predicate the standard on use of a lower numerical axle ratio. We have not applied downspeeding in any of the primary vocational vehicle standards.
- We wish to note an omission in the industry characterization for coach buses. Although the chassis manufacturers are large businesses, some coach buses are foreign-made and the importers are small businesses. These importers have a great deal of responsibility in the certification process, and the burden on them should not be ignored.
- Although we have several areas of disagreement with UCS, we have strengthened the coach bus standards in response to compelling comment, including use of a simplified method for recognizing transmission technology and defining a more representative baseline. With the improved baseline and more stringent standards, the opportunity for windfall credits is reduced.

#### *Refuse Trucks*

- We disagree that we should predicate the standard on transmissions with more than 6 gears. Refuse trucks with neighborhood collection routes may rarely use a 6<sup>th</sup> gear, and would not see real world benefits from additional gears.
- Although we agree that weight reduction is feasible for refuse trucks, we see this as simply regulating the status quo. As noted by OshKosh in its comments on weight reduction (see 6.3.9 below), less weight is a huge market driver in the refuse sector. However, we have not concluded that lightweighting has occurred to such an extent that it should be considered in the vocational vehicle Phase 2 baseline.
- Disagree on Axles: We disagree that we should predicate the standard on use of a lower numerical axle ratio. We have not applied downspeeding in any of the primary program standards.
- Disagree on idle: in response to other compelling comment, we have reduced the adoption (i.e. projected technology penetration rate on which stringency is calculated) of stop-start from 50% in the memo to 20% in the FRM. This is now the same adoption rate as for HHD Urban vehicles in the primary program. Because we believe it is appropriate to offer a PTO over-ride for stop-start systems, and many refuse trucks use PTO to compact while driving, a relatively small fraction of refuse trucks are likely to see real world benefits from stop-start systems that are not part of a strong hybrid or enhanced stop-start system that offers e-PTO function.
- We disagree with UCS comments with respect to Autocar. Although we note Autocar's comments that indicate their annual sales have a 5-year average of over 50% of vehicles with advanced drivetrains including natural gas and hybrids, we disagree that an annual sales cap of 200 would provide any degree of flexibility for Autocar's conventional vehicles. First, a 5-year average of 50 percent could still mean that in any single year less than 10 percent of their 2,000

refuse trucks had advanced drivelines. Further, prior to producing vehicles (when certification occurs), Autocar will not know how many will actually be sold; they may simply know if they plan to certify one family in the primary program and one family in the custom program. For these reasons and others as outlined in Section 6, we disagree that refuse trucks should be forced to certify in the primary program, and we disagree that a sales cap is appropriate for custom chassis refuse trucks.

- Based on compelling comment from manufacturers, we have relaxed the refuse truck standards including less projected penetration of stop-start and ATIS.

#### *Motor Homes*

- Disagree on transmissions: With a regional drive cycle and very low annual miles driven, we do not agree that adopting advanced transmissions (such as 7-speed DCT as suggested by UCS) for motor homes would provide any benefit to the vehicle owner.
- Disagree on aero. Although motor homes do have regional driving patterns, we are not convinced that the bolt-on technologies identified for box trucks could be feasible for RV's. If a manufacturer wants to get credit for aero, it may elect to certify to the primary program and conduct A to B testing to demonstrate a fuel efficiency improvement.
- We have considered UCS' recommendation to differentiate between Class A, B, and C motor homes. We agree that Class A vehicles have many similarities with coach buses, although the VMT is much smaller and they tend to be manufactured in very small numbers, some less than 100 per year. However, we believe the UCS industry characterization of Class B and C motor homes is in error with respect to the manufacturers of these vehicles. The certifying chassis manufacturer is generally not any of those listed; rather, it would more likely be Ford, Daimler, or Spartan. Because our final custom chassis regulations require that the certifying entity identify the vehicle type up front, we believe this presents a challenge for large diversified manufacturers. Because we believe that the motor homes sold by large diversified manufacturers could reasonably apply the same technology package as those sold by specialty manufacturers, we expect that these could be credit-using vehicles in large diversified fleets where manufacturers are unable or unwilling to track this production separately. Although it was not our intention to disadvantage large businesses, we believe it is acceptable in that having this flexibility be less accessible by large manufacturers than small businesses is protective of the environment.

#### *Cement Mixers*

- Although we agree that weight reduction is feasible for cement mixers, we see this as simply regulating the status quo. As noted by OshKosh in its comments on weight reduction (see 6.3.9 below), less weight is a huge market driver for cement mixers. However, we have not concluded that lightweighting has occurred to such an extent that it should be considered in the vocational vehicle Phase 2 baseline.

### **6.3 Projected Vocational Vehicle Technologies, Effectiveness, and Cost**

#### **6.3.1 General Comments about Vocational Technologies**

**Organization:** California Air Resources Board (CARB)

CARB staff notes that stop-start and transmission market penetrations are significantly affected by a switch from Alternative 3 to Alternative 4. However, these technologies are either already starting to penetrate the vocational marketplace or have prototypes and demonstrations in place as of today; therefore, CARB staff views the nine years of lead time until 2024 as ample time to meet the penetration goals that U.S. EPA and NHTSA have proposed.

**Organization:** Natural Resources Defense Council (NRDC)

Additional analysis by UCS describes opportunities for fuel consumption reductions with transmission improvements and aerodynamic device applications among regionally-operated vocational vehicles. When considered along with improvements to diesel and gasoline engines and hybrid effectiveness, the UCS analysis finds that vocational vehicles can reduce fuel consumption and emissions by at least 20 percent, a significant gain from reductions in the proposal of up to 16 percent.<sup>15</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.6] /15/ Analysis presented in UCS comments to the proposal.

**Organization:** Union of Concerned Scientists (UCS)

As illustrated below (Table 5), the current levels of stringency can be met entirely with conventional technologies, which is inconsistent both with the agencies' proposed pathway and their obligation under the Clean Air Act and Energy Independence and Security Act to set technology-forcing and maximum feasible standards, respectively. The agencies must therefore increase the stringency of the regulations. [EPA-HQ-OAR-2014-0827-1329-A2 p.19]

Diesel-powered vehicles can be improved by 20.6 percent over the Phase 1 baseline (compared to an NPRM value of 15.8 percent). Gasoline-powered vocational vehicles can be improved by 21.9 percent over the Phase 1 baseline (compared to an NPRM value of 13.4 percent).<sup>2</sup> [EPA-HQ-OAR-2014-0827-1329-A2 p.19] [Table 5, 'Recommended Vocation Vehicle Technology Penetration and Effectiveness in 2027', can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

**Organization:** CALSTART

We believe vocational segments could cost-effectively accommodate higher efficiency than is proposed and could be prime segments for some advanced technology implementation [EPA-HQ-OAR-2014-0827-1190-A1 p.1]

Because of the simplified structure of the Phase 1 regulations and the shorter lead-time, most advanced technologies, including strategies such as hybrid, plug-in and electric powertrains important to the NO<sub>x</sub> emissions strategies of such regions as California, were not included to set the stringency of the rule. In the Alternative 3 proposed for Phase 2, the agencies assume for the assessment calculations that some advanced technologies will penetrate the medium- and heavy-duty truck fleet in the timeframe of the rule, notably start-stop systems and some hybridization. [EPA-HQ-OAR-2014-0827-1190-A1 p.3-4]

Some of the technology that could provide greater efficiency and carbon reductions – such as plug-in hybrid and electric systems – will likely not be needed at current stringency targets, even though they are critical to goals in California and some other regions. These technologies can provide payback in the correct applications already identified in the Phase 2 segmentation approach; and these technologies, in their second generation and dropping in price, can provide life cycle paybacks to fleets that fall within the agencies' assessment framework. [EPA-HQ-OAR-2014-0827-1190-A1 p.9-10]

However, we are very concerned that the vehicle segments most conducive to these technologies, such as urban vocational, are the ones whose stringency levels are least likely to drive their use. Feedback we have received from multiple suppliers developing such technology is that they share this concern: the proposed stringency will not require their use. While we support the agencies' performance-based rules and technology-neutrality, the issue being raised here is not the need to drive any one technology, but rather the fact that achievable reductions are being left off the table. Interestingly, in discussions with suppliers about what mechanisms, including rule credit tools, could most help them bring such technology forward, most strongly felt higher stringency was what would most effectively "pull" their technology forward. Indeed, they believe credits are meaningless in the absence of any need for their use, which is driven by greater reduction requirements. [EPA-HQ-OAR-2014-0827-1190-A1 p.4]

**Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 242.]

By contrast, we feel that vocational cost targets are reasonable because the weight scalings become a more significant factor there.

**Organization:** Environmental Defense Fund (EDF)

We recommend that the agencies set more rigorous standards for vocational vehicles that meaningfully encourage advanced technologies like hybridization and electrification. The vehicle standard should be strengthened by reflecting the innovation of these manufacturers and recognizing transmission improvements possible in the timeframe of the standards [*as well as many technologies extracted from this comment and placed elsewhere*]. If all of these technologies are combined, the standards could be improved by about 7%.<sup>166</sup> A robust vocational vehicle standard in 2027 would provide plenty of lead-time to develop and test these advanced technologies. [EPA-HQ-OAR-2014-0827-1312-A1 p.38]

**Organization:** Navistar, Inc.

As discussed in the sections above, the assumptions that underlie the feasibility for vocational emission standards in the Proposed Rules are extremely optimistic. We have significant concerns regarding the assumed technology packages and penetration rates underlying the emission standards for vocational vehicles. As noted, there are entire applications for which there will be virtually no adoption of certain technologies. Refuse trucks and cement mixers simply cannot stop the engine during their operations. To assume any penetration in those applications is incorrect. [EPA-HQ-OAR-2014-0827-1199-A1 p.40]

Beyond that, the NPRM and RIA do not clearly identify the necessary steps in the technology development nor do they identify why the agencies believe that these technologies will be ready in the time allotted. The absence of this information is particularly notable in light of the additional uncertainties that come with the lack of clarity in this Proposed Rule stemming from the baseline changes and model year start date differences between vehicle and engine. [EPA-HQ-OAR-2014-0827-1199-A1 p.40]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The agencies' assumed penetration rates for hybrid powertrain systems are unrealistic. Manufacturers also question whether neutral-idle systems can be deployed at the agencies' assumed rates, and, if so, the adverse impact they will have on vehicle and engine component wear. Similarly, there are questions and concerns regarding the application of stop-start systems in HHD vehicles, including the deterioration of



certain components, the availability of other systems to maintain cabin comfort and starter systems, and various OBD implications. Vocational vehicles also cannot effectively utilize 6x2 axle configurations given the vehicles' need for traction and operation in tight spaces. In fact, almost all of the agencies' foundational premises and methods for establishing the proposed vocational vehicle standards are flawed. [EPA-HQ-OAR-2014-0827-1269-A1 p.31]

**Organization:** Motiv Power Systems

The agencies have made significant improvements compared to the MY2014-2018 standards, particularly in providing additional market segmentation options that reflect a larger share of transient operation as well as the addition of an idle-only cycle. These changes to the regulatory test cycles better reflect the diversity of the vocational fleet and the duty cycles of our customers and will help identify the appropriate technology solutions for reducing fuel use from this sector. [EPA-HQ-OAR-2014-0827-1184-A1 p.1]

Nonetheless, there are several modifications that should be made to the proposal to more effectively incorporate hybrid and plug-in powertrains in the future vision of the medium- and heavy-duty truck sector, thereby more significantly reducing oil consumption and greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1184-A1 p.1]

The agencies' pathway to meet the standards under the preferred alternative underestimates the potential reductions from conventional technologies, particularly integrated powertrains, which are most advantageous in transient operation. It also underestimates the potential reductions from hybrids—fleets often achieve levels of reduction exceeding the approximately 25% effectiveness assumed in the agencies' analysis of hybrids on the GEM certification cycle. And, finally, the agencies have completely excluded plug-in electric technologies in the preferred alternative. Underestimating the potential reductions from the vocational vehicle fleet across the board has thus led to a stringency level that is significantly lower than what the industry can achieve in the timeframe of the rule. Motiv, in particular, plans to have thousands of all-electric vocational vehicles on the road within the timeframe of this rule, and without greater stringency in the vocational vehicle segment, there will be no value to the credits these vehicles could otherwise generate. As shown with Tesla, credits for zero-emission vehicles can be a major influencing factor in the market development of clean, zero-emission technology because they allow for some re-capture of the benefits provided by these vehicles to the general population. [EPA-HQ-OAR-2014-0827-1184-A1 p.1]

The conservative target in the agencies' preferred alternative can be met purely with conventional technology. However, advanced technology vehicles are available today and should see a continued growth in market share as component prices fall and fuel price volatility continues to remain a fleet concern. The proposed rule, as currently crafted, misses an opportunity to fully capitalize on the oil and emission reductions that our technologies offer by not appropriately accounting for these technologies in the overall stringency of vocational vehicles. Therefore, the stringency of the vocational vehicle standard should be increased by at least 20% or more to help ensure the investments needed for moving beyond incremental improvements to conventional technology and promote the adoption of advanced alternative powertrain vehicles. Furthermore without increased stringency, the effectiveness of advanced technology credits is severely limited as there isn't a market for such credits when the standard is easily obtainable. Without stricter regulations driving investment and innovation, only incremental improvements will be captured despite the potential for broad emission reductions. [EPA-HQ-OAR-2014-0827-1184-A1 p.2]

**Organization:** Oshkosh Corporation

**Vocational Vehicle GEM Inputs are Too Optimistic**

The Phase II NPRM suggests a laundry list of items in Table V-17 through V-19 that manufacturers would use to meet the more stringent vehicle standards. EPA suggests that there may be additional technologies, but we believe that if there were viable and practical additional technologies, they would already be on the list. The fact is that major improvements to basic heavy duty vehicle components take a long time and significant funding to develop. The components required to transfer rotating power from an engine to the road have not changed significantly, in part because the laws of physics have been well understood for many years. Unlike engine improvements where advanced controls can be applied to a combustion cycle, the nature of gears, shafts, and bearings do not lend themselves to revolutionary change. [EPA-HQ-OAR-2014-0827-1162-A2 p.3]

Heavy duty vocational vehicles provide essential services hauling heavy loads at moderate speeds and in mixed on/off highway conditions. Vehicle configurations are not conducive to aerodynamic improvements, and low production volumes relative to line-haul vehicles limit the incentive for component suppliers to invest in improvements. It is clear that idle reduction technologies cannot be used in many vocational vehicles where the engine is needed to continue ancillary equipment operation even when the vehicle is stopped. Large Allison transmissions used in these applications already incorporate electronic controls and torque convertor lock-up technologies. We therefore urge EPA to limit Phase II vocational vehicle mandates to those improvements that can be gained from the engine alone. If significant improvements in the efficiency of other major components such as transmissions or axles become available over the next decade, then further regulation can be considered in Phase III. [EPA-HQ-OAR-2014-0827-1162-A2 p.7]

**Response:**

The agencies have established final vocational vehicle standards that carefully evaluate and balance the competing views of the commenters on the issue of how strongly to promote advanced technologies. In the subsections that follow, we describe how we have strengthened the final standards in a robust way that is supported by a strong technical analysis and relies partly on adoption of mild hybrid systems, although the technology path we identify to achieve each standard is only one of many paths that may be chosen by manufacturers. As discussed in Section 6.2.2 above, we are not setting the same average percent stringencies for each subcategory as was proposed, and thus projected improvements in the Urban subcategories are generally greater than in Regional or Multipurpose (albeit from a higher-emitting baseline). This should establish a strong regulatory driver for technologies that perform best over this cycle. In addition, we have made revisions in response to comments that we believe have lowered some barriers to entry for manufacturers of developing technologies, including clarifications on obligations of secondary manufacturers (See RTC Section 1.4), improvements to test procedures for hybrid systems (see Section 2.4), and special provisions for some types of hybrid systems to have a lower hurdle in terms of OBD compliance (see Preamble XIII.A.1). Further, in addition to the final standards being more stringent than proposed, we are adopting larger advanced technology credit multipliers than the Phase 1 multipliers (See Section 1.4). We also note that for many vocational chassis manufacturers this Phase 2 program represents the first time they have been regulated (such as for small businesses). Even those who are complying with Phase 1 using a single off-the-shelf technology may need to plan for significant changes to meet the Phase 2 performance standards. In view of these factors, we have determined it would not be reasonable to adopt more aggressive standards than those in the final rule. See Section 6.3.3.3 for responses to comments specifically on hybrids, Section 6.3.6.1 for responses to comments on zero-emission vehicles, and Section 6.3.6.3 for responses to comments on plug-in hybrid PTO systems.

Regarding the specific comment about cement mixers and refuse trucks not being able to turn off their engines, we are adopting allowable over-rides for AES and stop-start technologies that include PTO operation. In the HHD Urban subcategory the projected adoption rate of AES in MY 2027 is only 70 percent recognizing that some heavy urban vehicles will encounter too many over-ride conditions to make

this technology feasible. For similar reasons, this subcategory has an adoption rate of stop-start in MY 2027 of 30%. This recognizes that the development of stop-start technology by MY 2027 is not expected to have progressed to an extent that it will be acceptable to the majority of owners whose vehicles are classified in this subcategory. Further discussion of on idle reduction is located in Section 6.3.4.

### **6.3.2 SI Vehicle Standards**

**Organization:** Daimler Trucks North America LLC

**Baseline SI Vocational Engine and Vehicle Performance** - The agencies commented on the simplified manner in which the agencies set the HHD SI-powered vocational vehicle standards and requested comment on the merits of developing separate baseline levels and numerical standards for HHD vocational vehicles powered by SI engines, including any benefits that could be obtained by establishing a more representative baseline in order to avoid the risk of orphaning an SI vocational vehicle. 80 FR 40305. We share the agencies' concern about an orphaned vehicle. The SI-powered HHD vehicles are generally low volume, low cost products for limited applications. Too stringent a standard could drive such vehicles out of the market, leaving low cost buyers to keep old vehicles in service much longer than they would have otherwise. We would be happy to work with the agencies in a confidential setting to characterize our current SI-powered products so that the agencies can develop a baseline. [EPA-HQ-OAR-2014-0827-1164-A1 p.76]

**Response:**

The agencies are not finalizing any HHD SI vocational vehicle standards. In response to comments expressing concern about orphaned vehicles as well as concerns about mismatched engine and vehicle useful life, we are finalizing six subcategories for SI vocational vehicles: three LHD and three MHD. Where a manufacturer wishes to certify a SI vocational vehicle with a GVWR over 33,000 lbs, the final regulations allow that vehicle to be certified in one of the MHD subcategories. Please see Section 1.4 for further discussion of comments related to mismatched engine and vehicle useful lives. Please see Section 3.3.2 for the agencies' response to comments on the stringency of the separate SI engine standard. See further information on SI engines in vocational vehicles in the Preamble at Section V.C.1 b, and in the RIA Chapter 2.9.1.2.1.

### **6.3.3 Transmission Technologies**

**Organization:** Allison Transmission

#### **EPA and NHTSA Should Account for Secondary Shift Schedules**

In the Proposed Rule, EPA and NHTSA have identified the final drive ratio as a possible attribute that could be used to identify how a vocational vehicle is intended to be used and hence, what regulatory subcategory the vehicle would be assigned to. The Proposed Rule provides that vehicles will be certified over the Multipurpose Duty Cycle, unless certain conditions warrant its certification under the Regional or Urban Cycles. One element of this determination (Equation V-1) is axle ratio (the drive ratio entered into GEM) another element is the transmission ratio, or the ratio of the top transmission gear that is not permanently locked out. [EPA-HQ-OAR-2014-0827-1284-A1 p.44]

Allison produces ATs that can program two distinct shift schedules into the Transmission Control Module ("TCM"). This is used to limit top vehicle speed in specialty vehicles during part of its normal operation. Consequently, this also raises the issue with respect to how vehicles that utilize such transmissions should

be classified. For example, Allison transmissions are widely utilized in dual station refuse trucks. Side load dual station refuse trucks have the ability to be driven from either the right or left sides, depending on the needs of the route. The left hand drive is used when driving the truck to or from the refuse pickup neighborhood. Once the truck reaches the neighborhood, the operator will switch to the right hand side drive. This allows the operator to closely line the truck up with the trash can and the side loader will automatically pick the can up and dump it in the truck. [EPA-HQ-OAR-2014-0827-1284-A1 p.44]

Since it is desirable to not allow these trucks to be driven at high speed on the road from the right hand station, the transmission for these vehicles is calibrated to limit the vehicle to a maximum of 3rd gear while the right hand station is active. When the left hand drive station is active, the transmission is calibrated to allow the transmission to be a 6-speed. In 2015, Allison is on pace to sell over 2500 transmissions configured in this manner. Although the primary use of secondary shift schedules is found in refuse trucks, Allison is also aware of this capability being used in concrete mixers and some airport emergency vehicles. Over the timeframe of this rulemaking, it is also possible that other uses could emerge. If one of the criteria to decide a vehicle's regulatory subcategory is based on which top range is used most often, then the Proposed Rule would appear to require use of 3rd gear. With a 3-speed shift calibration, however, these vehicles would be assigned to the Urban classification. However, the Urban duty cycles are not consistent with the usage of the vehicle when not in the residential neighborhood. A 3 speed calibration will likely not be able to reach 55 mph. And, the top speeds of the transient portion of the cycle are significantly above the typical maximum operating speed in this mode. The result is the GEM determined CO<sub>2</sub> metric will be unrealistic and significantly above the standard. [EPA-HQ-OAR-2014-0827-1284-A1 p.44-45]

Below is a chart that depicts how refuse trucks built in May and June of this year would fare with the current version of GEM. A refuse vehicle configured with an Allison 4500 Wide Ratio, 0.49 Loaded Tire Radius, 4.30 Axle Ratio and 6 speed calibration would be classified as Multi-Purpose. The GEM run for this configuration results in 217.6 gCO<sub>2</sub>/ton-mile. With the 2021 regulatory standard of 200, this configuration is 17.6 gCO<sub>2</sub>/ton-mile above the standard. That same vehicle with a 3 speed calibration, however, would be classified as Urban. The GEM run for this configuration results in 252.6 gCO<sub>2</sub>/ton-mile. With the 2021 regulatory standard of 198, this configuration is 54.6 gCO<sub>2</sub>/ton-mile above the standard; it would be impossible for other improvements to the vehicle itself to overcome this deficit. [EPA-HQ-OAR-2014-0827-1284-A1 p.45]

[Chart, 'Refuse Vehicle Evaluation - 6 speeds vs. 3 speeds', can be found on p.46 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

To address this situation, Allison would recommend that where there are vehicles with significantly different shift schedules between primary and secondary modes, EPA and NHTSA should provide a regulatory exception. Specifically, such vehicles with top gears greater than 1:1 would be classified via the calibration with the lowest gear ratio (highest speed) regardless of the predominance of which shift schedule is used most often. [EPA-HQ-OAR-2014-0827-1284-A1 p.46]

**Response:**

The method of assignment to subcategories in the final rules is not a function of final drive ratio as was proposed. The examples of vehicles using secondary shift schedules in the comment are concrete mixers, emergency vehicles and refuse trucks. As stated above in 6.2.3, one reason the agencies are adopting optional standards using simplified GEM is for cases where the typical duty cycle of the vocational application is poorly represented by the final test cycles, especially for non-diversified manufacturers. We believe that the examples given by the commenter fit this reasoning. If a manufacturer certifies a vehicle with a secondary shift schedule to the primary Phase 2 standards using full GEM, it may be to the

manufacturer's advantage to conduct powertrain testing. If a regular transmission input file is used instead of powertrain testing, GEM should be run using a transmission input file with all the available gears of the shift schedule that is expected to be engaged for the greatest driving distance. This is consistent with the final regulations for vehicles with two-speed axles. The regulations also include a provision where in unusual circumstances, a manufacturer may ask to submit weighted average results of multiple GEM runs, as an off-cycle credit, to represent special technologies that no single GEM run can accurately reflect.

### **6.3.3.1 Architectural Improvements**

**Organization:** Truck & Engine Manufacturers Association (EMA)

The agencies also have failed to account properly for the use of AMT instead of manual transmissions in vocational vehicles. More specifically, GEM is not currently configured to treat AMT any more favorably than a manual transmission system. This is at odds with the agencies' representations and efficiency projections in the NPRM. (See 80 FR at 40297). It is also unclear whether (and why) the agencies are assuming that the use of AMT will require that a vocational vehicle be placed in the "Regional" category. This is another example indicating that the agencies' Phase 2 program for vocational vehicles may not be sufficiently developed to be included in any final rule. [EPA-HQ-OAR-2014-0827-1269-A1 p.31-32]

**Organization:** Allison Transmission, Inc.

EPA has noted that adding two gears (e.g., an 8-speed AT vs. a 6-speed AT) is expected to have better fuel economy than the current transmissions.<sup>68</sup> While you can just add additional ranges within the current gear ratio spread of a 6-speed transmission, a larger improvement can be achieved by increasing the total ratio spread of the 8-speed configuration. Allison configured an 8-speed transmission with a reasonably larger ratio spread, an appropriate engine and an appropriate axle ratio that would maintain equivalent vehicle performance.

**Organization:** Allison Transmission, Inc.

EPA and NHTSA lack a rational basis to provide more credits to automated manual ("AMT") and dual clutch transmissions ("DCTs") than fully automatic transmissions. Allison's real world studies indicate that automatic transmissions ("ATs") are as good as or better than AMT or DCTs in terms of greenhouse gas emissions and impact on fuel efficiency in most vocational applications and many tractor applications. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

While the agencies have made considerable efforts to determine the costs of various technological pathways, there are unfortunate errors of such a magnitude so as to affect EPA and NHTSA's evaluation of how soon a technology may be reasonably projected to be integrated into the medium- and heavy-duty market. For example, in the RIA for this rulemaking it is indicated that "[f]or vocational heavy HD regional vehicles, we have estimated the cost of a [dual clutch transmission ("DCT")], relative to a manual transmission as being equal to the move from a manual transmission to an AMT or \$3694 ([Direct Material Cost ("DMC")], 2012\$, in 2018, see 2.12.3.2 above)."<sup>21</sup> Allison believes this cost estimate is not correct. The DMC for a DCT in tractors in 2018 is \$12,676.<sup>22</sup> Allison believes this is a more realistic estimate for Class 8 vehicles. For other vehicle classes, the DCT's DMC is considered to be equal to the AT. Furthermore, the Volvo I-Shift DCT is substantially heavier and longer than the I-Shift AMT.<sup>23</sup> Therefore, even if all other factors are ignored, the costs would be higher just due to the weight and size increase. [EPA-HQ-OAR-2014-0827-1284-A1 p.13]

EPA and NHTSA have requested comment on “all aspects” of the feasibility analysis that underlies the regulatory alternatives presented in the Proposed Rule. With respect to the projections of the relative emission impact of various transmission technologies, the agencies are proposing a 2% technology input for ATs, AMTs and DCTs for Class 7 and 8 vehicles. While Allison ATs can exceed this level (versus the baseline contained in the Proposed Rule) we believe it is a reasonable level to apply based on the record for this rulemaking for ATs and AMTs. Moreover, we do not believe that EPA and NHTSA have articulated any basis in the Proposed Rule to differentiate between the technology inputs that should be available to ATs and AMTs.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.16][This comment can also be found in section 4.3 of this comment summary]

The Proposed Rule includes a 2.3% emission reduction credit for Class 8 vocational vehicles that are certified with the regional duty cycle if these vehicles include an AMT or DCT. ATs that are used in the same vehicles, however, would not qualify for any emission reduction credit. EPA and NHTSA do not have sufficient data or information in the record for this rulemaking to support this differential treatment between AMTs and ATs and, further, do not have any basis to grant DCTs a 2.3% credit since there is no data or technical assessment which supports such a credit. [EPA-HQ-OAR-2014-0827-1284-A1 p.17]

Although the basis for this difference is not entirely clear in the Proposed Rule, since AMTs and MTs share the same architecture Allison assumes that the 2.3% credit is due to the “automation” (i.e. consistent shift speeds) of the AMT transmission when compared to the MT transmission baseline. Allison ATs, however, control shifts in a consistent manner similar to an AMT and thus would result in at least the same or greater reductions in CO2 emissions. Moreover, while there are efficiency differences between an AMT and an AT, these differences are already captured in the GEM simulation model. [EPA-HQ-OAR-2014-0827-1284-A1 p.17]

**Organization:** Eaton Vehicle Group

Phase 2 does not prescribe technology and provides a flexible structure that allows OEM's to use advanced powertrains, and their significant potential to save fuel, for regulatory compliance. Eaton believes that deep engine-transmission integration, Dual Clutch Technologies and ultra-efficient transmissions are cost-effective methods to save fuel and achieve compliance, without adding the weight, cost and complexity common to some new and/or un-tested technologies. Technologies available to the market today are only partially accounted for in the pathways to compliance and cost analysis. We believe that they offer OEMs increased flexibility to achieve the standards in the NPRM without any significant additional cost, thus reducing the technology and reliability risks required to comply with the proposed standards. [EPA-HQ-OAR-2014-0827-1194-A1 p.5][This comment can also be found in section 4.3 of this comment summary]

**Organization:** GILLIG LLC

The agencies have placed considerable emphasis on continuous improvements in transmission technology in setting the standards for 2021, 2024 and 2027. The total U.S. transit market has been very consistent at about 5000 units annually. For GILLIG this is fragmented on the component side by three different engines, three conventional transmissions and two main hybrid system offerings. Other transit bus manufacturers have major powertrain component options different from GILLIG. Investment in technology by all these powertrain component manufacturers is already considerable. Investment over and above today's levels not to mention the development time involved for 'Deep Integration' for this multitude of powertrain combinations for the low volume transit market will be difficult for these component suppliers to justify. The exit of Detroit Diesel engines from the transit market, leaving just one engine supplier, should serve as a reminder of what can happen when the cost of development and

compliance outweigh the business opportunities in a low volume market. There are only three automatic transmission suppliers currently in transit, we surely don't want to see one of them exit the industry under similar pressures. We feel the agencies adoption rate of improvements brought about through 'Deep Integration' are overly optimistic for transit buses. We feel the same about the agencies projected adoption rates of 8 speed, AMT, DCT and Strong Hybrid technology in transit buses. We are unaware of 8 speed, AMT or DCT technology programs underway that are specifically targeted for the rigors/duty cycle/life expectations of the U.S. transit bus market. Strong Hybrids have been a decreasing portion of our annual production every year since 2010 and now constitute less than 10% of the vehicles produced. The cost of these systems have steadily increased since inception and are many times the cost the agencies assumed in the Regulatory Impact Analysis. Overly optimistic fuel economy projections, high system costs and increasing system complexity have limited hybrid adoption in transit buses. With continually declining hybrid volumes in transit buses GILLIG questions if the market can continue to support both suppliers we use and if increased levels of required investment will be the tipping point for one of them to exit. We request the agencies again review their assumptions on technology improvements and adoption rates applicable specifically to transit buses. [EPA-HQ-OAR-2014-0827-1156-A1 p.3-4]

Phase 2 GEM accounts for additional vocational vehicle technologies to reduce CO2 and fuel consumption but unfortunately the majority are not improvements available to aid transit buses in meeting the new standards. The proposed rule only allows AMT and DCT transmission options for tractors and regional duty cycles, neither apply to transit and additionally we are unaware of either of these technologies being developed for transit buses where severe duty cycles and heavy retarder operation are the norm.

**Organization:** Navistar, Inc.

The assumed adoption rate of Dual Clutch Transmissions (DCT) in the Vocational HHD Regional family, starting at agencies' estimated 22% in MY2021, is unrealistic. No HHD DCT is currently in production North America, nor has one even been announced. Furthermore, by the agencies' own statement for Regional LHD and MHD: The low projected adoption rates of DCT reflect the fact that this is a relatively new technology for the heavy-duty sector, and it is likely that broader market acceptance would be achieved once fleets have gained experience with the technology.

The DCT penetration rate should be adjusted. It is also unrealistic to assume 99% adoption of electronic transmissions in MY2024 for the Vocational HHD Regional family. This conflicts with the statement that "75 percent of the transmissions would be either automated or automatic (upgraded from a manual)." It appears that DCT transmissions were left out of the summation of electrified transmissions. [EPA-HQ-OAR-2014-0827-1199-A1 p.38]

**Organization:** Volvo Group

Given the current and expected continuing high penetration rate of manual transmissions within Volvo Group's vocational vehicles, as noted above, Volvo Group does not agree with either the baseline configuration or the stringency levels set for the HHD Urban and Multipurpose vocational subcategories that are incorrectly predicated on 100% penetration of ATs. The result of this is that both the baseline and the vehicles used to set stringency in these subcategories are erroneously presumed to include the full 2% improvement for the AT over the MT (as noted in the Preamble - section III.D.2.b.v). The baseline for HHD vocational vehicles should have a penetration weighting factor applied to the 2% credit attributed to an AT vs. an MT. Stringencies could then be set assuming some reasonable increased penetration of AT (or more likely, AT, AMT and DCT). Although Volvo Group questions the use of unsubstantiated penetration rates as a basis for setting stringency levels, given their inherent uncertainty, at a minimum

EPA should use similar penetration rates of MT, AT, AMT and dual-clutch transmissions (DCT) for setting HHD vocational stringencies as were used for Class 7 and 8 tractors (reference Tables III-8 to III-10 of the Preamble) and weighting the transmission penetration accordingly in establishing all stringency levels. [EPA-HQ-OAR-2014-0827-1290-A1 p.26]

**Organization:** Volvo Group

[*This comment was submitted in the context of the custom chassis program*]: “Need assurance that Manual and Automated Manual Transmissions will not only receive credit for neutral idle improvement, but also for efficiency benefit over an Automatic Transmission.”

**Response:**

We agree that adding gears to transmissions for transit buses is not practical, especially for those with exclusively inner-city drive cycles. We have adopted optional standards for transit buses that are largely blind to transmission improvements, for reasons described in above in Section 6.2.3 and RIA Chapter 2.9.3.

We appreciate Eaton’s comment about the cost-effectiveness of transmission improvements. We agree and it’s one reason that projected driveline improvements are a central part of the Phase 2 vocational vehicle program. We expect that with customers’ demands for reliable, durable products in this sector, advanced transmissions will be popular choices among manufacturers as they select technologies to apply in future years.

In response to comments, the fraction of manual transmissions in the HHD vocational baselines has been adjusted. See Section 6.2.1 above and Chapter 2.9.2 and 2.9.5.1.1 of the RIA. The agencies are projecting that the fraction of vocational vehicles that are sold with manual transmissions will decrease from nearly 40 percent today to under five percent by MY 2027. This translates to an 80 percent adoption rate of AMT, AT and DCT in the HHD Regional subcategory, which is less aggressive than at proposal where, as commenters noted, we projected 99 percent of the manual transmissions would be upgraded. The final projected adoption rates are based on an expectation<sup>183</sup> that by MY 2027, any vehicles with manual transmissions will be certified in the Regional subcategory, as the projected adoption rate of non-manuals in Multipurpose reaches 100% in MY 2024. In the HHD Regional and Multipurpose subcategories where we project adoption rates of automated transmissions as upgrades to manuals, we project a technology effectiveness value of 2 percent over the driving cycles and zero at idle. Unlike at proposal, this is now applied as a penalty when simulating manual transmissions, not as an improvement when simulating AMT. In response to comments from Volvo and others, no fixed adjustment is applied to automatic transmissions or AMT in the final program. This relative performance difference between AMT, AT, and manuals is the subject of many comments for both tractors and vocational vehicles. See Section 4.3 of this response to comments and RIA Chapter 2.8.2.5 for further discussion of HHD manuals compared with equivalently spec’d automated manual transmissions. For reasons discussed in Section 6.5.1, we are constraining certification of MT and AMT in vocational vehicles only to Regional and Multipurpose subcategories (i.e. vocational vehicles with AMTs can certify only in the Regional and Multipurpose subcategories).

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<sup>183</sup> The final rule in fact contains constraints on certifying vocational vehicles with MTs in anything but the Regional subcategory.



Although we had predicated the proposed standards in part on adoption of dual clutch transmissions in all subcategories, the final vocational vehicle standards do not rely on adoption of DCT for purposes of establishing stringency. The agencies agree with Allison: we have been unable to obtain conclusive data that could justify a final vocational vehicle standard predicated on adoption of a DCT with a supportable level of improvement over an AT. Dual clutch transmissions have very recently become available for medium heavy-duty vocational vehicles and very little data are available on their design or performance. We anticipate that in the future, some designs may have features that make them perform similarly to AMT's while others may have features that make them more similar to automatics with torque converters. The final vocational vehicle program thus allows chassis with DCT to be certified in any subcategory (including custom chassis), except that a vehicle with DCT may be certified using full GEM in the Urban subcategories only if certain criteria related to power-shifting are met (see Section 6.5.1).

Similar to our conclusions with respect to DCT, the agencies agree with Allison and have not been able to obtain conclusive data that could support a final vocational vehicle standard predicated on adoption of an AMT with a predictable level of improvement over an AT. Where we project adoption of automated transmissions in the two subcategories described above, we apply a cost associated with a HHD AMT compared with a manual, as well as an effectiveness that presumes the reference case is a vehicle with a manual transmission. As described in RIA Chapter 2.8.2.5, the agencies have evaluated Allison's TC10 automatic transmission for use in tractors. Overall, the CO<sub>2</sub> emissions and fuel consumption have been found to be equivalent to a comparable Eaton AMT. However, because the TC10 efficiency is significantly greater than the average heavy-duty vocational automatic transmission in the market today, the agencies have selected default losses in GEM for vocational automatic transmissions that are higher than the losses in a TC10. Some vocational vehicles that utilize automatic transmissions with similar efficiency to the TC10 transmission may achieve similar CO<sub>2</sub> emissions and fuel consumption as a 10-speed HHD AMT by either using the results of the optional powertrain test (40 CFR 1037.550) or the optional transmission efficiency test (40 CFR 1037.565).

As at proposal, we are predicating the final vocational vehicle standards in part on adoption of transmissions with added gears in all subcategories except HHD Regional, because this subcategory is predominantly modeled with a 10-speed transmission, and vehicles already using that number of gears are not expected to see any real world improvement by increasing the number of available gears. School and coach buses certified as custom chassis using simplified GEM may enter a fixed improvement value for applying a transmission with a greater number of gears than in the baseline, because we project this technology to be feasible on these vehicles but not on the other custom chassis types. We have adjusted our projected effectiveness for this technology since proposal. As proposed, we are allowing GEM to determine the improvement, where manufacturers will enter the number of gears and gear ratios and the model will simulate the efficiency over the applicable test cycle. The agencies have revised GEM based on comment, and we are confident that it fairly represents the fuel efficiency of transmissions with different gear ratios. We have run GEM simulations comparing 5-speed, 6-speed, 7-speed, and 8-speed automatic transmissions where some cases hold the total spread constant, some hold the high end ratio constant, and some hold the low-end ratio constant, where all cases use a third gear lockup and axle ratios are held constant. We have observed mixed results, with some improvements over the highway cruise cycles as high as six percent, and some cases where additional gears increased fuel consumption. We are therefore using engineering calculations to estimate that two extra gears offers one percent improvement during transient driving and two percent improvement during highway driving. Weighting these improvements using our final composite duty cycles (zero improvement at idle), for purposes of setting stringency, we are estimating that this technology will improve vocational vehicle efficiency between 0.9 and 1.7 percent. See the RIA at Chapter 2.9.3.1.

In response to the comment about certifying custom chassis in simplified GEM with manual and automated manual transmissions, the agencies will allow manufacturers to select Yes in the input field for

neutral idle when certifying custom chassis in simplified GEM with manual and automated manual transmissions, and an improvement will be calculated based on the default engine and the default automatic transmission embedded in the model. However the only other transmission-related improvement available for custom chassis is that associated with additional gears as mentioned above for school and coach buses.

### **6.3.3.2 Integration/Optimization**

**Organization:** Truck & Engine Manufacturers Association (EMA)

The Proposed Phase 2 Standards assume that, at least with respect to many vocational vehicles, the powertrain test for certification will be used as manufacturers try to achieve the assumed fuel efficiency benefits (5%- 7%) from “deep integration” of advanced engine and transmission systems. In those cases, then, the powertrain test will not be optional if manufacturers hope to achieve certification to the stringent vehicle emissions targets that the agencies have proposed. [EPA-HQ-OAR-2014-0827-1269-A1 p.39]

The agencies have not provided sufficient clarity on how “deep integration” is accomplished, nor have they demonstrated that it can achieve the assumed reductions in GHG remissions and fuel consumption.

The assumption that as of 2027 70% or more of vocational vehicles will utilize “deep integration” (Table V-15 references 100%) to achieve 5%-7% GHG/FE improvements grossly overestimates the penetration rate for deep integration – which is undefined and would require that nearly all vocational vehicles use the powertrain test for certification, which cannot and will not happen – and similarly overestimates the potential GHG/FE benefits from “deep integration,” and so is unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

The agencies assume that the powertrain test will be used extensively to take advantage of “deep integration” (a concept that the agencies do not define) between engine and transmission systems. As a result, the extensive use of “deep integration” and powertrain testing – which the agencies assume will increase to a 70% penetration rate by MY 2027 (see 80 FR at 40308; RIA, p. 2-137) – is another foundational assumption underlying the Proposed Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.31]

That assumption, however, is not appropriate, as the agencies have grossly underestimated the burdens associated with the powertrain test. Manufacturers have estimated that they would have to conduct powertrain tests of more than 100 combinations of engines and transmissions (not 20 as the agencies assert) to find the combinations that could actually generate the proposed GHG/FE credits (5% to 7%) for “deep integration.” Moreover, that testing burden would increase by a factor of 10 if manufacturers sought to identify the best performing combinations (as opposed to worst-case baseline combinations for potential certification purposes). Additional increases to the testing burden would result from the testing required to support any running changes that could impact an engine family’s fuel consumption/GHG emissions. Thus, the agencies’ proposed standards, to the extent they are premised on the expanded use of powertrain testing (all to chase down a potential 5%-7% efficiency improvement from “deep integration”) are simply unworkable. [EPA-HQ-OAR-2014-0827-1269-A1 p.31]

**Organization:** Navistar, Inc.

There is also insufficient evidence that the deep integration benefits of powertrain testing are applicable across the board or even possible. The RIA does not explain in detail, other than to state that some

manufacturers, but presumably not others, can take advantage of this optimization. It seems highly speculative to assume substantial transmission improvements based on the record in the RIA.

The scope has been small and has not been applied across an entire population of trucks. We see this as a potential risk; and should the assumed benefits not be found via powertrain testing, this leaves manufacturers in a position where there will be little to fill the gap, specifically in the vocational vehicle segment. In any event, it clearly falls short of the obligation the agencies have to clearly set out the technical pathway that is achievable within the timeframe set in the Proposed Rule.

The agencies assume that this integration can achieve as much as 7% improvement; however, as the agencies at one point project that this can create improvements from 3.5 to 4.8 percent but then refer to a table that shows 4.7-6.7%, this appears to be inconsistent. In addition, we note that the RIA appears to double count some of the elements considered in deep integration. For example, the addition of two gears to a transmission may reduce the benefit of deep integration, as the transmission will inherently achieve a more optimal operation state due the greater number of gears. We estimate that the addition of two additional gears to a deeply integrated system would not achieve the 2% benefit described in the RIA, but would instead only achieve a 1% improvement. [EPA-HQ-OAR-2014-0827-1199-A1 p.35-36]

It is unreasonable to assume greater than 90% of electronic transmissions in the Vocational HHD Regional family will be Transmission Improved in MY2027. This contrasts with an adoption rate closer to 50% as reflected in the statement “75 percent of the transmissions would be either automated or automatic (upgraded from a manual) with 70 percent of those also being deeply integrated by MY 2027.” Presumably, this has resulted in a double counting of the potential benefit. [EPA-HQ-OAR-2014-0827-1199-A1 p.38-39]

**Organization:** GILLIG LLC

GILLIG requests the agencies reconsider the Phase 2 proposed requirement for testing to quantify the CO<sub>2</sub> and fuel economy improvements from transmission driveline optimization, architectural improvements and hybrid powertrain systems. Considering the low volume nature of the transit bus business and the multiple powertrain configurations (noted above), the cost and time to run these tests not just once but continually as the technologies evolve will be onerous. GILLIG has no emissions test cells and no emissions testing team. If we were to embark on this endeavor significant initial capital investment and ongoing operations costs would be incurred. Alternatively, this work would have to fall to the transmission and hybrid suppliers or a third party. Ultimately, with limited production volume over which to spread these costs, either path leads to significant cost increases to our end users and additional financial burden for tax payers. [EPA-HQ-OAR-2014-0827-1156-A1 p.4]

**Organization:** Oshkosh Corporation

The first and most optimistic technology is advanced transmission and engine integration. This approach matches the transmission control algorithms to the engine performance tailored to a specific duty cycle. While this may be practical for high volume line haul applications, we believe it is unlikely to succeed in the low volume vocational world. The myriad range of vocations lead to a corresponding myriad of duty cycles, engine and transmission makes, models, and power ratings. Creating specialized engine and transmission integration algorithms takes time, money, testing effort, and a market driver. Engine and transmission suppliers will have little interest in creating the literally hundreds of optimizations needed to cover the low volumes that each combination will represent.

The GEM calculation for 2027 assumes an 8.9% improvement in fuel efficiency coming from either making the transmission more efficient, or by optimizing the shifting coordination between the engine and transmission. Many heavy duty vocational trucks use an Allison automatic transmission to improve performance and reduce driver fatigue. This is especially true for vocations with a lot of stop-start activities. Allison has improved the efficiency of their transmission over the past decade by providing lockup capability and reducing the amount of time the transmission remains in torque converter mode. In discussions with Allison they do not believe that much further efficiency can be gained beyond what they have already attained. [EPA-HQ-OAR-2014-0827-1162-A2 p.3-4]

As for the engine/transmission match optimization, we find several factors working against significant efficiency improvement.

-With the advent of electronically controlled transmissions, significant improvements have already been achieved.

-Optimization requiring hardware changes such as modified gearing ratios are unlikely based on the relatively low volume represented by each vocation, and the very high capital investment required to make new automatic transmission configurations. [EPA-HQ-OAR-2014-0827-1162-A1 p.4]

-Software changes to tweak each vocation may produce some benefit, but the sheer number of low-volume vocational duty cycles and engine/transmission combinations make it doubtful that the engine and transmission suppliers would be willing to invest the time for so many optimizations. [EPA-HQ-OAR-2014-0827-1162-A2 p.4]

-The control algorithms that will optimize fuel economy are diametrically opposed to those that optimize performance. A sluggish “economy” mode will not be acceptable to nearly all vocations that rely on good acceleration. Optimized performance for a bus, pickup and delivery truck, or waste collection vehicle is crucial to profitability. Optimized performance in a heavy truck or bus does not mean it is beating other vehicles off the starting line, it means it does not lag behind passenger cars as much as it otherwise would. When profitability hinges on the number of packages you deliver, the passenger schedule you keep, or the number of residential refuse containers you collect, the relatively small energy savings obtained by operating in economy mode will be far outweighed in the lost productivity of the vehicle. [EPA-HQ-OAR-2014-0827-1162-A2 p.4]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

The agencies’ estimate of 5% efficiency improvement, on average, from transmission integration (p. 40296), irrespective of transmission types, is too low. Such a blanket assumption fails to distinguish among the different transmission architectures and thus does not promote the most efficient technologies. Assign technology-specific effectiveness values for transmission and integration. [EPA-HQ-OAR-2014-0827-1280-A1 p.19]

**Organization:** Union of Concerned Scientists (UCS)

The average of a 6 percent improvement of the transmission measured via powertrain testing is much lower than is achievable in this timeframe. These levels are based on a comparison between Allison’s 6-speed AT and Eaton’s 7-speed DCT with the same axle—this assumption leads to a degradation in the performance of the Eaton transmission and is therefore incorrect. Comparing each transmission in its optimal configuration increases the average improvement by 1 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

However, this comparison does not further account for the difference between the baseline transmission (5-speed AT) and the 6-speed AT, nor does it account for any future improvements to Eaton's DCT (e.g., an 8-speed DCT under development). In their analysis, the agencies note an improvement of 2 percent simply for the addition of 2 gears—this should be a reasonable estimate of these two improvements. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

Correcting the data to reflect the appropriate powertrain results and accounting for improved gearing would raise the average powertrain improvement from 5.5 percent to 8.4 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

**Organization:** Volvo Group

Regarding vocational vehicles, the RIA states: "The agencies thus project that transmission and driveline optimization would yield a substantial proportion of vocational vehicle fuel efficiency improvements for Phase 2. On average, we anticipate that efficiency improvements of about five percent can be achieved from optimization, sometimes called deep integration, of drivelines."<sup>9</sup> No further detail is offered as to what "deep integration" is or how it is achieved to substantiate the efficiency claim. Although we have been able to demonstrate on-highway tractor efficiency via engine-driveline integration, we have no such experience with vocational applications in transient operating conditions nor have we demonstrated anything close to 5% efficiency improvement. Since the agencies have offered no evidence beyond supposition that "deep integration" is either feasible or effective for vocational applications, it cannot be expected as a means to achieve the vocational vehicle standards nor should it be included in setting these targets. [EPA-HQ-OAR-2014-0827-1290-A1 p.26]

**Organization:** PACCAR, Inc

The proposed powertrain integration testing requirements are significantly more burdensome than the agencies' estimate, particularly for PACCAR's mix of vehicles. PACCAR has a minimum of 130 unique hardware combinations of powertrain and transmission, not counting engine ratings and transmission calibrations that would have to be considered for tested under the proposed rule. The cost of conducting such a large number of powertrain integration tests would be prohibitive. In the proposal, EPA estimated an average test cost of approximately \$69,000 per test. If 70% of the 130 combinations needed to be tested to reach the 2027 vocational vehicle compliance, over \$6.25 million of testing would be required every model year, as compared to the much lower 20 configurations or \$1.4 million that the agencies' estimate. The OEM burden will increase each time a mid-year calibration change impacts engine fuel consumption or transmission shift strategy. [EPA-HQ-OAR-2014-0827-1204-A1 p.21]

**Response:**

At proposal the agencies included shift strategy, aggressive torque converter lockup, and a high efficiency gearbox among the technologies defined as driveline integration that would only be recognized by use of powertrain testing. The agencies continue to believe that an effective way to derive efficiency improvements from a transmission is by optimizing it with the engine and other driveline components to balance both performance needs and fuel savings. In considering the comments and available information, we believe it is reasonable to project that transmissions may feature advanced shift strategies where they make use of an additional sensor to improve fuel efficiency by, for example, detecting payload or road grade. The final rules provide separate procedures for recognizing aggressive torque converter lockup or use of a high efficiency gearbox, so these are considered separately for purposes of setting standard stringency. As at proposal, we project that adoption of an advanced shift strategy can provide improvements over a powertrain test of seven percent over the transient cycle and two percent over each of the highway cycles.

Volvo maintained that the agencies did not set forth any reasoning to justify the efficiency improvements attributed to advanced shift strategies (i.e. deep integration). The agencies' justification is fully set out in RIA Chapter 2.9.3.1.1. For example, as stated there, "[u]sing engineering calculations to estimate the benefits that can be demonstrated over the powertrain test, the agencies project that transmission shift strategies, including those that make use of enhanced communication between engine and driveline, can yield efficiency improvements ranging from three percent for Regional vehicles to nearly six percent for Urban vehicles. The calculation is an energy-weighted and cycle-weighted average improvement using cycle-specific CO<sub>2</sub> emissions reported in the GEM output file for baseline vehicles."

One change in effectiveness we have made since proposal is accounting for zero effectiveness at idle. The way we have done this is to expand the energy-weighting approach described in RIA Chapter 2.9.3.1 that was used at proposal to also account for fuel burned at idle. The file documenting these calculations is available in the docket.<sup>184</sup> In this way, each transmission technology effectiveness is subcategory-specific, including use of separate values for gasoline and diesel powertrains. The revised composite drive cycle weightings have also affected our estimates of the benefits of transmission technologies. In sum, since proposal the range of cycle-average effectiveness of driveline integration (aka shift strategy) has changed from 4.7-6.7 percent at proposal to 3.1-5.8 percent in the final rules. We do not agree with commenters that we need to set different effectiveness values for applying this type of upgrade to different types of transmission architectures. We believe these improvements are reasonable estimates of what can be achieved for AMT, DCT or AT. The next paragraph addresses our response regarding combining this with other technologies such as added gears.

The agencies have been careful to project adoption rates and effectiveness of transmission technologies in a way that that avoids over-estimating the achievable reductions. For example, as we developed the packages, we reduced the adoption rate of advanced shift strategy by the adoption rate of integrated hybrids, and we reduced the adoption rate of transmission gear efficiency by the amount of non-integrated hybrids. This is because we do not project that any driveline will undergo testing over both the powertrain test and the separate transmission efficiency test. Because we have projected adoption of combinations of transmission technologies in some subcategories, the sum of adoption rates of individual transmission technologies may exceed 100 percent in some cases. Transmission improvements are central to the Phase 2 vocational vehicle program, second only to idle reduction. We are projecting that many vehicles will apply more than one technology that improves vehicle efficiency with respect to the transmission. For example, with a 50 percent adoption rate of torque converter lockup and a 70 percent adoption of high efficiency gearbox for Regional vehicles in MY 2027, some vehicles may need to - and could reasonably - apply both. We are careful not to double count benefits in our analysis. To avoid doing so for technologies that are not simulated in GEM, we have estimated effectiveness values using conservative values and have made them subcategory-specific using an energy-weighting approach described in the RIA Chapter 2.9.3.1. In addition, where we have used GEM to determine effectiveness, we have run test cases with vehicles that have other improvements already applied (including future engines, LRR tires, and lightweighting), so that the physics inherent to GEM will produce results that reflect vehicle-level dis-synergies; meaning the incremental improvement of adding first gear lockup, for example, is smaller on an improved vehicle than on a baseline vehicle. Further, instead of summing the combined efficiencies, we combine multiplicatively. Thus, we have fairly accounted for dis-synergies of effectiveness where multiple technologies are applied to a similar vehicle system (including in Navistar's example of driveline integration adding a lesser benefit to a transmission with additional gears).

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<sup>184</sup> See spreadsheet file dated July 2016 titled, "FRM\_Vocational-Standards\_GEMpostprocess.xls."

We disagree with OshKosh that transmissions programmed for economy mode must necessarily have sluggish acceleration. Acceleration rate management is only one of many possible strategies that could be employed by transmission manufacturers, and some technologies may be combined to maintain utility such as shift strategy plus additional gears. Also with respect to the comment that electronically controlled transmissions have already brought significant improvements to this sector, we agree in part; however, as with engines, this is a major vehicle component for which manufacturers are continually seeking to make improvements over time. Just because we were able to establish Phase 1 diesel vocational engine standards that sought to improve engines over the MY 2010 baseline by nine percent didn't mean that we couldn't project an additional four percent improvement for those same engines in Phase 2.

We proposed a 70 percent adoption rate of driveline integration in MY 2027 on the basis that this approach to improving fuel efficiency is highly cost-effective and technically feasible in a wide range of applications, and that the additional lead time would enable manufacturers to overcome barriers related to the non-integrated nature of businesses serving this sector. We received persuasive comments from manufacturers emphasizing the diversity of their product lines and the extent of testing that would be needed to apply this technology to 70 percent of their sales, and as a result we have reduced our projected adoption rate for this technology to 30 percent in MY 2027. In cases where an advanced shift strategy can be applied to a popular powertrain, manufacturers may be able to sell a significant amount of their vehicles with this technology without needing to undergo development and testing for a large number of powertrain families. Also in response to comments, we are adopting a transmission efficiency test to recognize improved mechanical gear efficiency and reduced transmission friction, where the test results can be submitted as GEM inputs to override the default efficiency values. Because this test can be conducted with a bare transmission without needing to be paired with an engine, each test will be valid for a much broader range of vehicle configurations than are test results for a powertrain test (See Section 2.4.2 for responses to comments on powertrain families), and thus it is reasonable to project an adoption rate for high-efficiency vocational transmissions in MY 2027 of nearly 70 percent. The agencies project vehicle fuel efficiency can be improved by one percent from improved transmission gear efficiency in all cycles except idle (no improvement). Actual test results are likely to show that some gears have more room for improvement than others, especially where a direct drive gear is already highly efficient.

Commenters requested that the minimum torque converter lockup gear be enabled as a GEM input without requiring powertrain testing. In response, final GEM also includes an input field for torque converter lockup gear. The agencies project vehicle fuel efficiency can be improved up to three percent on a cycle average for torque converter lockup in first gear compared with lockup in third gear. Using the library of agency transmission files, GEM gives a different effectiveness value in every subcategory, reasonably reflecting the gear ratios, drive cycle, and torque converter specifications. Manufacturers will obtain slightly different results with their own driveline specifications.

We agree with the commenter that transmission suppliers are unlikely to invest R&D funds into optimization of low volume drivelines. That is one reason why we are not projecting any adoption of advanced shift strategy/driveline optimization for vehicles in the custom chassis program. However, we do expect that transmission manufacturers will be able to design improved gear efficiencies in some products for which the cost of driveline optimization would not be reasonable. These may be recognized during certification through the separate transmission efficiency test procedure.

In response to comments about the cost of powertrain testing, the agencies have updated our estimates of a per-test cost, as described in the Preamble to this rulemaking in Section IX and the RIA Chapter 7.1.1.2 and RIA Chapter 7.2.1.2. At proposal the agencies estimated the capital costs of new test cells and test cell upgrades at \$16.6 million, representing 6 test cell upgrades and 5 new powertrain testing facilities.

For the final rules we are retaining these estimates and have adjusted the dollar year to \$2013 so the new estimate is \$16.8 million for one-time expenses incurred at the beginning of the Phase 2 program.

At proposal we estimated the operating costs of powertrain testing at \$69,000 per test, and we projected three manufacturers would each conduct 20 tests per year for an annual operating cost associated with powertrain testing of \$4.1 million (see draft RIA at 7.1.1.2). In estimating compliance costs for the final rules, we have considered information from commenters and revised downward the per-test cost to \$40,000 for powertrain testing, which is an average value that includes some in-house testing (costing less) and some contracted testing (costing more). In estimating the operating costs associated with annual powertrain testing for the final rules, we have determined that a 30 percent average adoption rate by MY 2027 can be achieved with 10 tests annually beginning with the first implementation year of Phase 2 for an annual total of \$400,000 for vocational powertrain testing. We believe this is reasonable, not a vast underestimation as claimed by commenters, because the final standards do not rely as heavily on advanced shift strategy/driveline optimization as was proposed, and this path to compliance will likely be chosen only by a few manufacturers. Also, manufacturers who pursue this path will gain experience each year and learn how best to apply this technology to their products, so even if we underestimate early-year testing costs, we do not expect the average annual testing costs to greatly exceed \$400,000 for vocational powertrain testing.

Because we estimate manufacturers will be able to apply test results from the transmission efficiency test more broadly than results from the powertrain test, we have estimated these costs using an annual frequency of 11 tests at a per-test cost of \$24,600, for an annual total of \$270,600 for vocational transmission testing. These compliance costs as well as compliance costs estimated for the tractor program are described in the final RIA at Chapter 7.1.1.2 and RIA Chapter 7.2.1.2.

Please see Section 2.4.2 of this response to comment document to read our responses on comments related to the powertrain test procedure itself.

### **6.3.3.3 Hybrids**

**Organization:** California Air Resources Board (CARB)

Currently, XL Hybrids and Crosspoint Kinetics have commercially-available hybrid systems for both new purchases and existing vehicle conversions. XL Hybrids currently has hybrid systems for box trucks (Ford E-350/E-450 cutaway, Ford E-450 strip chassis), Reach walk-in commercial vans (Isuzu/Utilimaster), cargo vans and passenger wagons (Chevy Express 2500/3500, GMC Savana 2500/3500, Ford E-150/E-250/E-350, Ford Transit), shuttle buses (Ford E-350/E-450 cutaway, Ford E-450 strip chassis, GM 3500/4500 cutaway (available September 2015)), and commercial stripped chassis (F59 super duty) for walk-in van fleets. Crosspoint Kinetics currently has hybrid systems for a variety of new class 3-7 trucks and buses, including a retrofit option for existing vehicles. Their systems have been tested and approved at Altoona and have been certified by the Federal Transit Administration.

CARB staff believes that if there is a projected demand created by regulatory Phase 2 (Alternative 4) requirements, these two companies, and likely other companies, would make additional hybrid systems available for the targeted heavy-duty truck and van sector. Since the basic hybrid system designs from XL Hybrids and Crosspoint Kinetics have been proven in actual fleet operations, additional demands for their products would lower the price of hybrid technologies due to increased production. The technology could also be more economically designed for other vehicle platforms, creating additional growth and development for hybrids in general. [EPA-HQ-OAR-2014-0827-1265-A1 p.68]



**Organization:** United Parcel Service (UPS)

The specific market penetration rates that concern UPS, given our particular fleet, are listed below and UPS strongly recommends reduction of these MPRs: Certain Market Penetration Rates for MHD Vocational Vehicles are Questionable

Electrification and Hybridization (18% in 2027)

UPS agrees with ATA's following comments on this point: 'To date, the only heavy-duty vocational applications that have demonstrated commercial viability are urban bus applications where public dollars are available. Despite several manufacturers developing hybrid technology that is production-ready, potential customers who had positive experience with demonstrators could not make the business case for additional purchases due to exorbitant costs. Hybridization remains the most expensive technology option under Phase 2 ranging from \$23,904 to \$18,534 in 2021 and 2027 respectively. Heavy-duty hybrid penetration is essentially non-existent outside the municipal arena. If the agencies still wish to include vocational vehicle hybridization market penetration rates, ATA recommends treating these technologies as advanced technologies and not assess specific MPRs under the rule. ATA further expands upon the need for the agencies to retain advanced technology credits under the Phase 2 Rule below.'

UPS also agrees that EPA/NHTSA should treat these technologies as advanced technologies, not assign them MPRs, and should give them advanced technology credits. We would add in this category natural gas and software controlled, engine/transmission uncoupling. The latter technology is potentially very low-cost and yet impressive in improving fuel efficiency. Note that the use of natural gas should be viewed in light of the possible use of pipeline ready bio-methane, which UPS is already doing. If an adoption rate is truly needed, then UPS would suggest an adoption rate for natural gas of about 5.5%.

UPS urges EPA to adopt a broad flexible definition of 'hybrid'. The definition of that term should include launch assist, and electric generation by an internal combustion engine that only operates when the vehicle is stationary or that is 'geo-fenced' to comply with urban emission/congestion requirements. (UPS is procuring such stationary electric generation and geo-fenced electric hybrid vehicles now). [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

**Organization:** Truck Renting and Leasing Association

Hybrids. The agencies have assumed hybrid technology will be adopted by the vocational vehicle sector for compliance, and that up to 18 percent of vehicles certified in the Multi-Purpose and Urban subcategories will have this technology by 2027 (See page 40309). In addition the agencies note that hybridization is estimated to range between \$15,000 and \$40,000 per vehicle for vocational vehicles (See page 40313). In general, hybrids have proven to be much too costly relative to their benefit and should not be considered a viable technology in Phase 2.[EPA-HQ-OAR-2014-0827-1140-A1 p.5]

**Organization:** Oshkosh Corporation

While there was much excitement over the potential for hybridization in heavy trucks during the early 2000s, enthusiasm for hybrid technology in the commercial sector has all-but disappeared. The TMC Hybrid Truck Task Force of the American Trucking Association tracked the hybrid trends in vocational trucks biannually over the past 15 years. This task force officially disbanded this fall due to an almost total lack of interest. Fleets that adopted hybrid chassis found that projections of fuel economy improvements were over-stated, and increases in initial investment and maintenance costs made the business case untenable. The business case fell apart the minute government tax advantages ran out. Even

with the tax breaks, the case for heavy truck hybrids did not make business sense. Additional weight, complexity, cost, and maintenance all detracts from the potential savings in fuel. [EPA-HQ-OAR-2014-0827-1162-A2 p.5]

**Organization:** Daimler Trucks North America LLC

The agencies requested comment on the expected costs to accelerate hybrid development to meet the projected adoption rates of Alternative 4. 80 FR 40320. As we comment elsewhere, we recently dropped out of the hybrid market. The systems proved too costly relative to their benefit, and the hybrid OBD certification obstacles were too great. In light of this history, we think it unlikely that we would be able to meet the expected sales volume of hybrids in Alternative 3, much less Alternative 4. [EPA-HQ-OAR-2014-0827-1164-A1 p.75]

**Organization:** National Waste & Recycle Association

The solid waste industry is extensively pursuing technologies to lower fuel consumption such as hybrid power trains. The Phase 2 proposal, page 40297, left column, states that refuse haulers are well suited for hybrid powertrains because of the significant amount of stop-and-go activity, engine idling and PTO usage. While the adoption of hybrid powertrains has moved slowly in this industry due to cost and technological limitations, the industry continues to pursue this option and encourages the agencies to consider creating viable incentives for truck owners to make the investment in this technology. [NHTSA-2014-0132-0071-A1 p.7]

**Organization:** Navistar, Inc.

Alternative 3 also presumes extremely aggressive technology adoption rates. This is particularly the case for the use of hybrid powertrains in the vocational vehicle sector. The NPRM is based on 18% of urban and 18% of multi-purpose vocational vehicles utilizing hybrid powertrains by 2027. As we note in our discussion on hybrids, this is not likely to be feasible. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

The adoption rate for hybrid vocational vehicles is essentially zero today because of low fuel prices and the significant regulatory burden that hybridization faces in the commercial vehicle space. As one of the first companies to market commercial hybrid vehicles, we know there is little evidence to suggest our customers will be willing to buy vocational hybrids in sufficient numbers to meet the standard in 2027. In fact, at its highest, the penetration rate for hybrids never exceeded 1%. Predicating this alternative on the assumption that hybrid adoption rates will reach 18% by 2024, instead of 2027 will inject significant risk into the technology path that the NPRM lays out for vocational vehicles to achieve compliance. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

Navistar led the initial development and deployment of electric and hybrid vehicles beginning in 2007. Navistar's leadership in this area is defined by introduction of the first commercially available plug in hybrid school bus, as well as an all-electric Class 4 pick-up and delivery vehicle (eStar) and a range of hybrid electric trucks equipped with the recently newly developed Eaton AMT/Hybrid system. Navistar was the only manufacturer to certify for sale, diesel hybrid vehicles under the stringent CARB interim hybrid certification procedure. This experience has provided Navistar with a unique perspective on the issues and opportunities facing hybrid vehicle development. [EPA-HQ-OAR-2014-0827-1199-A1 p.39]

Navistar respects the agencies' desire to promote strong hybrid systems; however, hybrid applications are limited by their considerable cost and inability to optimize for the diverse vocational applications segment. This limitation is acknowledged in the Agency's response in the RIA<sup>37</sup>. This segment represents

the broadest range of combined mobile, stationary (EPTO) applications and duty cycles. The resulting complexity makes it difficult, if not impossible, to demonstrate the proposed GHG differential improvement of 25% for urban vocational vehicles and 22% for Multi-Purpose vocational vehicles. [EPA-HQ-OAR-2014-0827-1199-A1 p.39]

Customer demand for these products will be tempered by the cost, packaging, payload and range tradeoffs for a given vocational application. Generally with the increase in differential fuel economy, these tradeoffs become more costly, complex and specialized for a given fleet. Underlying in each of these permutations is the NO<sub>x</sub> compliance risk, and potential warranty obligation associated with the ability to maintain adequate aftertreatment conversion temperature. While it is possible to optimize an aftertreatment system for a given hybrid application, production volumes may not be sufficient to justify the considerable expense of performing a full certification and deterioration factor determination exercise. These costs will naturally increase as the proliferation of hybrid options increase. [EPA-HQ-OAR-2014-0827-1199-A1 p.39]

Finally, the cost of any hybrid system must compete directly with alternative fuel options (CNG, LNG and LPG) which offer competitive or better cost per mile fuel economy savings along with reduced GHG emissions. In many cases the resulting payback interval and warranty cost exposure are lower than equivalent hybrid systems. This is supported by Navistar's previous experience when hybrid sales volumes peaked in 2009 and 2010 when fuel prices were reaching historic levels, then declined as fuel prices decreased and with the increased availability of alternative fuel options. For these reasons Navistar believes the agencies' expectation for hybrid vehicle penetration are overstated and do not account for the cost, complexity, warranty exposure and alternative fuel vehicle options currently available in the market. [EPA-HQ-OAR-2014-0827-1199-A1 p.40]

**Organization:** Allison Transmission, Inc.

The agencies should make several changes related to hybrid vehicles. Assumed adoption rates for this technology are overstated. At the same time, EPA and NHTSA should be careful not to create new regulatory barriers for hybrids, including onboard diagnostic requirements and additional testing for nitrogen oxides ("NO<sub>x</sub>"). [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

Allison has several concerns in this area. First, the likelihood of a 5% adoption of hybrid technologies in the MD/HD sector must be seen as remote. Early adopters had poor experiences with initial market entrants that led to several hybrid manufacturers withdrawing from the market. This has resulted in a general reluctance by vehicle manufacturers to offer a hybrid powertrain given low market demand. Even if EPA and NHTSA seek to promulgate "technology forcing" regulations, there will be a lingering resistance to adopting hybrids due to what is widely perceived as market failure. The 2010 NAS Report validated the history of these market behaviors.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.10]

Allison supports provisions of the Proposed Rule that would end specific Phase 1 incentives for hybrids, fuel cell and electric vehicles ("EVs"). We concur with the agencies that the potentially large credits that may be available for such vehicles through certification of very low emission rates should provide sufficient incentive for improved introduction of such vehicles into the commercial MD/HD fleet. In addition, Allison believes that hybrid vehicles should be certified on a duty cycle on the same basis as non-hybrid vehicles because the vehicles must perform the same work regardless of the powertrain technology. [EPA-HQ-OAR-2014-0827-1284-A1 p.51]

As the agencies indicate at the beginning of the Proposed Rule, the Phase 2 standards are intended to be technology-forcing. While the agencies' ability to require technology-forcing standards is not

unbounded,<sup>82</sup> manufacturers should not receive what could amount to a “double credit” of meeting their compliance obligations through hybrids, fuel cell and electric vehicles are receiving additional credits on account of this action. In addition, we would note that expanded delegated assembly for vehicles is an additional avenue whereby new technologies can be introduced into the market. [EPA-HQ-OAR-2014-0827-1284-A1 p.51]

With regard to comparable certification, the agencies recognize that vocational vehicle GEM test cycles are “expected to better recognize hybrid technology effectiveness than the Phase 1 hybrid test cycle, especially in the Urban subcategory.” EPA and NHTSA are proposing to remove the chassis test option for the Phase 2 rule (although proposed regulations would allow for the generation of advance technology credits through “A” to “B” chassis testing). Allison believes the best course of action to integrate hybrid vehicles into the fleet is to implement equivalent testing and certification of hybrid and non-hybrid vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.51-52]

### **Assumed Hybrid Adoption Rates in Alternative 4 Are Unreasonable and Unsupported**

EPA and NHTSA have requested comments on the expected costs to accelerate hybrid development in order to meet the projected adoption rates in Alternative 4, i.e., a 5% overall penetration rate in 2024 for hybrids in vocational vehicles. To achieve an overall 5% adoption rate of hybrid technology, the economics of the hybrid ownership would have to substantially change over the period of time covered by this rulemaking. Sustained progress in reducing battery costs would be needed along with decreases in motor costs, and progress in reducing inverter costs. In addition, other external elements would be needed such as a significant increase in fuel cost (to increase demand) and/or additional subsidies for hybrid vehicle purchases. Past history concerning hybrid adoption should breed caution. For example, even though transit buses have had hybrid systems available for over a decade (supported in many cases by subsidies), the adoption rate of hybrids in the U.S. transit bus market is only 13.2%.<sup>85</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.52]

In their report “Strategic Analysis of the Global Hybrid and Electric Medium-and Heavy duty Truck Market,” Frost and Sullivan published that supplier-level costs for batteries were \$600-650/kWh in 2014 and predicts \$400-450/kWh in 2022. This cost level requires passenger car production volumes and a plug-in sized battery. Additionally, batteries for non-plug-in hybrids are more expensive per kWh. Inverter and controller costs are expected to increase from 2014 levels “due to a shift in propulsive power from diesel engine to electric motor, thereby increasing complexity of power management in trucks.” (This report, NEOC-18, was published in December 2014). With respect to motors, Frost and Sullivan predict a slight to no reduction from 2014 to 2022. EPA must consider that motor costs are largely driven by the cost of copper and permanent magnet rare earth materials (or their replacement materials which are under development for future motor applications). These raw material costs are not controllable by hybrid vehicle manufacturers. [EPA-HQ-OAR-2014-0827-1284-A1 p.52]

A significant investment is required to reduce the cost of batteries, which are a key system cost driver. Battery cost predictions over the past decade have been optimistic and Allison has doubt as to the future projections being achieved for HDV. Batteries do not follow Moore’s Law and there is no accepted model for predicting battery costs over time. Cost data is not publicly available; however, the MSRP of a replacement Toyota battery pack has remained at \$2588 (\$1976/kWh) since September, 2008.<sup>86</sup> Also, a global consulting firm retained by Allison, reported in 2008 that the Eaton hybrid battery and battery management system cost \$4000/kWh and its costs would substantially decline in the future. Instead of Eaton realizing a large cost reduction for batteries, they exited the U.S. hybrid market in 2014. Since EPA is projecting far into the future, there is great uncertainty based on not realizing prior projections as to the realistic cost and volumes that will be achieved. [EPA-HQ-OAR-2014-0827-1284-A1 p.52-53]

Additionally, EPA and NHTSA should recognize that many of the cost reductions from the automotive industry are not directly scalable to the heavy duty manufacturers. As discussed in other sections of our comments, a heavy-duty vehicle has a very demanding duty cycle, which in turn, requires much more challenging design requirements for robustness. Also, the emissions regulatory life of HDVs is much longer than LDVs. The economies of scale from volume are not realized in a relatively low volume market. Allison's hybrid experience is that the cost levels expected from scaling automotive cost levels are not achievable in heavy-duty hybrid systems. To illustrate this point, the MSRP of a non-plug-in Toyota Prius battery pack is \$2589. Scaling that same battery pack to account for the additional modules and controllers of an HHD vocational vehicle would be \$20,712, but the MSRP is \$45,884.<sup>88</sup> The battery pack alone is higher than the DMC for a strong hybrid as shown in Table 2-182 of the RIA. Allison believes that a factor of 2-4X would be more appropriate for non-plug-in hybrids and 1.5-2X for plug-in hybrids when scaling DMC from LDV to HDV. [EPA-HQ-OAR-2014-0827-1284-A1 p.53]

**Organization:** Parker Hannifin

Parker Hannifin appreciates the opportunity to submit comments on this important matter. For all of the reasons stated above, Parker urges the EPA to increase the expectations of efficiency standards and include hydraulic hybrid technology in the equation to better the consumers, industry, and environmental impact. [EPA-HQ-OAR-2014-0827-0725-A1 p.3]

It is important to note that the 40% reduction in fuel consumption and emissions in Class 6-8 vehicles proposed in the new rule is not something for the future. *It is happening now.* Parker has developed and is actively marketing a hydraulic hybrid medium- and heavy-duty vehicle transmission that is currently achieving and surpassing the 40% reduction in fuel consumption and emissions sought in the new rule. [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

Parker's hydraulic hybrid transmission replaces a conventional transmission to propel the vehicle by mechanical and hydraulic power. Every time the driver presses the brakes, the hydraulic hybrid transmission system captures and stores that energy. When the driver presses the throttle, the stored energy is used to propel the vehicle. [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

Parker's hydraulic hybrid transmissions are in use in medium- and heavy-duty vehicles in municipalities and large fleets across the country. These refuse fleets are averaging 43% reduction in fuel consumption and emissions, with some individual fleets exceeding 50% in fuel consumption and emissions reductions. Vehicles with the Parker transmission are operating in large fleets (like UPS and FedEx) and smaller fleets (like Waste Industries), as well as with municipalities as diverse as Orlando, FL, Tacoma, WA, Baltimore, MD, Oberlin, OH, and Loveland, CO. A total of 246 such systems are on the road today. Weather and climate have no impact on the superior performance of Class 6 to Class 8 vehicles using the Parker transmission. [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

Other direct benefits these fleets have realized from using vehicles with the Parker transmission include: [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

-Virtual elimination of brake dust (a harmful bi-product) from the air because the hydraulic hybrid transmission controls truck speed instead of the brakes; [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

-Scheduled brake replacements changed from once every four months to once every six years (or more), saving ten thousand dollars or more *per year per vehicle*; [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

-Duty cycle efficiency improvements of 5-10%, meaning vehicles with Parker's drivetrain do more work in the same amount of time as vehicles with traditional diesel drivetrains or the same amount of work can be done with fewer vehicles; and [EPA- HQ-OAR-2014-0827-0725-A1 p.2]

-No infrastructure investment required to operate the system [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

Parker's hydraulic hybrid transmission is based on proven technology. There are more than 200 medium- and heavy-duty vehicles (parcel delivery and refuse) operating with the Parker transmission today. They have collectively accumulated more than 250,000 hours of run time and 1.5 million miles on the road. The fuel consumption and emissions reductions results are real-world, on-road results, not theoretical or lab-based. [EPA-HQ-OAR-2014-0827-0725-A1 p.2]

**Organization:** Natural Resources Defense Council (NRDC)

Vocational vehicles stringency should be strengthened to account for improvements available in hybridization. [EPA-HQ-OAR-2014-0827-1220-A1 p.5]

**Organization:** Environmental Defense Fund (EDF)

Wrightspeed currently has the capacity to convert diesel-and-automatic-transmission powertrain to a turbine-electric, plug-in series hybrid. These innovative trucks hold the potential- today- to "save 50% to 90% in fuel over a straight diesel powertrain."<sup>162</sup> XL Hybrid recently announced its XL3 Hybrid System for Ford Transit vans. The hybrid electric drive system offers fuel and greenhouse gas emission savings- today- of 20%.<sup>163</sup>

162 See <http://www.truckinginfo.com/article/story/2015/06/tantalizing-turbine-electric.aspx>

163 See <http://www.businesswire.com/news/home/20150504005280/en/XL-Hybrids-Introduces-Hybrid-Electric-Ford-Transit#.Vg1YKJf9moU>

**Organization:** Autocar, LLC

CNG and Hybrid Power. As set forth in the introduction to this letter, Autocar is an industry leader in the integration of fuel-efficient CNG engines and hybrid power units<sup>11</sup> in refuse trucks and street sweepers. The positive effects of CNG and hybrid technology on fuel efficiency and pollutant emissions are widely recognized and are acknowledged in the Proposed Regulations. Autocar's applications may be more suited to CNG and hybrid power than other vocational applications. But these sophisticated technologies come with a significantly higher purchase price. Autocar and its customers actively participate in CNG and hybrid incentive programs from coast to coast. These programs have been successful in bridging the cost gap between diesel trucks and CNG or hybrid trucks and infrastructure. We encourage the agencies to build on that proven success and provide additional incentives for the purchase of CNG and hybrid trucks, for Low-speed/Frequent-stop Vehicles as well as other vocational and non-vocational vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.15]

**Organization:** American Trucking Associations (ATA)

**Electrification and Hybridization (18% in 2027)**

To date, the only heavy-duty vocational applications that have demonstrated commercial viability are urban bus applications where public dollars are available. Despite several manufacturers developing hybrid technology that is production-ready, potential customers who had positive experience with demonstration projects could not make the business case for additional purchases due to exorbitant costs. Hybridization remains the most expensive technology option under Phase 2 ranging from \$23,904 to \$18,534 in 2021 and 2027 respectively. Heavy-duty hybrid penetration is essentially non-existent outside the municipal arena. If the agencies still wish to include vocational vehicle hybridization market penetration rates, ATA recommends treating these technologies as advanced technologies and not assess specific MPRs under the rule. ATA further expands upon the need for the agencies to retain advanced technology credits under the Phase 2 Rule below. [EPA-HQ-OAR-2014-0827-1243-A1 p.9]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The assumptions of a 22-25% fuel efficiency improvement from hybrid systems over the powertrain test (which has not been run by many manufacturers), and an overall hybrid system adoption rate of 10% for vocational vehicles (stemming from an adoption rate of 18% in the Multi-Purpose and Urban vehicle subcategories) are grossly over-stated, premised on significantly underestimated costs, and not supported by current data. [EPA-HQ-OAR-2014-0827-1269-A1 p.71-72]

The agencies' Proposed Phase 2 Standards for vocational vehicles are premised on the significant development and utilization of "strong hybrid" systems. The agencies define strong hybrid systems as those that combine two significant sources of propulsion, one using a combustible fuel (like diesel fuel or gasoline) and one that is rechargeable, either during operation (such as through regenerative braking) or through a supplemental power source (for battery recharging at the end of the vehicle's work day). As the agencies note in the RIA (at page 2-34): [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

A hybrid drive unit is complex and consists of discrete components, such as the electric traction motor, transmission, generator, inverter, controller and cooling devices. Certain types of drive units may work better than others for specific vehicle applications or performance requirements....Despite the significant future potential for hybrids, there are no simple solutions applicable for each heavy-duty hybrid application due to the large vocational fleet variation. [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

Despite noting the very substantial complexities and costs associated with deploying hybrid systems in vocational vehicles, the agencies have proceeded to significantly overestimate the future market penetration of hybrid systems in crafting the Proposed Phase 2 Standards for vocational vehicles. More specifically, the agencies are assuming the following penetration rates and unit costs for "strong hybrid" systems: [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

| <b>Vocational Vehicles</b><br>(Urban and Multi-Purpose) |    | <b>2021</b> |    | <b>2024</b> |     | <b>2027</b> |
|---|----|-------------|----|-------------|-----|-------------|
| LHD   | 4% | (\$15,207)  | 7% | (\$12,578)  | 18% | (\$11,791)  |
| MHD   | 4% | (\$23,904)  | 7% | (\$19,771)  | 18% | (\$18,534)  |
| HHD   | 4% | (\$39,919)  | 7% | (\$33,017)  | 18% | (\$ 30,952) |

The agencies are further assuming that, where deployed, the hybrid systems will generate efficiency gains of 25% for Urban vocational vehicles, and 22% for Multi-Purpose vocational vehicles. The assumed efficiency gains are premised on unrealistic vocational duty cycles that significantly over-estimate the amount of transient operation, at least with respect to Class 8 vocational vehicles (for which detailed field data have been provided to the agencies). Nevertheless, the agencies have incorporated those projected

efficiency gains into the agencies' determination of the Proposed Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

The agencies' assumptions regarding the deployment and penetration rate of strong hybrid systems in heavy-duty vocational vehicles also are not realistic. Thus, to the extent that the Proposed Phase 2 Standards for vocational vehicles are premised on those assumptions, those standards are unrealistic as well. [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

To date, the only heavy-duty application where hybrid systems have been deployed with any measure of success is for urban buses. However, that application is truly unique, since a wide array of public funds are available to cover the very significant incremental costs associated with hybrid systems. [EPA-HQ-OAR-2014-0827-1269-A1 p.60]

At the same time, it is very telling that hybrid systems have not been deployed successfully to any significant measure in residential refuse haulers. That is an application seemingly well-suited to the deployment of hybrid systems, since refuse haulers function primarily over a transient cycle with almost constant stop-start operations to support energy recovery with regenerative braking. Even so, and by way of example, the New York City Department of Sanitation, which has run a number of demonstration programs with hybrid systems provided by a major manufacturer, could not make a viable business case for operating a hybrid fleet due to overall cost considerations. Indeed, given the total incremental launch costs for heavy-duty hybrid vocational vehicles – in the range of \$60,000 to \$100,000 per vehicle – it is unrealistic to assume any large scale cost-effective penetration of hybrid systems. [EPA-HQ-OAR-2014-0827-1269-A1 p.61]

In that regard, it is important to recognize that a refuse hauler's typical payload is approximately 11 tons or 22,000 pounds. At the same time, a strong hybrid system's net weight (net of transmission replacement) is approximately 2,000 pounds, resulting in a payload loss of roughly 10%. The net result to fleet operators is very significant. In essence, 11 hybrid waste haulers are required to carry the same aggregate payload of 10 non-hybrid waste haulers. This calls into question EPA's postulated 25% gains in overall efficiency, as well as EPA's cost estimates, which failed to account for the need for additional vehicles and the related additional maintenance and labor costs. The Agency also failed to account for the corollary 10% increase in criteria pollutants from the resultant increased number of hybrid vehicles in operation, which is yet another offset against the Agency's assumptions. Lastly, refuse haulers that have a reduced payload would need to make more frequent trips to landfills to dump their reduced loads. Those more frequent on-highway drive cycles mean that the refuse hauler would spend less time in the stop-go duty cycle that is well-suited to hybrid operation. All of these factors lead to the clear conclusion that the agencies are significantly overestimating the assumed penetration rates for hybrid systems in vocational vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.61]

The passenger car experience informs this issue as well. In light-duty applications, the weight impacts of hybrid systems can be readily offset by their fuel savings, and there are no vocational work constraints or heavy loads that need to be accounted for. Nonetheless, even in the passenger car market, the penetration rate for hybrids is still only approximately 3% of U.S. sales, notwithstanding more than 17 years of product availability. Given this 3% penetration rate in the much more favorable light-duty market, it is difficult to accept as either reasonable or realistic the agencies' assumed 18% penetration rate for vocational hybrid vehicles over a 6-year time period (2021-2027). [EPA-HQ-OAR-2014-0827-1269-A1 p.61]

Another factor that the agencies have not fully accounted for is the potential impact that hybrid systems can have on NOx emissions. In particular, hybrid systems can result in a heavy-duty vehicle's operation at



lower average power. Such operation can impact the function of SCR systems. Moreover, with the increasing focus on NOx, it can be anticipated that even greater optimization of SCR systems will be necessary, which will make the countervailing impacts of hybrid systems that much more difficult to accept. [EPA-HQ-OAR-2014-0827-1269-A1 p.61]

In sum, the agencies' assumed penetration rates for hybrid systems deployed in vocational vehicles are not realistic. To the extent that the Proposed Phase 2 Standards are premised on those assumptions, those standards will be similarly unrealistic and unreasonable as well. Consequently, and as noted previously, the unrealistic assumptions behind the agencies proposed standards for vocational vehicles lend additional support to the conclusion that the agencies should consider the option of maintaining the Phase 1 program for vocational vehicles until a better-reasoned supplemental rulemaking process can be undertaken. [EPA-HQ-OAR-2014-0827-1269-A1 p.61-62]

**Organization:** PACCAR

Another technology that offers improvements in both fuel efficiency and emission reduction is hybridization. PACCAR's history with hybrid technology was a niche market application appealing to "green" companies as long as incentives offset the cost of the technology. The low volumes was not based on performance, but rather the combination of the payback of the high initial cost based on the limited number of gallons saved in low mileage pick up-and-delivery applications and on the concern over resale value, since at some point in the vehicle's life the battery must be replaced at a significant cost to the owner. Many potential purchasers are reluctant to become the second or third owner of these vehicles, particularly if the battery has not already been replaced, as this is viewed as an extremely high cost of ownership that makes non-hybrid used vehicles more attractive. Based on this experience and feedback from our customers, PACCAR is not optimistic that this technology will gain anything but marginal acceptance. [EPA-HQ-OAR-2014-0827-1204-A1 p.3]

**Organization:** Daimler Trucks North America LLC

Adoption Rates for Hybrids in Alternative 4 - The agencies requested comment on the expected costs to accelerate hybrid development to meet the projected adoption rates of Alternative 4. 80 FR 40320. As we comment above, we recently dropped out of the hybrid market. The systems proved too costly relative to their benefit, and the hybrid OBD certification obstacles were too great. In light of this history, we think it unlikely that we would be able to meet the expected sales volume of hybrids in Alternative 3, much less Alternative 4. Therefore, we recommend against Alternative 4. [EPA-HQ-OAR-2014-0827-1164-A1 p.97] Hybrids – In section 2.4.4.5 of the RIA, the agencies state that "industry is currently developing many variations of hybrid powertrain systems." We think that is a mischaracterization of the market, given that most major manufacturers have pulled out of the hybrid market due to a lack of business partners and purchasers—quite the opposite of developing (new) variations. We did develop a hybrid system for our Super Truck vehicle but found it infeasible for production. In conclusion, we disagree with the agencies' characterization of the hybrid market, and we think that hybrids should not be used as the premise for vehicle standards. 2.4.4.5 of RIA [EPA-HQ-OAR-2014-0827-1164-A1 p.97]

Costs of Hybrids are Underestimated – The agencies seem to dramatically underestimate the costs of hybrids. In particular, when we used to sell hybrid vehicles, the full-vehicle up-charge for the hybrid system was between [redacted], depending on the vehicle and its features. So the agencies' estimate of \$5,571 is less than [redacted]% of the price. Although we prefer not to use the agencies' method of ignoring the per-vehicle up-charge for technologies and instead spreading that cost across the entire fleet of vehicles, at an 18% penetration rate (the agencies' assumed rate) the hybrid cost should be at least \$[redacted],000 (18% x \$[redacted],000). Even under this analysis, the cost-benefit analysis is much

different than the agencies assumed. But under a more realistic analysis, where the entire hybrid cost is borne by the hybrid purchaser and not spread across the fleet, the cost-benefit is far worse. For this reason, we recommend against including hybrids in standard setting. [EPA-HQ-OAR-2014-0827-1164-A1 p.97]

**FCRs for Hybrids** – We have several concerns about the way that the agencies developed FCRs for hybrids, especially considering how heavily the hybrid FCRs factor into standard setting. First, the agencies assumed a hybrid FCR of 22 to 25% on the Phase 2 test cycles based upon NREL measurement of 28% on the NYC Composite Test Cycle. 80 FR 40297. This test cycle has a very high kinetic intensity, such that it may overestimate achievable FCRs for hybrids. Similarly the use of HTUF4 data may fail to capture the actual fuel savings possible on the agencies’ test cycles. We recommend that if the agencies intend to continue to premise the standards on hybrids that the agencies base FCR values on tests using the correct duty cycles. Second, we recommend that the agencies perform these tests with batteries aged to represent the worst-case FCR over the vehicles’ useful lives, as the agencies would require manufacturers to certify. Taking optimal test data to represent full useful life emissions is not appropriate. Third, and similarly, we recommend that the agencies not measure the optimal hybrid configurations for generating FCR numbers, as manufacturers will be unable to do so. Rather, manufacturers will have to certify the worst-case configuration of a family of hybrid vehicles. So while the best tests might show 22 to 25% FCRs, if the worst show 10%, then the standards must be set based on 10% as that is how manufacturers will certify. [EPA-HQ-OAR-2014-0827-1164-A1 p.81]

**Organization:** Volvo Group

As part of the NoDA release the agencies proposed a simplified model for evaluating the benefit of hybrid systems (HD GHG Simple Hybrid Model v4 - EPA-HQ-OAR-2014-0827-1725). In our review of the simplified model, Volvo noted two primary concerns. First, the agencies have assumed 100% efficiency for the batteries ability to absorb and release energy, as well as not accounting for additional electrical system inefficiencies. Second, the agencies’ accounting for drag and friction appear to only account for tire rolling resistance and aerodynamic drag, without accounting for the additional mechanical inefficiencies such as oil churning, gear efficiencies, etc. Without accounting for the noted concerns Volvo does not believe this model is acceptable as a calculation tool for use in stringency determination. [EPA-HQ-OAR-2014-0827-1928-A1 p.20]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

ACEEE strongly supports the inclusion of a modest number of hybrid vehicles in the compliance package for the vocational vehicle standards. Many vocational vehicles spend a significant amount of time in idling and in stop-and-go operation, making them suitable candidates for hybridization. We agree with the agencies’ estimate of 22-25% improvement from hybridization using the powertrain test (p. 40297).

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

The agencies recently uploaded a physics-based simple hybrid model, which can be used to quickly estimate the potential fuel savings for different vocational hybrid designs.<sup>15</sup> It is clear from this model that there is a wide range of hybrids that can result in significant fuel savings, even those with relatively small batteries as would be found in a mild hybrid. [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

Mild hybrids were not discussed in the proposal as part of the compliance package; however, as is evident from this modeling, these cheaper hybrid variants could offer much of the same benefit in certain applications at reduced cost. We strongly encourage the agencies to include mild hybridization as part of

its compliance package in addition to cost-effective full hybrid application, as already identified in the proposal. [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

**Organization:** Eaton Vehicle Group

Hybrids did not penetrate the commercial vehicle landscape, in spite of the Phase 1 ATC program. This is due to a combination of high battery costs and low fuel prices. According to the current EIA analysis, fuel prices are expected to stay low in the foreseeable future. However, the Hybrids potential to reduce fuel consumption and CO2 emissions still exists, and under specific economic and regulatory circumstances, hybrid sales thrive, e.g., in China. For the US market, we see a combination of factors needed to re-ignite the hybrids business: lower battery costs and increased efficiency of the hybrid systems for Class 6-8, lower cost mild hybrid powertrains in Class 3-5, and continued regulatory pull. Our market penetration assumptions for the end of this decade are pessimistic. We are encouraged by steady progress in battery costs driven by light duty applications, but we also observed recently a reduction in sales in that segment, putting in question the timing of lower cost battery availability. On the other hand, the proposed standards in the vocational space are likely to drive significant hybrid adoption as the conventional powertrain improvements are realistically limited to approximately 10-12% fuel consumption reduction in the Mixed and Urban categories, while the MY2027 standards call for a 1416% overall fuel consumption reduction. [EPA-HQ-OAR-2014-0827-1194-A1 p.17]

For Class 3-5 vehicles, it is possible replace Diesel engines with downsized hybrid gasoline powertrains. A form of mild hybridization for such situations is described [Benjey 2015]<sup>2</sup>, where a low-voltage and low-power system (48V and 6kW) is used to provide significant electrically generated boost at low engine speed. This enables 12% fuel consumption reduction over a baseline MD diesel powertrain under drive conditions, with the further added value of an engine-off at idle. Because of the low voltage system and simplified emissions controls of gasoline engines, such systems should not increase vehicle cost. [EPA-HQ-OAR-2014-0827-1194-A1 p.18]

In the Class 6-7 urban segment, there is a potential to further increase the MD hybrid system value through deeper integration with the vehicle controls and the use of predictive methods to optimize the electrical versus engine power distribution. This enables a 10-15% improvement of the hybrid fuel savings through advanced controls, i.e., without incremental costs of weight to the conventional hybrid system [Patil 2015]<sup>3</sup>. [EPA-HQ-OAR-2014-0827-1194-A1 p.18]

From a regulatory perspective, we agree with the EPA approach to Hybrids, namely that these should be powertrain tested for actual fuel consumption. We believe that while the EPA is looking at not continuing the Advanced Technology Credits program for Hybrids after 2021, the Hybrid market is still very fragile and driven by the cost of fuel. As we look toward a long period of lower cost fuel as predicted by the EIA, we do not see market conditions improving for Hybrid commercial vehicles except for a few mild Hybrid applications in the Class 3-4 segment. We are not optimistic that Hybrid technology will evolve significantly before the rule comes into effect, a situation similar to 2012-13 when the slump in Hybrid sales occurred. We believe contributing factors included hybrid OBD requirements during the low-volume phase of commercialization and unclear battery warranty associated with useful life requirements that shifted development resources away from Hybrid cost reduction. [EPA-HQ-OAR-2014-0827-1194-A1 p.18-19]

**Recommendation:** The EPA and CARB should develop an OBD and battery warranty strategy for Hybrids that should stay in place until sufficient numbers of Hybrid-equipped vehicles are on the road. As the NPRM requires powertrain testing for Hybrids, it may be opportune that OBD requirements are

replaced with the requirement to demonstrate there is no backsliding in criteria emissions on the powertrain test data. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

Odyne

Odyne believes that improvements in drivetrain, hybrid control system optimization – both from technology advancements and increased data incorporation of workday assumptions, and duty-cycle optimization – along with continually decreasing costs for components (as EPA has very accurately estimated going forward) and continuing volatility in fossil fuel prices will drive the value proposition for hybrid deployment in the coming years. Odyne believes hybrids will play a larger role in fleet procurement in the next decade at efficiency rates higher than is currently modeled in Scenario Three's assumptions. [EPA-HQ-OAR-2014-0827-1239-A1 p.4] [This comment can also be found in EPA-HQ-OAR-2014-08267-1372, p.230.]

In addition, the accounting for the efficiency improvements from hybrid technology is not as clear as it could be in the proposed GEM model. Odyne would welcome the opportunity to work with the EPA on best practices and potential pathways for modeling fuel efficiency increases from various applications of hybrid PTO mode, in addition to hybrid propulsion. [EPA-HQ-OAR-2014-0827-1239-A1 p.6-7] [This comment can also be found in EPA-HQ-OAR-2014-08267-1372, p.232.]

Odyne believes that future hybrid systems will be capable of reducing fuel consumption and GHG emissions by 50% or greater at paybacks of 3 years by 2021 and 2 years by 2027 for vocational multipurpose, urban, and potentially other classes of trucks. We believe that hybrid projections assumed by the EPA in its draft rule – including effectiveness rates of —25% and paybacks from 4-6 years – can and should be strengthened in light of this and other stakeholder data and analysis. We welcome the opportunity to work with the EPA on assumptions made in the final rulemaking from cost projections and performance data Odyne can offer. [EPA-HQ-OAR-2014-0827-1239-A1 p.17]

EPA: Mild hybrid - A small, engine driven (through a belt or other mechanism) electric motor/generator/battery combination to enable features such as start-stop, energy recovery, and launch assist. [EPA-HQ-OAR-2014-0827-1239-A1 p.35]

Or

EPA: Mild hybrid electric vehicle means a hybrid electric vehicle that has start/ stop capability and regenerative braking capability, where the recovered energy over the Federal Test Procedure is at least 15 percent but less than 65 percent of the total braking energy, as measured and calculated according to § 600.116–12(d). [EPA-HQ-OAR-2014-0827-1239-A1 p.35]

EPA Strong hybrid - A powerful electric motor/generator/battery system coupled to the powertrain to enable features such as start-stop, and significant levels of launch assist, electric operation, and brake energy recovery. For HD pickups and vans, the engine coupled with the strong hybrid system would remain unchanged in power and torque to ensure vehicle performance at all times, even if the hybrid battery is depleted. [EPA-HQ-OAR-2014-0827-1239-A1 p.35]

Or

EPA Strong hybrid electric vehicle means a hybrid electric vehicle that has start/stop capability and regenerative braking capability, where the recovered energy over the Federal Test Procedure is at least 65

percent of the total braking energy, as measured and calculated according to § 600.116–12(d). [EPA-HQ-OAR-2014-0827-1239-A1 p.35]

Odyne: If changes reflected in our comments above on start/stop are made, then changes are not needed for hybrids. Otherwise, we would suggest adding “or other means to eliminate fuel consumption when the vehicle is stopped.” The same considerations for Mild Hybrid should be applied to Strong Hybrid and it should mention heavy-duty trucks as well. [EPA-HQ-OAR-2014-0827-1239-A1 p.35-36]

**Response:**

The agencies are including hybrid powertrains as a technology on which some of the vocational vehicle standards are predicated. We proposed ten percent overall adoption of strong hybrids by MY 2027, which meant approximately 18 percent adoption in the Multipurpose and Urban subcategories in that model year. The agencies also discussed mild hybrid availability in the Preamble (80 FR 40298). In consideration of comments from Eaton, ACEEE, UPS, Odyne and others expressing familiarity with and support for consideration of mild hybrids in the standards, we have determined that mild hybrids are more likely than strong hybrids to succeed initially in the vocational sector. Accordingly, the stringency of the final standards is not predicated on use of strong hybrids, but does reflect deployment of mild hybrid systems at a rate of 14 percent in the Multipurpose and Urban subcategories in MY 2027.

We appreciate the comments from manufacturers of hybrids including Odyne, Parker, XL Hybrids, Eaton, and others who supported including hybrids in the stringency of the Phase 2 vocational vehicle program. We believe that the drive cycles and test procedures for recognizing hybrids in the final program are significantly improved since Phase 1, and should provide good opportunities for marketing these products. We appreciate comments in support of hybrids from those with the fleet perspective, including UPS and CalStart, as these customers can give the true measure of whether the products are worthwhile. We recognize the concerns of commenters who cautioned against consideration of hybrids in developing standard stringency, including OshKosh, Daimler, Allison, TRALA, EMA, Paccar, and Navistar. In particular, the comments from Navistar provide an excellent summary of the challenges presented by this technology. In considering all these comments as well as other supporting information, we believe that manufacturers and suppliers will be able to overcome these challenges to a large extent in the timeframe of Phase 2. Furthermore, the technology path we have identified is only one of many that may be pursued.

We are projecting adoption of two types of mild hybrids, defined using system parameters based on actual systems commercially available in the market today. We have taken into consideration the concerns of secondary manufacturers by assuming that some mild hybrid systems will be integrated with an engine sufficient to enable use of an engine stop-start feature, while some mild hybrids will not be integrated and these “bolt-on” systems will only provide transient benefits (i.e. benefits under transient operating conditions) related to regenerative braking. We also have reconsidered our effectiveness estimation method as a result of comments. Instead of relying on previously published road tests over varying drive cycles, we are applying engineering calculations to account for defined hybrid system capacities and inefficiencies over our certification test cycle. We are using a spreadsheet model that calculates the recovered energy of a hybrid system using road loads of the default baseline GEM vehicles over the ARB Transient test cycle. See RIA Chapter 2.9.3.1.3 for details regarding the assumed motor and battery capacity, swing in the state of charge, and system inefficiencies. We appreciate the comments from Volvo and ACEEE regarding the agencies’ analysis of mild hybrid effectiveness as detailed in the draft

spreadsheet model that was released around the time of the NODA.<sup>185</sup> In response to comments, we have amended the model to include additional inefficiencies.<sup>186</sup> The projected cycle-weighted effectiveness reflects an assumption of zero effectiveness under highway cycles. For the non-integrated models, the same system was assessed for all weight classes (not scaled up for heavier vehicles); however, for the integrated models with stop-start we have scaled up the system specifications to account for the larger road loads, to ensure the projected effectiveness is not decreased for systems on heavier vehicles relative to that projected for lighter vehicles. As described in the RIA Chapter 2.11.7.2, these costs have been scaled up by the curb weight of the vehicles. However, in analyzing different system designs using the spreadsheet model we found that some systems were limited only by the motor, and costs of motors may not need scaling to the same degree as other components. Therefore, we believe that our hybrid system manufacturing costs are conservative. In considering the costs relative to the technology effectiveness, we estimate the cost per percent reduction of mild hybrids to be on the order of the cost per percent of adding two gears for Class 8 Urban vocational vehicles. For Class 6-7 Urban vocational vehicles we estimate the cost per percent of an integrated mild hybrid with stop-start to be on the order of the cost per percent of advanced shift strategy for a conventional powertrain, and the non-integrated bolt-on to be on the order of adding two transmission gears. For class 2b-5 Urban vocational vehicles we estimate the cost per percent of an integrated mild hybrid with stop-start to be about half of the cost per percent of advanced shift strategy for a conventional powertrain, and the non-integrated bolt-on to be on the order of electrified accessories. Actual cost-effectiveness for the individual user will depend on many things including the annual miles driven by the vehicle owner under transient conditions.

We received many comments on the feasibility of hybrids for refuse trucks. The National Waste & Recycle Association, Parker, and Autocar commented in support of hybrids for the refuse sector, while EMA's comments point out examples where hybrids have failed to meet expectations for refuse fleets. We believe these conflicting viewpoints can be reconciled by consideration of technology and duty cycles. In a meeting with Effenco, the agencies discussed confidential information based on telematics data obtained from refuse fleets indicating that some refuse drive cycles have such low kinetic intensity that the energy available for recapture from regenerative braking was not worth pursuing. Importantly, the efficiency with which a system captures and reuses braking energy depends on its design -- including whether it is battery-electric, capacitor-based, or hydraulic. Further, for drive cycles where the speed between stops is under 10 miles/hr, Effenco found capacitor-based stop-start technology to be more cost-effective than its previously-tested hybrid systems. Effenco observed these low-speed driving patterns for some neighborhood refuse collection trucks and some inner-city transit buses.<sup>187</sup> Effenco's comments on stop-start systems can be found in Section 6.3.4, below. As noted by OshKosh in its comments above (see Section 6.1.5), there are many types of refuse trucks with many duty cycles serving a variety of purposes related to collecting and hauling refuse and recycled materials in communities across the U.S. Therefore it is entirely possible that some portions of the refuse fleet may be well suited to various hybrid systems and/or stop-start systems, and some may not be. For discussion of comments related to hybrids on vehicles certified to the optional custom chassis standards, see Section 6.2.3.

Although the final Phase 2 vocational vehicle program reflects certain estimates that are more stringent than those proposed, the projected hybrid adoption rate is less aggressive than proposed. The Alternative 4 path would have projected 10 percent strong hybrids overall by MY 2024, which at proposal was estimated at 18 percent in the Multipurpose and Urban subcategories. Although we agree with CARB that there are companies selling small volumes of hybrids today, we disagree that projecting an optimistic

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<sup>185</sup> See spreadsheet file dated February 2016 titled, "HD GHG Simple Hybrid Model v4.xlsx, Docket ID EPA-HQ-OAR-2014-0827-1725.

<sup>186</sup> See spreadsheet file titled, "HD GHG Simple Hybrid Model v7.xlsx".

<sup>187</sup> See docket memo with meeting log, specifically Web Conference with Effenco, August 31, 2015.

hybrid adoption rate in the early years of the Phase 2 program would induce higher sales of those systems in the short term. There are complex market barriers to adoption of hybrids, not the least of which is that few if any chassis OEM's build these, and business relationships with second stage manufacturers are virtually nonexistent today. As noted by Daimler in its comments, one of the reasons it dropped out of the hybrid market was related to the hybrid OBD certification obstacles. See Section 14.3.1 and 14.3.3 for responses to comments about hybrid OBD. Although there is a (costly and time-consuming) path that has been successfully navigated by some manufacturers to obtain hybrid OBD approval, this will likely remain a significant market barrier to hybrid adoption for many years.

Responses to comments on hybrid PTO systems are found in section 6.3.6.3 below. Where a hybrid system is capable of improving vehicle efficiency while driving as well as while parked in PTO mode, the certifying manufacturer may submit powertrain test data as well as data from the hybrid PTO test procedure, and would be eligible for both types of credits. See Section 6.1.1 for responses to comments on NOx emissions from workday idle, see Section 15.8 for responses to comments on NOx from hybrids.

#### **6.3.4 Workday Idle Reduction Technologies**

This section addresses comments relating to three workday idle reduction technologies: neutral idle, stop-start, and automatic engine shutdown. See Section 6.3.6.3 for comments relating to electrified power take-off systems, which reduce high-idle emissions through electrification of the PTO function.

**Organization:** Allison Transmission, Inc.

#### **EPA and NHTSA Should Not Assume Adoption of Idle Reduction Technologies For Emergency Vehicles**

EPA and NHTSA have requested comment on whether the agencies should assume any market adoption rate for idle reduction technologies for emergency vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.48]

Allison does not support inclusion of an adoption rate for idle reduction technologies in emergency vehicles; instead we would urge a large degree of caution in this area due to the possible introduction of operational risk. For example, it could be possible for emergency lights and sirens to drain batteries to the point where a restart of the engine could not be commanded. The existence of such risks weighs heavily against any incremental gains that might accrue through reduction emissions from such specialized vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.48]

Additionally, a typical emergency vehicle duty cycle would result in much less use of the idle reduction technologies than for vehicles in the commercial sector. For a typical duty cycle, when vehicles are "on their way to an emergency," stops are not made and distances may not be long given the practice of dispatching nearby vehicles. Although there can be "normal" driving on the return trip from an emergency run, as well as some routine daily driving to ensure all equipment is working, the unique use pattern of these vehicles would prevent a significant amount of the benefits to be derived from idle reduction technologies. [EPA-HQ-OAR-2014-0827-1284-A1 p.48]

Allison's OEM customers, who manufacture safety and emergency vehicles, have also conveyed their concern for implementing idle reduction technologies that may introduce this operational risk for their end-user customers. Emergency responders always expect to be able to promptly complete every emergency run; the best course of action in this rulemaking would be to not assume any adoption rate for idle reduction technologies and instead, allow the emergency vehicle market to consider when such technology is useable with acceptable levels of any risk. [EPA-HQ-OAR-2014-0827-1284-A1 p.48]

**Organization:** Fire Apparatus Manufacturers' Association (FAMA)

FAMA does not support idle reduction technology in fire apparatus for the following reasons: [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

- Shutting off the engine at every stop will not be practical for fire apparatus where every second counts on the way to an emergency. [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

- HVAC is powered by the engine and used to keep the occupant areas warm in the winter and cool in the summer. This provides an essential place for fire fighters to recover after exposure to the elements. [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

- Firefighters keep the engine running to maintain pump pressure so that it is available when needed. [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

- The water pump is powered by the engine. Pump water circulation in cold weather keeps the water in the tank and lines from freezing [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

- Hydraulic pumps for aerial operator are powered by the engine. Hydraulic fluid circulation keeps the fluid warm and avoids sluggish aerial device operation. [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

- Engine idling maintains battery charge when operating warning lights, communication equipment, and other current draw at the scene. [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

FAMA does not support idle reduction technology in ambulances for the following reasons: [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

- Shutting off the engine at every stop will not be practical for ambulances where every second counts on the way to an emergency and while in transit to the hospital. [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

- HVAC is powered by the engine and used to keep the cab and patient compartment warm in the winter and cool in the summer. This is critical for patient care. HVAC in ambulances also includes air filtering and decontamination that protects patients and EMTs. [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

- Engine idling maintains battery charge when operating warning lights, communication equipment, medical equipment and other current draw at the scene. [EPA-HQ-OAR-2014-0827-1163-A1 p.2]

**Response:**

We agree with commenters that the workday idle technologies considered in this rulemaking are not feasible on emergency vehicles. For an idle reduction technology to match the needs of an emergency vehicle, it would need to perform additional battery load management functions. If an emergency vehicle were to be built with such a system, and if it met the criteria in the regulations for AES, the manufacturer may obtain certification credit for it in GEM. Otherwise, off-cycle credit may be requested.

**6.3.4.1 Stop Start**

**Organization:** Daimler Trucks North America LLC



**GEM Inputs for Stop-Start Technologies** – We are not certain that we understand how GEM credits stop-start. As we understand: First, for any engine, there are two idle points in the fuel map, one with no load and one with torque converter load. If the engine has stop-start functionality, then the fuel rate is zero at idle points. If we understand correctly, then the stop-start approach may overestimate fuel savings, in that any stop-start system will take some time to shut off (based on light-duty vehicle experience). How to properly credit that technology, without over-crediting it, is something we should discuss with the agencies. [EPA-HQ-OAR-2014-0827-1164-A1 p.63]

**Criteria for Stop-Start Approval** - The agencies request comment on an appropriate definition of stop-start technologies for vocational vehicles. 80 FR 40300. Recognizing that there are no heavy-duty stop-start technologies on the market right now, we think that it might be difficult to perfectly define the qualifying criteria. However, we wish to avoid the scenario like we had with innovative technology certification in Phase 1, when we had to go through numerous lengthy discussions with [redacted] To avoid unnecessary certification burden, and to avoid the error of failing to qualify a truly fuel-saving technology for the credit it deserves, we recommend that the agencies stick to a simple definition. For example, a vehicle should get stop-start credit if its engine will automatically stop itself rather than idle under some conditions and will turn itself back on when the driver requests torque. The agencies need not define what the conditions are, given that manufacturers might need to limit the stopping functionality under different sets of conditions, such as when the air conditioner is operating or when a hydraulic system demands power for on-vehicle vocational work. Although the agencies might be concerned that the engine will not shut off in all instances of zero torque demand, the agencies should rest assured that if a manufacturer installs a starter system, electrical system, HVAC, etc. capable of operating when the engine is off, then the manufacturer will try to return the vehicle owner's investment by maximizing the associated fuel savings. In short, the agencies should use as generic a definition as possible, because they are safe in the knowledge that the systems will maximize fuel savings to the extent technically possible. [EPA-HQ-OAR-2014-0827-1164-A1 p.67]

**Organization:** GILLIG LLC

Regarding the Stop/Start Idle Reduction Strategy, we see this as a strong hybrid only strategy at this point and only with some modifications to how long and how frequently after zero vehicle speed it can be employed. Transit buses transport people in extreme hot and cold environments and maintaining conditioned air in the bus at layovers or extended bus stops for passenger comfort and safety is essential. Currently, idling the engine or drawing power from a sizeable battery pack such as those employed with strong hybrids are our only options for maintaining interior climate control. [EPA-HQ-OAR-2014-0827-1156-A1 p.2-3]

**Organization:** Bosch

**Stop-Start** - Bosch supports the inclusion of an Idle Cycle, such as the one outlined in the draft Regulatory Impact Analysis (RIA) section 3.4.2.3, to recognize the benefits of stop-start technology for Vocational Vehicles. [EPA-HQ-OAR-2014-0827-1466-A2 p.10]

Bosch further suggests that recognition of the benefit of stop-start for other vehicles, such as urban delivery vehicles, should be included in the regulation. In cases where lower fuel rates during idle cannot be easily quantified on these vehicles, for inclusion in the Greenhouse Gas Emission Model (GEM), an off-cycle credit should be assigned. [EPA-HQ-OAR-2014-0827-1466-A2 p.10]

**Organization:** Effenco Hybrid Solutions

Another comment regards the cost estimates for stop-start technologies. While “Stop-start systems can be viewed as having a place on the low-cost end of the hybridization continuum” as it is mentioned in the RIA section 2.9.3.4, one can appreciate that a minimum of additional hardware is required to deliver enough power to frequently and seamlessly restart a large engine as well as to keep accessories and equipment operational with the engine turned off. We believe that with volume and integration, the incremental costs of stop-start technologies for vocational vehicles will range between \$5,000 and \$10,000 in MY 2027 vs the \$1,374 estimated by the agencies. [EPA-HQ-OAR-2014-0827-1148-A1 p.3]

Finally, the fuel efficiency improvements that we measured on the field with our Active Stop-Start technology range between 11 and 30% depending on duty cycles. We would be glad to provide the agencies with additional data on this matter. [EPA-HQ-OAR-2014-0827-1148-A1 p.3]

**Organization:** Allison Transmission, Inc.

The technological adoption rates for Alternative 3 are too ambitious in several areas, in addition to the rate that is assumed for adoption of Stop-Start technology. Thus, Alternative 4 should be rejected and Alternative 3 modified to account for slower adoption of Stop-Start technology than projected. [EPA-HQ-OAR-2014-0827-1284-A1 p.15]

Allison also believes the DMC is understated for engine Stop-Start in all three of the vocational categories, LHD, MHD, and HHD vehicles. The 25% upward scaling factor is insufficient to address the differences between LDV and HDV. The duty cycle for a work truck is much more severe than HD pickups and vans which results in larger components. Also, the vocational vehicle volume is much lower than HD pickups and vans so the economies of scale are not able to be realized. Costs will increase from LDV's due to the high degree of design and integration of new components among the vehicle manufacturer, engine manufacturer, and transmission manufacturer to assure that the system is reliable, but more importantly, safe. It is anticipated that many components will need to be redesigned to be durable based on the number of additional cycles imposed by Stop-Start operation. The 25% upward scaling factor from each vehicle size to the next is believed to be too low due to the non-linearity of cost as vehicle size increases. [EPA-HQ-OAR-2014-0827-1284-A1 p.14]

Allison believes the costs associated with an adoption rate of 70% are also understated. Vocational vehicles that operate in climates with temperature extremes have situations where a truck operates at idle in order to provide heating and/or air conditioning for the work crew. In these situations, the cost of additional technology to provide power for the HVAC system is not included in EPA's and NHTSA's analyses. Energetics Incorporated conducted an idle-reduction study in vehicles operated by New York Department of Transportation. This study reported that costs for a system to provide cab heat was \$8995. A basic system with only Stop-Start capability, i.e. no heat or exportable power, cost \$1995, which is consistent with Allison's projections for an entry-level system for an LHDV. Most vehicles had a payback in excess of 5 years, with approximately half of the vehicles studied, having a payback less than 10 years.<sup>25</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.14]

Allison is aware of a stop-start system that is used with the 3000 Series and 4000 Series TM transmissions in Class 8 refuse trucks and terminal tractors. Effenco's Active Stop-Start™ system's current installed cost is in the \$30,000-\$35,000 range. Although Effenco plans to reduce this cost by half, it is still reflective of the complexity to implement this technology on HHD vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.14]

In addition, while Allison does not have data that would confirm whether 70% of vocational vehicles could adopt Stop-Start technologies without impacting their specific work functions, Energetics was also

not able to draw a conclusion for the NYSDOT fleet. Instead, this review noted that “[l]ong-term monitoring may also provide a clearer picture of which vehicles need certain auxiliary vehicle functions that requires the engines running to perform their job.”<sup>26</sup> Even so, it is clear that certain vehicles, such as refuse packers, fire trucks, concrete mixers and other specialized vehicles are very unlikely to adopt technology to turn off engines at stop. Although Stop-Start equipment may be theoretically available to such vehicles, the energy requirements of the vehicles are so large as to preclude electrified options at reasonable costs. This calls into question the ability to reach a 70% penetration rate assumed by the agencies. [EPA-HQ-OAR-2014-0827-1284-A1 p.15]

Allison Transmission

Consistent with comments that Allison submitted with respect to the Proposed Rule, we are concerned that EPA has projected overly-aggressive adoption rates for stop-start [for custom chassis] based on the technology reach and the high costs of start-stop systems in the time frame of Phase 2 rules. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

There are two factors which make these assumed rates overly optimistic. First, given the nature of the heavy-duty industry, high technology adoption rates require close cooperation between vehicle OEMs, engine manufacturers, major component suppliers and body builders. It is simply unrealistic to believe that the high projected adoption rates for engine stop-start are feasible given these interactions and the fact that the end market for vehicles drives production. Second, for at least some vehicles, high adoption rates for engine stop-start may not be possible in the time frames projected. For example, projecting that refuse vehicles will achieve 50% penetration by Model Year 2027 does not account for the large increase in the cost and weight of such vehicles since some energy storage is expected to be required to power the pack cycle. Other types of heavy heavy-duty (“HHD”) vehicles may have relatively low annual production volumes, making it difficult to recoup the added cost of engine stop-start technology. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

### **EPA and NHTSA Should Incorporate Regulatory Definition of Stop-Start Technologies**

Within the discussion of workday idle reduction technologies, EPA and NHTSA have requested comment concerning an appropriate definition of Stop-Start technologies for vocational vehicles. Allison recommends that the agencies incorporate a specific definition for Stop-Start technologies. We believe that such technologies can be defined in a straightforward manner as follows: [EPA-HQ-OAR-2014-0827-1284-A1 p.46]

Stop-Start Technology means (a) a computer controlled event that occurs when a vehicle is stopped with no (or low) driver demand for propulsion torque and when fuel is not flowing to the engine; (b) which allows for restart of the engine; and (c) is capable of being off for the entire stopped time in the ARB Transient and regulatory Idle Cycles. [EPA-HQ-OAR-2014-0827-1284-A1 p.47]

EPA must recognize that some conditions as determined by a computer may prevent the engine from stopping each time the conditions defined above are met. This may include, but not be limited to extreme grades, engine and transmission operating temperatures, and emission control-related parameters. [EPA-HQ-OAR-2014-0827-1284-A1 p.47]

**Organization:** Waste Management (WM)

### **WM is Concerned that EPA Assumptions Regarding Technology Penetration May not be Reflective of Vocational Refuse Fleets**

As discussed above, heavy-duty refuse trucks are not typical of most vocational fleet vehicles. Some of the technologies that the agencies assume will penetrate all vocational vehicle fleets may not be workable for refuse trucks. For example, start/stop technology would be highly problematic for our operations. When a refuse vehicle stops and idles, the vehicle is still engaging in significant work lifting heavy loads, and operating a trash compactor and heavy doors. The trucks stop often, with commercial refuse vehicles averaging about 100 stops per day, while residential refuse vehicles may make between 800-1200 stops per day. Our trucks burn more than 30 percent of the total fuel used while stopped and operating heavy vehicle accessories to service the customer. [EPA-HQ-OAR-2014-0827-1214-A2 p.7]

The agencies need to recognize that vehicles with a significant power take-off (PTO) load will not be able to accommodate start/stop technology. In section 3.7.4 of the Regulatory Impact Analysis, the agencies assert that “typical PTO systems require no more than 19 kW at any time.” WM disagrees with this assertion in regard to refuse trucks. Our refuse trucks routinely require a range of 36kW to 80kW power level to supply significant hydraulic system demands. While some vocational vehicles might be able to use start/stop technology in combination with electric PTO (ePTO) to operate smaller accessories or lift lighter loads, a refuse vehicle will require a large electric motor and a large battery with significant storage capacity to enable the vehicle to lift heavy dumpsters or operate a heavy-duty compactor. Such additions to a refuse truck might offset the benefits of weight reduction technologies and significantly increase vehicle costs. We also note that ePTO technologies are not used anywhere in our fleet or by any major refuse company that we are aware of. Therefore, we believe that assuming significant penetration of ePTO technology or start/stop technology into the refuse sector would be overly optimistic. [EPA-HQ-OAR-2014-0827-1214-A2 p.7]

**Organization:** Navistar, Inc.

Stop-start technology is defined under proposed section 1037.520(f)(8) as a vehicle system that shuts off the engine under idle conditions within 30 seconds of a vehicle coming to a stop. The application and benefits of stop-start strategies must carefully weigh the fuel savings benefit against the impact on durability and operator safety of engine emissions components. These strategies must have sufficient engine, aftertreatment and occupant protections in place such that any fuel cost savings are a net benefit for the owner/operator without compromising safety. [EPA-HQ-OAR-2014-0827-1199-A1 p.32-33]

There are certain operating conditions in which a stop-start strategy are not recommended for mission-critical operations, these would include any PTO operation, emergency vehicle, utility truck, concrete mixer, refuse applications and many off road applications including utility and digger derrick. Loss of power to the PTO during normal mobile or stationary work operations can have severe safety implications for the driver/operator and or passenger/worker. In such cases a PTO inhibitor would preclude any start stop operation and associated fuel savings. [EPA-HQ-OAR-2014-0827-1199-A1 p.33]

Engine and aftertreatment durability protections should inhibit or aggressively control start stop operation. For example, the periods during a DPF regeneration or when an aftertreatment warm up strategy is in process each represent normal operating modes when maintaining fuel and or exhaust flow to the aftertreatment system is critical to ensuring long term durability and effective emissions conversion. These limits would need to account for other engine parameters, such as coolant, oil and ambient air temperature where it is important to achieve and maintain normal operating temperature. [EPA-HQ-OAR-2014-0827-1199-A1 p.33]

Engine turbocharger failures due to coking can occur during a high load, hot shut down events when the cooling and lubricating oil is removed. When this occurs the lubricating oil can partially volatilize leaving a layer of coked oil on the bearing surfaces. With repeated occurrences the bearing clearances and

turbocharger performance decrease. This in turn affects the turbocharger efficiency and by extension engine efficiency, as well as durability. With the cost and complexity of turbocharger systems increasing, the impact of a single turbocharger failure can add several thousand dollars and can easily offset any fuel economy benefit to be gained from an aggressive stop-start strategy.[EPA-HQ-OAR-2014-0827-1199-A1 p.33]

Assurance of customer comfort (heat/AC/other accessories), as well as safety for vehicles operating on steep grades, off road and for vehicles using air brakes must be taken into consideration. Advisable steps might include allowing start/stop strategies to monitor the vehicle orientation, battery state of charge and accessory power loads and adjust start/stop operation accordingly. This would ensure there is sufficient power to operate any engine-off accessories up to a point where the battery capacity has reached a critical point. At that critical point the engine would need to be restarted automatically to maintain normal vehicle operation. [EPA-HQ-OAR-2014-0827-1199-A1 p.33]

In some cases where the stationary electrical demands are high, customers may elect to install additional batteries to ensure that their extended engine off operation does not compromise the ability to restart the vehicle. This added weight may partially negate the fuel efficiency impact of any stop-start system. Finally, underlying all of these durability and safety concerns is the cost of upgrading or replacing engine starters which need to be resized to accommodate the higher frequency of starting events. Additional costs of upgrading alternators and battery capacity would also need to be addressed depending on the application and on customer demands. [EPA-HQ-OAR-2014-0827-1199-A1 p.33-34]

As previously mentioned air brake equipped vehicles will need sufficient inhibit features to allow the application or release of the service brakes in order to operate the vehicle safely. The threshold limit would need to be set reasonably high to account for vehicle foundation brakes as well as any trailers and associated system leakage. In addition some fleets--e.g. heavy haul, refuse, mixer trucks and tow trucks--may elect to have this feature set as a programmable parameter to ensure maximum safety is maintained. [EPA-HQ-OAR-2014-0827-1199-A1 p.34]

In every instance, the concept of increasing fuel economy by adding seemingly simple features like engine stop-start comes with a broad range of concerns that can impact vehicle safety, functionality, engine and emissions component durability and passenger comfort. An integrated approach must be taken to develop this functionality in order to ensure that any incremental fuel economy benefit is achievable without any underlying customer cost or inconvenience. [EPA-HQ-OAR-2014-0827-1199-A1 p.34]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The assumptions that as of 2027 70% of Class 7 and 8 vocational vehicles will utilize stop-start technologies and 30% of those vehicles will utilize neutral-idle technologies are grossly overstated and not supported by current data, and so are unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

“Stop-start” technology is defined under proposed section 1037.520(f)(8) as a vehicle system that shuts off the engine under idle conditions within 30 seconds.<sup>3</sup> Proposed section 1036.501(g)(2) also would allow manufacturers to run emissions tests of engines with the engine turned off during the idle portions of test cycles, based on good engineering judgment, if the engine is to be used in a vehicle with stop-start technology. [EPA-HQ-OAR-2014-0827-1269-A1 p.48] EPA anticipates that stop-start technology will reduce fuel consumption from 0.5% to nearly 7%, depending on duty cycle, with the greatest reduction over the Urban duty cycle. In the NPRM, the agencies assume that stop-start systems will be deployed in 100% of vocational vehicles in MY 2024-2027. However, a detailed spread sheet from the RIA shows that the agencies actually project that start-stop technologies will be applied at varying penetration rates

significantly less than 100% (i.e., ranging from 5% to 85%) in the several different vocational vehicle categories over the 2021-2027 time period.

Application of stop-start technology is more challenging for HHD vehicles than for MHD vehicles where systems are more likely to be implemented. In Table 2-177 of the RIA, the agencies provide cost estimates for stop-start technology for HHD vehicles, starting at \$1444 in MY 2024, and reducing to \$1374 in MY 2027. The agencies' cost estimates, however, have not fully considered the impacts on engine or vehicle components for HHD vocational vehicles. For example, previous HHD engine tests with high numbers of stop-start cycles have resulted in high wear of various engine components, particularly main and rod bearings. In addition, an enhanced starter system may be required and, even then, replacement of the system could be anticipated one or more times during the HHD vehicle's full useful life. There would need to be alternative power sources to support not just power steering, cabin heat, and transmission pressure, but also cabin cooling, lights and other functions – recognizing that idle times can be quite extended for vocational vehicles waiting to perform their functions. Given all of this, the actual cost for stop-start technologies in HHD vocational vehicles could be materially higher than the agencies' estimate. [EPA-HQ-OAR-2014-0827-1269-A1 p.49]

Due to the lack of fully-demonstrated stop-start technologies in heavy-duty vehicles, an expectation of significant deployment – let alone up to 85% – appears to be unreasonable. Moreover, since a significant part of the vocational vehicle fuel savings is predicated on uncertain rates of deployment of start-stop systems, attaining compliance with the Proposed Phase 2 standards for vocational vehicles will be uncertain to that same extent. [EPA-HQ-OAR-2014-0827-1269-A1 p.49][Tables V-13 thru V-15 from FR and an EPA spreadsheet on Alternative 3 Vocational Target Derivation can be found on p.50-52 of docket number EPA-HQ-OAR-2014-0827-1269-A1] /3/ A number of over-rides and exemptions will need to be provided in the “stop-start” definition to account for ambient temperatures and other relevant factors, and the agencies and manufacturers will need to define more clearly the operative entry and exit conditions for stop-start systems.

**Organization:** Oshkosh Corporation

By 2027, the table V-19 plan assumes a 70% adoption rate in the multi-purpose category. The NPRM suggests a savings of 3%: “Based on these projected adoption rates and the effectiveness values described above in this section, we expect overall GHG and fuel consumption reductions from workday idle on vocational vehicles to be approximately three percent in MY 2027.” While this approach may be practical in some vocations, it will be completely impossible in others leading us to believe that the percent savings is overstated. For example, shutting off a concrete mixer engine will stop the drum from rotating and risk the concrete setting up in the drum. Shutting off the engine at every stop will not be practical for fire apparatus where every second counts on the way to the emergency. Refuse trucks need the engine running when they stop to operate collection and packing equipment. [EPA-HQ-OAR-2014-0827-1162-A2 p.4]

**Organization:** Odyne Systems LLC

EPA has development definitions for various technologies and processes included in the draft Phase Two rule, and has requested comment on the draft definitions. Odyne has proposed definition changes on a number of these as described below. [EPA-HQ-OAR-2014-0827-1239-A1 p.33]

EPA: Seeking comment on a definition for Start / Stop technology, “equivalent technology that eliminates fuel consumption when the truck is in drive but stopped.” [EPA-HQ-OAR-2014-0827-1239-A1 p.33]

Odyne: A start-stop system, or stop-start system, automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, or reduces the load on the engine during the idle event, thereby reducing or eliminating fuel consumption and emissions when the vehicle's motion is stopped. [EPA-HQ-OAR-2014-0827-1239-A1 p.33]

Odyne would like the flexibility to electrically power the rotation of the prime mover without consuming fuel during stops in order to continue powering accessories such as the transmission fluid pump, oil pump, brakes, HVAC, steering or other systems that may derive their power from the rotating engine. [EPA-HQ-OAR-2014-0827-1239-A1 p.33]

EPA:(i) Stop-start technology for vocational vehicles. Phase Two vocational vehicles qualify for reduced emissions in GEM modeling if the engine shuts down no more than 30 seconds after the onset of any of the following conditions: [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

(A) The vehicle's brake is depressed at a zero-speed condition. [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

(B) A vehicle with automatic transmission goes into "Park." [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

(ii) Neutral-idle technology for vocational vehicles. A Phase Two vocational vehicle with an automatic transmission qualifies for reduced emissions in GEM modeling if the vehicle goes into neutral (or reduces torque equivalent to being in neutral) at a zero-speed condition. [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

(iii)Extended-idle reduction. If your sleeper cab is equipped with idle reduction technology meeting the requirements of § 1037.660 that will automatically shut off the main engine after 300 seconds or less. [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

Odyne: In item (i) we recommend focusing on the desire to reduce fuel and emissions and not focus on how that is actually accomplished. As we described in the proposed definition for Start / Stop load could be reduced on the engine instead of stopping it. This would allow the engine to keep turning and reduce the need for electrification of the engine driven components and still accomplish the same results. This would be similar to how the transmission reduces the load on the engine except for it would be handled by another system (i.e. – hybrid system). [EPA-HQ-OAR-2014-0827-1239-A1 p.34]

**Organization:** Volvo Group

Throughout the regulatory process Volvo has continually stated objection to engine start-stop feasibility for Heavy-Heavy Duty engines. In Volvo's comments to the NPRM we stated: [EPA-HQ-OAR-2014-0827-1928-A1 p.12]

"Test of less than 50,000 stop-start cycles [on Heavy-Heavy Duty engines] have resulted in failures of critical engine bearings and overhead systems. We don't even know the range of problems that will surface with this mode of operation, much less if there are feasible solutions. At a minimum, we must anticipate a need for improvements (that have not been developed) to all bearing surfaces, lubrication, and starter systems...Engine development costs will be very high since stop-start cycling tests can only be accelerated by a limited amount before the failure mechanisms are altered." [EPA-HQ-OAR-2014-0827-1928-A1 p.12-13]

The agencies' assessment of this technology does not consider impacts on engine durability, reliability, or even suitability for a specific weight class. [EPA-HQ-OAR-2014-0827-1928-A1 p.13]

In section 2.9.5.1.4 of the Regulatory Impact Analysis to the NPRM the agencies state

“We are projecting a five percent adoption rate of stop-start in the six MHD and LHD subcategories for MY 2021 and zero for the HHD vehicles, because this technology is still developing for vocational vehicles and is most likely to be feasible in the early years of Phase 2 for vehicles with lower power demands and lower engine inertia. Stopping a heavy-duty engine is not challenging. The real challenge is designing a robust system that can deliver multiple smooth restarts daily without loss of function while the engine is off. Many current light-duty products offer this feature, and some heavy-duty manufacturers are exploring this.<sup>146</sup> The agencies are projecting an adoption rate of 15 percent stop-start across all subcategories in the intermediate year of MY 2024. The agencies are projecting this technology to have a relatively high adoption rate (70 percent as stated above) by MY 2027 because we see it being technically feasible on the majority of vocational vehicles, and especially effective on those with the most time at idle in their workday operation. Although we are not prepared to predict what fraction of vehicles would adopt stop-start in the absence of Phase 2, above in draft RIA Chapter 2.9.3 the agencies explain why we are confident that this technology, which is on the entry-level side of the hybrid and electrification spectrum, will be widely available in the Phase 2 time frame.” [EPA-HQ-OAR-2014-0827-1928-A1 p.13]

“146 See Ford announcement December 2013, <https://media.ford.com/content/fordmedia/fna/us/en/news/2013/12/12/70-percent-of-ford-lineup-to-have-auto-startstop-by-2017--fuel-.html>. See also Allison-Cummins announcement July 2014, [http://www.oemoffhighway.com/press\\_release/12000208/allison-stopstart?utm\\_source=OOH+Industry+News+eNL&utm\\_medium=email&utm\\_campaign=RCL140723006](http://www.oemoffhighway.com/press_release/12000208/allison-stopstart?utm_source=OOH+Industry+News+eNL&utm_medium=email&utm_campaign=RCL140723006)”

The agencies use the press releases in footnote 146 to Chapter 2 as evidence that stop-start technology will be feasible during the regulatory period for all heavy-duty engines and applications. The referenced Ford press release from December of 2013 references Ford Motor Company's target to have stop-start engine technology on 70% of vehicles by 2017, while the Allison-Cummins announcement of July 2014 is in reference to a “demonstration” of stop-start technology on a Cummins Ethos 2.8L spark ignited engine running on E85 and backed by an Allison 2000 series automatic transmission. [EPA-HQ-OAR-2014-0827-1928-A1 p.13]

Ford Motor Company's 2015 monthly sales volume reports for the U.S.<sup>4</sup> can be seen in the table below. From these reports it is noted that Ford Motor Company's total U.S. volume for its Ford and Lincoln Brands was over 2.6 million vehicles. Ford Heavy Trucks and Transit vans would all be subject to the Phase II heavy duty GHG rule. Only a portion of the F-series and E-series vehicles would meet the definition of a heavy-duty vehicle given in 40 CFR 1037.801 and not be excluded from the rule by 40 CFR 1037.5. Unfortunately, it was not possible to discern how many of the F- and E-series vehicles would be certified to 40 CFR 1037; however, even assuming that the excluded Ford F-150 accounted for 50% of the total F-series population and the all E-series vans were included, the resultant percentage of Ford Motor Company's 2015 U.S. sales that would be subject to the HD GHG rule would be slightly less than 22% of the total. Since the Ford Motor Company is targeting 70% of their total U.S. sales volume to have stop-start engine technology, their entire vehicle population covered under the HD GHG Phase II regulation would not be affected. [EPA-HQ-OAR-2014-0827-1928-A1 p.13-14]

[Table 4 can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1928-A1]



In the case of the Allison-Cummins announcement, it is a significant stretch to associate demonstration of a technology on a Light-Heavy Duty spark ignition engine with commercial feasibility on a Heavy-Heavy Duty compression ignition engine. According to the release, Cummins accumulated only 1,500 hours of operation over a 2 ½ year period. In addition, the release notes that “to complete on-road validation testing” the vehicle was subjected to a two-month demonstration on California roads; if this testing were additional to the 1,500 hours we could estimate an additional ~650 hours (12 hours per day, 6 days per week, for 9 weeks). It must be noted that a single engine or vehicle, even approximating 2,150 hours of operation, is not a statistically valid sample to determine either reliability or durability to meet the demands of a mature production technology. In short, the continued reference in the release to a “demonstration” shows this effort was to show the technology could provide a benefit, not that it was reliable or durable. [EPA-HQ-OAR-2014-0827-1928-A1 p.14]

In addition, the agencies have not investigated what would be required to develop HHD engine systems to withstand the potential 10-times, or more, increase in engine start cycles. The only discussion noted in the RIA or Preamble to the Proposed Rule was around additional battery capacity (see also RIA Section 2.4.8.2). As such, Volvo still asserts that there is insufficient evidence to suggest that stop-start engine technology is feasible on a Heavy-Heavy Duty engine at any time within the regulatory period. [EPA-HQ-OAR-2014-0827-1928-A1 p.14]

As noted in the RIA section quoted above and repeated in Preamble Chapter V(C)(2)(b)(iv) and Table V-17, the agencies are not projecting penetration of engine stop-start in HHD vehicles for 2021. Their reasoning is that the technology is “still developing” and is “most likely feasible” only for LHD and MHD in the early years of Phase II; however, they have predicated Custom Chassis compliance on penetrations of stop-start technology in 2021 for transit buses, school buses, and refuse, all of which have a high percentage of Class 8 volumes. It is not then acceptable to require Custom Chassis manufacturers with no ability to average outside a Custom Chassis sub-category to meet any penetration of a technology without which they would either need to have substantially higher penetrations of other credited technologies, or would not be able to comply. This will be further compounded by the agencies’ increase in idle times for vocational duty cycles, as the NPRM value for stop-start improvement factor was 7% under the NPRM urban duty cycle, which will substantially increase under increased idle. [EPA-HQ-OAR-2014-0827-1928-A1 p.14]

For all of these reasons Volvo does not believe that start-stop engine technology is feasible in any Heavy-Heavy Duty context and further asserts that, even if the technology were proven feasible, it should not be relied upon in the Custom Chassis proposal due to the limited GEM inputs available for compliance. [EPA-HQ-OAR-2014-0827-1928-A1 p.15]

**Organization:** Volvo Group

Start/stop technology is described as: ‘...the engine shuts down no more than 30 seconds after the onset of any of the following conditions:

- (A) The vehicle’s brake is depressed at a zero-speed condition.
- (B) A vehicle with automatic transmission goes into “Park.”

No Class 8 vehicle or engine has ever demonstrated capability of running in this mode for even a reasonable portion of its full expected lifetime of more than one million miles. A vocational vehicle could easily be subjected to hundreds or more such events in a full day of operation (UPS reports more than 1000 such stops per day for delivery vehicles in urban traffic) and millions of cycles in its life. No tests

have ever been documented to demonstrate continued functionality over even 10% of these cycles. Test of less than 50,000 stop-start cycles have resulted in failures of critical engine bearings and overhead systems. We don't even know the range of problems that will surface with this mode of operation, much less if there are feasible solutions. At a minimum, we must anticipate a need for improvements (that have not been developed) to all bearing surfaces, lubrication, and starter systems. In addition, unless provision is made to allow continued engine operation when air conditioning is deployed, auxiliary AC systems will need to be deployed. Engine development costs will be very high since stop-start cycling tests can only be accelerated by a limited amount before the failure mechanisms are altered. None of this has been considered in the casual assumptions that such systems are readily available for deployment. [EPA-HQ-OAR-2014-0827-1290-A1 p.20]

**Response:**

The agencies proposed to predicate the vocational vehicle standards in part on 70 percent adoption of stop-start in MY 2027. Our assessment of workday idle reduction technologies has been refined since proposal, and part of this refinement includes less reliance on adoption of stop-start than at proposal.

Stop-start is a technology that requires an integration between engine and vehicle systems, and is seeing increasing acceptance in today's passenger vehicle market. The agencies are aware that for a vocational vehicle's engine to turn off during workday driving conditions, there must be a minimal reserve source of energy to maintain engine-protection and safety functions such as power steering, transmission pressure, engine lubrication and cooling, among others. As such, stop-start systems can be viewed as having a place on the low-cost end of the hybridization continuum. 80 FR 40300. However we must be clear to distinguish this technology from the AES described below. Stop-start technologies will be recognized only over the drive idle cycle and the transient cycle in GEM, not the parked idle cycle. This is a change since proposal because we had proposed only a single idle cycle during which a stop-start system could have qualified for reduced emissions during modeling if it turned off the engine either while stopped in traffic or while parked. The addition of a second idle cycle (i.e. both parked idle and drive idle) has allowed us to distinguish stop-start from AES as two very different technologies with different test cycles, different over-rides, different costs, and different effectiveness.

In the final rules, there are differences between drive idle and parked idle in many respects. See RIA Chapter 2.9.3.4, RIA Chapter 3.4.2, and the NREL duty cycle report for more information about the different idle cycles. One example of a difference in over-rides is that stop-start does not have an over-ride related to ambient temperature, because the period of zero speed during which the engine may be off is relatively short, on the order of seconds to minutes, compared with the period of parked idle engine off that could be on the order of minutes to hours. The different over-rides may be reviewed in the regulations at 40 CFR 1037.660. Another example of a difference is in the fueling rate. During the parked idle cycle the fueling rate represents the vehicle being out of gear, either in neutral or park depending on the transmission type. This fueling rate can be significantly lower for some vehicles than the fueling rate that occurs while stopping in traffic in a drive idle situation, because of the torque applied by some transmissions when in gear. Another difference is in effectiveness, where stop-start is assumed to have a 90% effectiveness over the drive idle cycle, and AES is assumed to have an 80% effectiveness over the parked idle cycle. See RIA Chapter 3.4.2.3.

For stop-start in the final rules, the purpose of the additional hardware is to protect the engine for short duration stops such as at traffic lights, not to power accessories such as HVAC systems while the vehicle is parked. We are not aware of stop-start systems that are commercially available for conventional vocational vehicles today, but this feature is available as part of some current hybrid systems. Effenco is a supplier who is demonstrating today a capacitor-based stop-start system with on-board electronics

sufficient to protect a HHD engine and even power a PTO. Allison correctly noted that Effenco's system is currently selling for prices that are more expensive than we are projecting. Effenco's comment suggests that by MY 2027 the incremental manufacturing costs will be in a range that is three to six times the agencies' estimate for stop-start systems on class 8 vehicles. However, Effenco's system delivers more sophisticated functions than we believe are necessary for most vocational vehicles, especially with the over-rides that we are allowing. See Section 11.3 for responses to comments on the agencies' cost analysis including R&D and markups.

Volvo's comments about the feasibility of stop-start for HHD engines (generally 11L and larger) include concerns about engine development costs for durability testing and other challenges; however, they do not actually show the technology to be infeasible. We appreciate these comments that help us understand that before this technology can be made widely available, testing must be conducted to show reliability of systems and components including starters, lubrication, and bearing surfaces. It's possible that some time may also be needed for development work where manufacturers elect to shift away from reliance on batteries for starting the engine and begin to rely instead on ultracapacitors, which do not have the same problems with cold weather operation and long term fatigue as do batteries.<sup>188</sup> We agree with commenters that this type of development work would likely be part of bringing this technology to the vocational vehicle market, and thus we have included costs for similar upgrades to those described for all sizes of engines, not just for those over 11L. In the event that an engine manufacturer needs to delay adoption of stop start to roll these changes into a planned engine platform redesign, we believe our relatively modest adoption rates of 20 to 30 percent in MY 2027 will accommodate this.

Volvo is inaccurate in claiming in its comments that we had cited press releases for stop-start on light-duty vehicles and LHD demonstration vehicles as evidence that stop-start will be feasible for all vocational vehicles. We cited Ford's announcement as evidence that this technology is currently available on light-duty vehicles, and we cited the Cummins-Allison press release as evidence that some HD manufacturers are exploring this technology (See 80 FR 40310). At proposal we reasoned that those developments and other facts led us to conclude that stop-start would be technically feasible on a majority of vocational vehicles by MY 2027. After considering comments and accounting for the revised idle cycles, the agencies are projecting only 20 percent adoption of stop-start for HHD vehicles other than Regional, and 30 percent for non-Regional LHD and MHD vehicles in MY 2027. We are confident heavy-duty stop-start systems for conventional vehicles will be feasible on these vehicles at these rates in the time frame of Phase 2. Where stop-start is relied upon as part of a certified configuration with components installed by a secondary manufacturer, these will be subject to specifications and installation instructions of the certifying manufacturer (See 40 CFR 1037.621 and 1037.622).

The effectiveness of stop-start as recognized in GEM will be evaluated on an engine-specific basis, with a five second shutoff assumed as it is run in GEM during the transient cycle. During the separate drive idle cycle a 90 percent effectiveness is assumed. This addresses commenters' concern about over-estimating the effectiveness of this technology, and is appropriate because we expect a wide variety of stop-start solutions to be deployed in the vocational vehicle market, and we anticipate modest use of over-ride conditions, which include an over-ride for PTO use. Setting a shorter duration before shutdown could over-estimate the reductions achieved by this technology in use. We believe this is a fair way to represent that the system may not have the designed effectiveness under all conditions. As with neutral idle and AES technologies, stop-start can reasonably be applied for vocational vehicles where this feature would not frequently encounter an over-ride condition. Vehicles with very little driving in transient conditions

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<sup>188</sup> Maxwell Technologies, How Ultracapacitors Improve Starting Reliability for Truck Fleets, 2016, available from <http://www.truckinginfo.com/channel/products/whitepapers/detail/how-ultracapacitors-improve-starting-reliability-for-truck-fleets.aspx>.

or with high PTO operation can apply this technology, although they would see reduced effectiveness in use.

As noted above, we are projecting zero adoption of stop-start for Regional vocational vehicles, and this also includes motor homes and coach buses certified to the optional custom chassis standards, as these vehicles have characteristically regional driving patterns. Cement mixers must continually rotate the drum using the PTO while underway, and we are not aware of any electrified PTO system that could meet the performance needs of a cement mixer without adding an unacceptable amount of weight to a vehicle in this highly weight-sensitive application. Emergency vehicles have sophisticated onboard electronics that would make designing a stop-start system very complex, and because these vehicles accumulate so few miles, it does not seem cost-effective to develop this technology for this application. For the other custom chassis that typically have urban driving patterns, we have determined that stop-start is feasible for school buses, transit buses, and refuse trucks. See Preamble at V.C.2.b. For school buses, we concluded that the reasoning we applied to determine that MHD Urban vehicles in the primary program can adopt this at a rate of 30 percent in MY 2027 is also valid for school buses.

Although Gillig commented that current market offerings of stop-start for transit buses are only available as part of a full hybrid package, our reasoning pertaining to development of this technology in the time frame of Phase 2 also applies to transit buses. Engines for transit buses are typically medium heavy-duty 9-liter engines, and because commenters primarily raised concerns about lead time in the context of HHD engines, we expect MHD engines will need less lead time than HHD engines in terms of developing robust non-hybrid stop-start systems. This makes sense because the smaller engines have less rotational inertia and thus may not need as many engineering design upgrades, and with shorter regulatory useful lives these may not need as extensive durability testing as HHD engines. Further, where a hybrid system with a stop-start feature is installed on a transit bus using the custom chassis option, the manufacturer will be eligible to obtain reduced emissions for stop-start without needing to perform powertrain testing, because the technology may be credited in GEM via the default engine. We thus believe it is reasonable to project that by MY 2027, 30 percent of custom chassis transit buses will have stop-start systems that are part of either conventional or hybrid drivelines.

Refuse trucks that routinely compact waste throughout their neighborhood collection activity would likely either experience the PTO over-ride condition too frequently to make stop-start cost-effective, or manufacturers may elect to install a system similar to Effenco's that has been designed with the refuse vocational vehicle in mind. As noted above in Section 6.3.3.3, there are a wide variety of refuse drive cycles, and some may lend themselves to stop-start better than others. Along with the variety of duty cycles comes a variety of engines typically powering refuse trucks, from 9 to 13 liters, some of which may need less lead time than others in terms of developing robust non-hybrid stop-start systems. As with transit buses, chassis manufacturers certifying refuse trucks to the optional custom chassis standards may enter Yes in the input field in GEM for stop-start (whether part of a conventional or hybrid system) and the effectiveness will be computed based on the default 350 hp engine with 5-speed HHD automatic transmission. We thus believe it is reasonable to project that by MY 2027, 20 percent of custom chassis refuse trucks will have stop-start systems that are part of either conventional or hybrid drivelines.

#### **6.3.4.2 Neutral Idle**

**Organization:** Allison Transmission, Inc.

Allison believes that the Direct Material Cost ("DMC") assumptions for Neutral-Idle are understated. EPA assumes that no additional hardware is required for this capability.<sup>24</sup> At the time when the transmission baseline configuration was established, however, all fully automatic transmissions did not

have the hardware needed for Neutral-Idle. Thus, there is obviously an increased cost associated with this capability. Specifically, a vehicle sensor is also necessary to assure the brakes are “on” in order to activate Neutral-Idle. Allison believes that a more appropriate DMC assumption is \$100. [EPA-HQ-OAR-2014-0827-1284-A1 p.14]

**Organization:** Daimler Trucks North America LLC

### **GEM Inputs for Neutral Idle**

We are not certain that we understand how GEM credits neutral idle. As we understand: First, for any engine, there are two idle points in the fuel map, one with no load and one with torque converter load. If the transmission has a neutral idle, then at any idle time-step in GEM, the fuel consumption rate is the no load rate; otherwise, it is the loaded rate. If we understand correctly, then the neutral idle approach is correct. [EPA-HQ-OAR-2014-0827-1164-A1 p.63]

**Organization:** Oshkosh Corporation

With respect to Neutral Idle, the NPRM states that “Based on GEM simulations using the currently proposed vocational vehicle test cycles, the agencies estimate neutral idle for automatic transmissions to provide fuel efficiency improvements ranging from one percent to nearly four percent, depending on the regulatory subcategory.” This approach shifts the transmission to neutral whenever the engine is at idle. Certain vocational trucks spend a lot of time at idle, but the transmission is already in neutral, and the engine power is performing work at that time. This technology is not feasible for Concrete and Refuse for the same reasons described in our comments under stop-start. [EPA-HQ-OAR-2014-0827-1162-A2 p.5]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The assumptions that as of 2027 30% of Class 7 and 8 vocational vehicles will utilize neutral-idle technologies are grossly overstated and not supported by current data, and so are unreasonable. [EPA-HQ-OAR-2014-0827-1269-A1 p.71]

“Neutral-idle” is also described in that proposed regulatory section, and refers to a system that automatically shifts a vehicle “into neutral (or reduces torque equivalent to being in neutral) at zero-speed condition.” Apparently, the agencies anticipate that neutral-idle technology will be offered by one or more automatic transmission suppliers in the timeframe for the Phase 2 Standards, but it is unclear by which suppliers, at what cost, and with what restrictions on vehicle operations.

As an initial matter, vehicle manufacturers should not be held responsible for determining whether a particular transmission meets the agencies’ rather vague definition of “neutral-idle” systems. Rather, the agencies should require transmission manufacturers to provide a certification that a given transmission system meets the “neutral-idle” criteria. Similarly, the agencies should hold the transmission manufacturer responsible if that certification later proves to be incorrect, just as pertains with respect to tire manufacturers under Phase 1. [EPA-HQ-OAR-2014-0827-1269-A1 p.48]

EPA estimates that neutral-idle will reduce fuel consumption by 1% to 4% for vocational vehicles. In the NPRM, the agencies assume that neutral-idle will be used in 100% of vocational vehicles in MY 2021 (although it is only applicable to automatic transmissions). (See Tables V13 through V-15, reproduced below). However, a detailed spread sheet from the RIA shows that the agencies actually project that neutral-idle technologies will be applied at varying penetration rates significantly less than 100% (i.e., ranging from 5% to 85%) in the several different vocational vehicle categories over the 2021-2027 time

period. A screen shot of the agencies' spread sheet is included below. [EPA-HQ-OAR-2014-0827-1269-A1 p.49]

**Organization:** Volvo Group

Although we have some indication that a “neutral idle” automatic transmission may be available from one manufacturer, we do not know the cost, reliability, or performance of this product. With this situation, we cannot endorse or support the contention that all automatic transmissions can offer this feature by MY 2021. In addition, it is unclear as to how a vehicle manufacturer could ensure that any particular transmission meets the requirements for neutral idle, stated as: [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

“A Phase 2 vocational vehicle with an automatic transmission qualifies for reduced emissions in GEM modeling if the vehicle goes into neutral (or reduces torque equivalent to being in neutral) at a zero-speed condition.”

If the agencies intend to provide credit for this technology and to include it in stringency expectations, provision should be made for suppliers to certify that the technology is approved for the credit. [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

**Response:**

Neutral idle may be programmed on any automatic transmission, and can reasonably be applied for vocational vehicles where this feature would not frequently encounter an over-ride condition. The adoption rates we project for this technology are described in Section V.C.2.b (iv) of the Preamble and RIA Chapter 2.9.5.1.4. Neutral idle is essentially a transmission technology, but it also requires a compatible engine calibration. Torque converter automatic transmissions traditionally place a load on engines when a vehicle applies the brake while in drive, which we call curb idle transmission torque (CITT). When an engine is paired with a manual or automated manual transmission, the CITT is naturally lower than when paired with an automatic, as a clutch disengagement must occur for the vehicle to stop without stalling the engine. The engineering required to program sensors to detect the brake position and vehicle speed, and enable a smooth re-engagement when the brake pedal is released makes this a relatively low complexity technology that can be deployed broadly. Allison provided information in its comments that the agencies' cost estimates for neutral idle were too low. We have revised our costs upward for neutral idle in response to Allison's comment and specifically have included the cost of a sensor.

Allison has publically available information about its transmissions that feature neutral at stop, including its FuelSense Plus and FuelSense Max products.<sup>189</sup> The only concern we have heard from stakeholders about performance is that without some engineering adjustments, a re-engagement bump when returning to drive from neutral may produce a minor driver annoyance. Based on currently available information, we expect neutral idle technology to be available in the near term for many vehicles, and we expect technology or engineering to minimize a re-engagement bump should not meaningfully increase the lead time or cost of this technology.

An example of an allowable override is if a vehicle is stopped on a hill. Skilled drivers operating manual transmissions can safely engage a forward gear from neutral when stopped on upslopes with minimal roll-

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<sup>189</sup> See <http://www.allisontransmission.com/docs/default-source/marketing-materials/sa7567en--vocational-model-guide.pdf?sfvrsn=4>

back. With an AT, the vehicle's computer would need to handle such situations automatically. In addition, engagement of the PTO while driving will be an allowable over-ride condition. In the Phase 2 certification process, transmission suppliers will attest whether the transmission has this feature present and active, and certifying entities will be able to enter Yes or No as a GEM input for the applicable field.

The effectiveness of the neutral idle technology will be calculated using data points collected during the engine test, using the appropriate fueling over the drive idle cycle and the transient cycle. This technology has no effect on the parked idle cycle, thus it need not have any effect on vehicle operation while parked to qualify in GEM.

We agree with OshKosh that this technology is not feasible for cement mixers. As this is a drive idle technology and cement mixers must rotate the drum at all times while underway, a reduced torque at zero vehicle speed would not be possible without a very advanced (and prohibitively costly) e-PTO system. However, we disagree with OshKosh with respect to refuse trucks. There are a wide variety of refuse drive cycles. Refuse vehicles that may benefit from neutral idle may be front loaders and those that must convey a fully compacted load across town after completing a neighborhood collection route. We are projecting 50 percent adoption of neutral idle on refuse trucks in the custom chassis program by MY 2027, which is considerably less than the 70 percent adoption projected for HHD Urban vehicles in the primary program. See Preamble at V.C.2.b.

Because we are considering stop-start and neutral idle to be mutually exclusive on a per-vehicle basis (see RIA Chapter 2.9.5.1.4), the sum of adoption rates for these two technologies does not exceed 90 percent in MY 2027. Neutral idle adoption rates start at 50 percent in MY 2021 because we expect this technology will not need much lead time, if any (given that the technology already exists, is commercially available, and does not present significant engineering challenges). By MY 2027 the adoption rate of neutral idle does not exceed 70 percent because we are not projecting it to be combined with stop-start on a vehicle. Although these may be combined in GEM, any additional effectiveness during the ARB transient and drive idle cycles would be very small.<sup>190</sup> An exception to the projected 90 percent maximum adoption rate is transit buses, where we believe all vehicles of this type can reasonably apply some form of drive idle reduction technology.

#### **6.3.4.3 Automatic Engine Shutdown**

**Organization:** Alliance of Idle Mitigation Technologies

Idling is an activity that occurs in the off duty cycle. A more comprehensive scheme is needed to ensure that the credit awarded for vehicle efficiency reflects what happens in the real world, and that unintended consequences do not extinguish the businesses that are already doing a great job reducing the very waste that the rule intends to curb – and our business are quickly growing. The Alliance is not directly regulated by the fuel efficiency standard, but it deserves a seat at the table. The agencies did confer with a diverse group of industry and stakeholders, however, our companies were not part of that dialogue, nor were we permitted to attend the Small Business Administration roundtable created to evaluate the unintended effects of the proposed rule, in as much as we are not OEMs. [EPA-HQ-OAR-2014-0827-1311-A1 p.1]

Fuel efficiency standards are a relatively straightforward calculus involving only OEMs, until it endeavors to regulate the off-duty cycle behavior of idling. We believe that extra participation of the idle reduction industry is required in order to form the most effective method of addressing the wasteful

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<sup>190</sup> The final GEM input file allows users to apply multiple idle reduction technologies within a single vehicle configuration.

practice of idling. Please consider further deliberations with us prior to adoption of the final rule. [EPA-HQ-OAR-2014-0827-1311-A1 p.2]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The real world use of idle shutdown on cement mixers must be taken into account in the final regulations. [EPA-HQ-OAR-2014-0827-1895-A1 p.3]

**Organization:** ABC Bus Companies, Inc.

The climate control of passenger compartments during the loading or unloading process is essential in Passenger Carrying Vehicles just as it is on airplanes or trains. Extreme seasonal weather conditions and temperatures can dictate vehicle idling operations to ensure the health and welfare of passengers being transported in these vehicles. Putting passengers on an extremely HOT or COLD could prove harmful to passengers. In addition, ADA wheel chair lift operation can require that engines be running while these passengers are loaded and unloaded into a motorcoach. Most over-the-road coaches also have to provide rest room facilities for passengers. Mandating AES standards for (PCV's) could adversely affect the health of the traveling public. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

The NREL should consider the PCV operation as described above to help define this vocational vehicle test cycle. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

**Response:**

Automatic engine shutdown (AES) is an engine technology that is widely available in the market today, but has seen more adoption in the tractor market than for vocational vehicles. Although we did not propose to include this technology as part of the technology packages used to develop standard stringency and cost, we received many comments suggesting that it would be appropriate to do so. Some commenters may have conflated the concept of stop-start with AES, such as a comment we received asking us to consider the on-board need to power accessories while the vehicle is in stationary mode. We believe that automatic engine shutdown is effective and feasible for many different types of vehicles, depending on how significant a portion of the work day is spent while parked. Most truck operators are aware of the cost of fuel consumed while idling, and importantly, the wear on the engine due to idling. Engine manufacturers caution owners to monitor the extent of idling that occurs for each work truck and to reduce the oil change interval if the idle time exceeds ten percent of the work day. Accordingly, many utility truck operators track their oil change intervals in engine hours rather than in miles. The agencies are adopting an allowable AES over-ride for PTO use. We are also adopting an allowable AES over-ride if the battery state of charge drops below a safe threshold. This would ensure there is sufficient power to operate any engine-off accessories up to a point where the battery capacity has reached a critical point. Where a vocational vehicle has such extensive stationary accessory demands that an auxiliary power source is impractical or that an over-ride condition would be experienced frequently, we do not consider AES to be feasible. Examples include coach buses, motor homes, transit buses, refuse trucks, concrete mixers, and emergency vehicles. To make AES practical for a coach or transit bus, for example, a much larger auxiliary power source would be needed than the one projected as part of this rulemaking. We have based the school bus standards in part on adoption of AES because although many school buses have voluntarily adopted idle reduction strategies for other reasons, we do not believe many have tamper-proof automatic shutdown systems. See Section V.C.2.b (iv) of the Preamble and RIA Chapter 2.9.5.1.4.



In the Phase 2 certification process, engine suppliers will attest whether this feature is present and tamper-proof, and certifying entities will be able to enter Yes or No as a GEM input for the applicable field.<sup>191</sup>

As with neutral idle described above, the effectiveness of AES will be calculated in GEM using data obtained through engine testing. The appropriate data points over the parked idle cycle will be used for calculating the fueling.

### **6.3.5 Lower Rolling Resistance Tires**

**Organization:** Daimler

**Lower Rolling Resistance Tires** - The agencies request comment on the use of the adjustment factor for LT tires. We have no comment on this topic except to say that the agencies should now have enough information to set tire Crr targets for each regulatory sub-category based on the RSCs' needs and without extrapolation. [EPA-HQ-OAR-2014-0827-1164-A1 p.79]

**Organization:** GILLIG LLC

We believe with regard to tire rolling resistance that transit buses should be treated separately from the rest of the vocational vehicles. The average speed of transit buses is lower than the other vehicles in the vocational vehicle category. If Phase 2 is going to continue to use tire rolling resistance as a GEM input, then the decrease in tire rolling resistance associated with lower vehicle speeds needs to be accounted for in the GEM calculation for CO2 and fuel efficiency. [EPA-HQ-OAR-2014-0827-1156-A1 p.3]

**Organization:** National Automobile Dealers Association (NADA)

The Phase 2 proposal significantly overestimates the potential for vocational vehicle LRRTs uptake. For those vocational customers where LRRT use may be technologically acceptable, their higher cost may not be, given the number of miles and speeds driven. For example, many vocational vehicle purchasers spec tires with heavy-duty sidewalls designed to resist damage in stop/go, urban, heavy-load, bad weather, and off-road operating conditions. Since LRRTs often trade sidewall durability and traction for lower weight, they are not appropriate for vocational customers whose operations place a premium on durability, traction and/or safety. Given these constraints, NADA/ATD suggests that the projected MY 2027 vocational vehicle LRRT MRP be reduced by half. [EPA-HQ-OAR-2014-0827-1309-A1 p.9]

**Organization:** National Waste & Recycle Association

We are disappointed in the agencies continued advocacy of low rolling resistance tires as the primary fuel efficiency solution for vocational vehicles in the face of evidence that these tires do not offer fuel efficiency benefits for refuse vehicles. [NHTSA-2014-0132-0071-A1 p.2]

The agencies continue to place great reliance on the use of low rolling resistance tires to achieve the fuel consumption standard for the universe of vocational vehicles. Yet the NAS report noted that low rolling resistance tires “do not generate the same level of fuel savings for drive cycles that include frequent stops and starts as for drive cycles with minimal amounts of braking” and that as a result of these factors, the contribution of rolling resistance to truck fuel use is less in delivery trucks and still less in refuse haulers...” (see NAS, page 115) and that “the use of low rolling resistance tires has some application in

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<sup>191</sup> We will consider non-tamper-proof AES as off-cycle technologies for a lesser credit. See 40 CFR 1037.610.

refuse packers, but their low vehicle speed profile and the need for good traction makes the application questionable” (see NAS, page 141). [NHTSA-2014-0132-0071-A1 p.7]

Nonetheless, the agencies state, see page 40299, right column, that “vocational vehicles are likely to see the most benefits from reduced tire rolling resistance with they are driving at 55 mph” and that “both vocational vehicles tested had greater benefits of LRR tires at 100 percent payload than when empty.” As noted above, refuse trucks have patterns of extensive stopping. In addition, while those trucks can travel at 55 mph on the way to a transfer station or landfill, highway driving provides a small percentage of their road travel time. Finally, refuse trucks fill up throughout the day and only achieve 100 percent legal payload at the end of the route. As a result, we do not anticipate any fuel efficiency savings from lower rolling resistance tires. [NHTSA-2014-0132-0071-A1 p.7]

**Organization:** Michelin North America, Inc.

The 'conventional wide base' (sometimes known as 'wide base singles' or 'super singles' sizes), e.g. 385/65, 425/65 and 445/65, are different from the NGWBS75 mph speed rated tire technology in use today. These 'conventional wide base singles' or 'super singles' are not typically known for fuel efficiency and long haul highway applications in the North American market and have speed ratings of 62, 65 or 68 mph. They are mostly targeted for vocational on-off road and urban applications where they offer a larger single mount load capacity (steer) or some weight reduction on drive and trailer applications. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

The above clarification will assist users to select the appropriate tires for their needs. [EPA-HQ-OAR-2014-0827-1286-A1 p.3]

**Organization:** UPS

UPS fully supports the following excerpt from ATA's comments and notes that our concern focuses on Class 6 truck tires. We approve taking weight out of the tread, but not from the tire casing: [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

'Tire rolling resistance must be tailored to each vehicle subcategory. This especially holds true with respect to Class 4-6 vocational vehicles. SmartWay tire verification focuses on in-use highway applications — not vocational operations. Class 6 tires currently have a heavy-rub band on the sidewall to prevent sidewall damage largely caused by excessive scrubbing against curbs during urbanized hauls. Thicker sidewalls help maintain casing integrity and affords fleets the ability to get close to four subsequent retreads. LLRTs typically do-away with thicker side bands to lower tire weight (in the range of 30%) and get better fuel economy test track results. Unfortunately, fleets do not deliver goods on test tracks and even the best drivers have contact with curbs throughout their delivery schedules. [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

'The four tire levels set out under the rule will have shorter useful lives and will minimize recap opportunities. As referenced prior, it takes 23 gallons of oil to manufacture a new tire and only 8 gallons to retread — a statistic that cannot be ignored in undertaking both carbon and fuel use analyses under the proposal. If better tire rolling resistance levels can in fact be achieved while maintaining heavy-rub bands needed for greater casing integrity and durability, ATA would be in a better position to support the vocational tire requirements set out under the rule. [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

'Finally, many vocational applications need to go off-road at construction sites, mining operations, landfills, and similar locales. The transition to LLRTs would not satisfy customer needs for adequate

traction in these environments. ATA requests that the agencies conduct independent and robust studies of new LRRT generation tires in advance of their entry into the marketplace to assess safety, traction, and availability.' [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

**Organization:** California Air Resources Board (CARB)

The Phase 2 proposal for emergency vehicles allows emergency vehicles to continue to use tires meeting only Phase 1-level Crr performance. While CARB staff understands the unique functionality, performance, and reliability criteria applicable to emergency vehicles, it also believes that as tires with Phase 2-level Crr values become more readily available in the market place and at a lower cost, emergency vehicle manufacturers will be able to overcome remaining technical challenges associated with the use of lower-rolling resistance tires in the emergency vehicle sector, particularly in the latter years of the Phase 2 program. As such, CARB staff proposes U.S. EPA and NHTSA to consider provisions, utilizing a phase-in approach, to require the use of tires meeting lower Crr levels than required by Phase 1, in the emergency vehicle sector. [EPA-HQ-OAR-2014-0827-1265-A1 p.139]

**Organization:** American Trucking Associations (ATA)

**Lower Low Rolling-Resistance Tires (50% 6.9 Crr Steer Tires in 2027; 15% 6.5 Crr Drive Tires in 2027)**

Tire rolling resistance must be tailored to each vehicle subcategory. This especially holds true with respect to Class 4-6 vocational vehicles. SmartWay tire verification focuses on in-use highway applications – not vocational operations. Class 6 tires currently have a heavy-rub band on the sidewall to prevent sidewall damage largely caused by excessive scrubbing against curbs during urbanized hauls. Thicker sidewalls help maintain casing integrity and affords fleets the ability to get close to four subsequent retreads. LRRTs typically do away with thicker side bands to lower tire weight (in the range of 30%) and get better fuel economy test track results. Unfortunately, fleets do not deliver goods on test tracks and even the best drivers have contact with curbs throughout their delivery schedules. [EPA-HQ-OAR-2014-0827-1243-A1 p.9]

The four tire levels set out under the rule will have shorter useful lives and will minimize recap opportunities. It takes 23 gallons of oil to manufacture a new tire and only 8 gallons to retread – a statistic that cannot be ignored in undertaking both carbon and fuel use analyses under the proposal. If better tire rolling resistance levels can be achieved while maintaining heavy-rub bands needed for greater casing integrity and durability, ATA would be in a better position to support the vocational tire requirements set out under the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.9]

Finally, many vocational applications need to go off-road at construction sites, mining operations, landfills, and similar locales. The transition to LRRTs would not satisfy customer needs for adequate traction in these environments. ATA requests that the agencies conduct independent and robust studies of new generation LRRTs in advance of their entry into the marketplace to assess safety, traction, and availability. [EPA-HQ-OAR-2014-0827-1243-A1 p.9]

**Organization:** Oshkosh Corporation

Phase 1 is already mandating improvements, and we believe that by 2017, further rolling resistance improvements will not be possible without degrading the traction capabilities that most vocational trucks require. Even if rolling resistance could be reduced without sacrificing traction, the proposal correctly

points out that the tire manufacturers have little incentive to put research into those tire sizes appropriate, only for low volume vocational applications.

The 2027 upper limit values of 6.4 for steer tires and 7.0 for drive tires are lower than the averages we currently see for our concrete mixer tires. Since concrete mixers must often operate off-road in muddy job sites, it is essential that maximum traction be maintained. A number of other vocational vehicles must also be able to operate both on-road and off-road. Further rolling resistance improvements may not be possible without degrading the traction capabilities beyond an acceptable range. Even if rolling resistance could be reduced without sacrificing traction, the NPRM points out correctly that tire manufacturers have little incentive to put research into those tire sizes appropriate for low-volume vocational applications only. [EPA-HQ-OAR-2014-0827-1162-A2 p.5]

Since implementation of Phase I, we have not seen any vocational vehicle tire changes from suppliers. The CRR values provided at the beginning of Phase I are still the same values provided today. Consider that the larger market for truck tires is not those purchased by the OEM for new vehicles, but rather the replacement and re-tread markets. Neither the OEM nor the EPA can control the tires purchased for replacement, so tire manufacturers can continue to see significant market sales of current high CRR tires regardless of pressure by small volume vocational truck OEMs. We question whether implementation of Phase II will cause tire suppliers to place any emphasis on CRR improvements for the low-volume tire models that serve our vocations. [EPA-HQ-OAR-2014-0827-1162-A2 p.5]

**Organization:** Rubber Manufacturers Association (RMA)

#### **RMA Evaluation of GEM Inputs for Tires (non-speed restricted) for Vocational Vehicle Fitments**

RMA appreciates that the agencies collected data to better understand the rolling resistance performance of tires that are equipped on vocational vehicles for purposes of this rule. Yet, the data collected does not represent the breadth of vocational vehicle applications and appropriate tire fitments. [EPA-HQ-OAR-2014-0827-1304-A1 p.16]

Some tire fitments in the vocational vehicle segment are designed for low speed, heavy load applications where rolling resistance is not a key design parameter since typical use would not yield meaningful fuel economy benefits and other tire performances are more critical. After evaluation of member company data showing rolling resistance of tires for certain vocational fitments, RMA concludes that the same GEM inputs should not be used for all tires used on vocational vehicles. [EPA-HQ-OAR-2014-0827-1304-A1 p.16]

RMA collected rolling resistance data from its member companies for several tire size and load range combinations for both steer/all-position and drive tires. In particular, RMA evaluated tires with rim diameters of 17.5 to 24.5 inches across several load ranges where current rolling resistance performance may not be equivalent to the proposed GEM tire inputs for vocational vehicles. After its review, RMA recommends that the agencies consider adjusting the GEM inputs and resulting fuel economy and resulting GHG emission limitations for drive tires installed on vocational vehicles. [EPA-HQ-OAR-2014-0827-1304-A1 p.16]

#### **The Agencies' Proposed GEM Inputs for Steer/All-position Tires (non-speed restricted) are Appropriate**

Figures 7 and 8 show the rolling resistance coefficients for each of the tire size/load range combinations evaluated for steer/all-position tires. Based on the data in Figure 7 and Figure 8, RMA concludes that the

proposed GEM inputs for steer/all-position tires are appropriate. Although not all current tires will meet the 2021 GEM input value (7.1 kg/T), it seems achievable. [EPA-HQ-OAR-2014-0827-1304-A1 p.17]

[Figure 7, 'Distribution of Rolling Resistance Values of Steer/All-Position Tires for Vocational Vehicles', p.17 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

[Figure 8, 'Analysis of Rolling Resistance Values for Steer/All-Position Tires for Vocational Vehicles', can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

### **The Agencies Should Adjust the GEM Inputs for Drive Tires (non speed- restricted) and Resulting Limits for Vocational Vehicles**

RMA also collected rolling resistance data for drive tires used in vocational vehicle applications, presented in Figures 9 and 10. Of significance, nearly half of the values are higher than the baseline value (7.7 kg/T) proposed by the Agency. The vast majority of products represented would require major redesign in order to meet the proposed GEM Inputs for 2021, 2024 and 2027. [EPA-HQ-OAR-2014-0827-1304-A1 p.18]

RMA believes the drive tire GEM inputs are not appropriate, given the performance demands placed on these tires. As shown in Figure 9 and Figure 10, the average RRc for many current vocational drive tires do not meet even the 2017 baseline target. That is because the design parameters for drive tires, and especially for certain types of vocational drive tires, inherently cause them to have significantly higher rolling resistance than their all position counterparts. In order to perform their intended function of providing driving traction, drive tires are designed with tread block or lug type tread patterns that tend to increase rolling resistance and with tread depths that are substantially (up to 50%) deeper than for comparable all position tires. Furthermore, a number of tires that are considered “vocational” are designed for on/off road applications, with heavier tire constructions and with tread compounds designed to resist cutting and tearing, which inherently cause higher rolling resistance than typical highway treads. Because of the very nature of what makes a drive tire a functional drive tire, we propose that the agencies revise the GEM inputs for drive tires for vocational applications. [EPA-HQ-OAR-2014-0827-1304-A1 p.19]

[Figure 9, 'Distribution of Rolling Resistance of Drive Tires for Vocational Vehicles', can be found on p.19 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

[Figure 10, 'Analysis of Rolling Resistance Values for Drive Tires for Vocational Vehicles', can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

In order to assess what revised GEM inputs might be more appropriate for drive tires used in vocational vehicle applications, RMA used the steer/all-position data it collected as a guide. RMA evaluated the percentage of products surveyed that would meet the baseline targets and the various GEM inputs for 2021, 2024 and 2027. RMA then compared the steer/all-position percentages with the percent of drive tires that would meet the baseline and GEM inputs proposed. Figure 11 shows the results of this analysis. It is apparent that the proposed GEM inputs would be much more severe, in terms of impact to the industry, for drive tires than for steer/all-position tires. As discussed above, due to the performance demands on drive tires, it would be very difficult to meet the proposed GEM input levels. RMA proposes that the Agency set the GEM inputs for drive tires for vocational vehicles by targeting a similar percentage of current products that can meet the GEM inputs set for future model years 2021 and 2024, or 8.3 and 8.1 kg/T respectively. This proposal is shown in green in Figure 11. For 2027, RMA does not believe this same approach is warranted, given the performance needs of drive tires for vocational

vehicles. Instead it recommends that the 2027 GEM input target be set at a level where roughly 50 percent of current products could meet the level, 7.5 kg/T. [EPA-HQ-OAR-2014-0827-1304-A1 p.20-21]

[Figure 11, 'Percent of Current Steer and Drive Tires that Would Meet Proposed GEM Inputs for Vocational Tires', can be found on p.21 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

Vocational trucks and non-van type trailers, and by extension the tires on them, are designed for specialized kinds of work over a wide range of specialties. Expectations will be that the tires will continue to perform in a manner that facilitates the truck performing its tasks effectively. In other words, it is not generally acceptable to trade off one performance parameter in order to improve another such as rolling resistance. These tires are designed with features that enable them to perform effectively in their specialized applications, and a number of those features add to the tire's rolling resistance. It will take significant time and effort to identify or develop new materials and design features that can reduce rolling resistance and still maintain current dynamic performances. [EPA-HQ-OAR-2014-0827-1304-A1 p.34]

**Organization:** Volvo Group

In the technology packages anticipated to set Phase 2 stringency levels, the agencies have further relied on unreasonable expectations for lower rolling resistance tires in all regulatory subcategories. Tire manufacturers have continued to claim that they are able to balance tire life, safety, and traction concerns; however, as the agencies have noted in the Regulatory Impact Analysis section 2.4.3.1, tires with higher rolling resistance are likely designed to address only some of these concerns. We continue to hear customer feedback that low rolling resistance tires often lack adequate traction. The reality is that many of the features that provide for traction, especially deep lugs and pliable sidewalls, also create high rolling resistance, but without these features many customers are finding that attaining adequate traction is nearly impossible under many of the demanding conditions that trucks and tractors experience, such as snow and off-road. Customers have stated that, in some cases, they are being pushed into low rolling resistance tires at the point of sale only to be left with no choice but to replace the tires with higher rolling resistance, traction tires immediately after taking delivery of the new vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

In addition, heavy-duty fleets expect to retread tires as many as five times and have concerns that tire casing durability may be compromised with low rolling resistance (LRR) tires. Retreading saves cost and about two thirds of the oil required to produce a new tire (reported to be between 22 and 44 gallons depending on tire size). [EPA-HQ-OAR-2014-0827-1290-A1 p.21]

In the Preamble section V(C)(1)(a)(iii), the agencies again note the trade-offs between low rolling resistance and traction, as well as the fact that in vocational applications many customers value traction over decreased rolling resistance. The agencies go on to state, however, that input from tire manufacturers indicates that performance parameters will not be affected by Phase 2 LRR tires. It is unclear how these claims have been validated, but given the tire manufacturers' inability to deliver on these same claims for Phase 1 it is not likely there will be significant advancement made prior to the implementation of Phase 2 to justify the levels used to set stringency. [EPA-HQ-OAR-2014-0827-1290-A1 p.21-22]

After the promulgation of the Phase 1 regulation the agencies performed independent testing of tire coefficient of rolling resistance (CRR) values and determined that the average values for vocational tires were 7.8 for drive tires and 6.7 for steer, with tires available at approximately +/- 20% of these values, including wide based singles suitable for vocational applications. The agencies did not, however, discuss the feasibility of these tires across the staggering array of vocational vehicle types and applications in the regulated vehicle range from Class 2b to 8. The agencies only offer what they deemed as a conservative

assessment of projected adoption rates that does not differ by weight class. As a solely HHD vocational vehicle manufacturer the Volvo Group in North America does not believe that a tire appropriate in one weight class may be appropriate for another, or that a tire appropriate for a highway box truck (of which Volvo Group manufactures few) is suitable for use in an on/off-road HHD vocational vehicle. Due to these concerns Volvo Group does not believe the proposed adoption rates in Table 2-54 of the RIA are feasible for the Volvo Group product mix nor do we believe that the AB&T flexibility should be construed as a means to meet stringency requirements within a regulatory subcategory of vehicles, e.g. Class 8 urban vocational, when those stringencies are predicated on a mix of technologies deployed across the entire range of weight classes and vocational subcategories. [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

Tables 2-188 and 2-190 of the RIA show Alternative 3 HHD vocational tire package costs calculated with a penetration of “Level 3” and “Level 4” steer tires from 2021 and 2024 respectively and drive tire penetrations from 2024 and 2027. Section III.D.iii of the Preamble defines tire CRR “levels” as follows: [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

- “Level 1 rolling resistance performance represents the threshold used to develop SmartWay designated tires for long haul tractors.”
- “Level 2 threshold represents an incremental step for improvements beyond today’s SmartWay level and represents the best in class rolling resistance of tires we tested.”
- “Level 3 values represent the long-term rolling resistance value that the agencies predicts (sic) could be achieved in the 2025 timeframe.” This last step provides a 25% improvement over Level 2.

No definition of “Level 4” was provided in either the RIA or the Preamble to the regulation and there was no inclusion in the tractor cost or stringency tables of any Level 4 penetration. [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

It is unclear from the cost determinations whether these levels of tire CRR values were actually considered in the penetration and stringency considerations. Table V-16 of the Preamble does not suggest anything beyond a 20% improvement in steer CRR and a 15% improvement in Drive CRR for 2027. Volvo Group requests clarification of this issue. [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

With respect to highway tractor and heavy-haul tractor penetration and stringency setting the agencies show penetration of Level 3 tires starting in MY 2021. It is unclear how this can be possible given the agencies own determination that this technology “could” be achieved only in the 2025 timeframe. [EPA-HQ-OAR-2014-0827-1290-A1 p.22]

These comments were submitted by Volvo in the context of the custom chassis program: “Mixer tire Crr levels are not appropriate for off-road use and should reflect the same level as Emergency vehicles. Need to accommodate Crr averaging for Transit and Coach buses that have single drive and single drive/dead axle configurations.” [EPA-HQ-OAR-2014-0827-1928-A1 p.15]

**Organization:** Navistar, Inc.

Similar to the tractor tires, vocational vehicles will not necessarily see the benefit from Level 2 and 3 low rolling resistance tires and will trade-off other desired attributes such as traction for on-off highway operation and durability. Therefore, achieving the predicted penetrations for these tire levels will be extremely challenging for many applications [EPA-HQ-OAR-2014-0827-1199-A1 p.40]

**Organization:** National Automobile Dealers Association (NADA)

Two strategies in the Phase 2 proposal are of particular concern; tires and hybridization. [EPA-HQ-OAR-2014-0827-1309-A1 p.9]

**Response:**

In consideration of comments, we are changing our projected adoption rates of LRR tires on vocational vehicles from proposal, by differentiating the tire rolling resistance improvement level by both weight class and duty cycle, recognizing that heavier vehicles designed for highway use can generally apply tires with lower rolling resistance than other vehicle types, and will see a greater benefit during use. We disagree there is a direct trade-off between traction and rolling resistance. As stated in the RIA Chapter 2.8.3.2, tire design requires balancing performance, since changes in design may change different performance characteristics in opposing directions. A single performance parameter can easily be enhanced, but an optimal balance of all the criteria would require improvements in materials and tread design at a higher cost, as estimated by the agencies. We agree with Volvo and other commenters that rolling resistance is less of a priority for some vehicles with off-highway duty cycles. Accordingly, the final rules project adoption of tires with less advanced levels of CRR for vehicles in Urban and some custom chassis subcategories, recognizing the special needs of these applications.

We include tire maintenance costs at intervals of 40,000 miles (vocational vehicles) and 200,000 miles (tractors and trailers). Those maintenance costs include the same incremental costs as the new tire, so our maintenance costs could potentially be conservative if the maintenance intervals are the same with retreads as with new tires.

We disagree with comments questioning the ability to retread low rolling resistance tires. In discussions with EPA's SmartWay team, tire manufacturers have claimed that their low rolling resistance tires are as retreadable as those with higher rolling resistance. There is no evidence in the record indicating otherwise. The comments themselves contain assertions which are not documented. EPA followed up and asked fleets and others for data regarding this topic, but no data were provided. Although there may be individual tire models that do not perform as well in terms of retreadability, we do not believe this is a systematic issue related to low rolling resistance tires. If (contrary to our view) there is, in fact, a loss of tire casing durability and, therefore, a need to replace tires earlier (rather than just replacing treads at the same interval), then at most the agencies' costs may be slightly underestimated. See Section 5.3 for responses to other comments related to tire maintenance. See Section 11.3 for responses to comments about other types of maintenance costs.

The RMA comments included CRR values for a wide range of vocational vehicle tires, for rim sizes from 17.5 inches to 24.5 inches, for steer/all position tires as well as drive tires. The RMA data, while illustrating a range of available tires, are not sales weighted. The 2014 certification data include actual production volumes for each vehicle type, thus both steer and drive tire population-weighted data are available for emergency vehicles, cement mixers, school buses, motor homes, coach buses, transit buses, and other chassis cabs. The certification data are consistent with the RMA assessment of the range of tire CRR currently available. We also agree with RMA's suggestion to set a future CRR level where a certain percent of current products can meet future GEM targets. We disagree with RMA that the MY 2027 target should be a level that 50 percent of today's products can meet. With programmatic averaging, such a level would mean essentially no improvements overall from tire rolling resistance, because today when manufacturers comply on average, half their tires are above the target and half are below. Further, with Phase 2 GEM requiring many more vehicle inputs than tire CRR, manufacturers have many more degrees of freedom (i.e. available potential compliance paths) to meet the performance standard than they do in



Phase 1. None of the rolling resistance levels projected for adoption in MY 2027 are lower than the 25<sup>th</sup> percentile of tire CRR on actual vocational vehicles sold in MY 2014. Thus, we believe the improvements will be achievable without need to develop new tires not yet available.

In the final rules, the agencies are using **Error! Reference source not found.** the descriptors 1v through 5v to refer to levels of rolling resistance among the population of tires installed on vocational vehicles. Level 1v is considered a baseline level and ranges from 7.5 to 8.1 kg/ton. Level 5v represents the greatest degree of improvement projected in this rulemaking and ranges from 5.8 to 6.29 kg/ton. Levels 2v, 3v, and 4v fall in between, and the corresponding ranges are presented in Table V-15 of the Preamble. The agencies have defined these levels for purposes of estimating the manufacturing costs associated with applying improved tire rolling resistance to vocational vehicles. These levels are not applicable for estimating degrees of improvement or costs of LRR tires on tractors, trailers, or HD pickups and vans as part of this rulemaking. Furthermore, these levels do not represent the full range of tire CRR available for vocational vehicles. There are both steer and drive tires on certified vocational vehicles today with CRR ranging from 5 kg/ton to 15 kg/ton. This technology is also feasible on all custom chassis, with similarly larger improvements feasible for coach buses and motor homes with typically regional drive cycles, and similarly smaller improvements feasible for school and transit buses, refuse trucks, and concrete mixers with typically urban drive cycles. Absent specific data on tires for refuse trucks, we have considered the comments and are thus projecting LRR levels for refuse trucks that are equivalent to those projected for transit buses: Level 1v through MY 2026 and level 3v beginning in MY 2027.

In response to comments about the projected CRR levels for concrete mixers, these are based on actual certification data from MY 2014 submitted by custom chassis manufacturers who manufacture these vehicles and designated them as such in their production reports. They exhibited very different characteristics than those observed for tires on emergency vehicles.<sup>192</sup>

With respect to the comment about averaging CRR values where a vehicle (such as transit or coach) has either single drive and single drive/dead axle configurations, GEM will require CRR levels to be entered in two places or three depending on the axle configuration specified (ie 4x2, 6x4). This is true for both simplified as well as full GEM.

The final tire packages recognize the variety of tire purposes and performance levels in the vocational vehicle market, and maintain choices for manufacturers to use the most efficient tires (i.e. those with lowest rolling resistance) only where it makes sense given these vehicles' differing purposes and applications.

### **6.3.6 Electrification**

#### **6.3.6.1 *Zero-Emission Trucks & Buses (Battery-Electric & Fuel Cell)***

**Organization:** CALSTART

**Electric vehicles** - The agencies proposed to allow certification of electric vehicles without testing and without a cap on sales above which upstream emissions are counted. 80 FR 40331. We agree with the agencies' approach. Electric heavy-duty vehicles are now and for the foreseeable future a low volume, niche product. The agencies should smooth the way to their production with a minimum of certification requirements and as relaxed of standards as possible. Similarly, the EPA proposed to continue to deem

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<sup>192</sup> See memorandum dated May 2016 on Vocational Vehicle Tire Rolling Resistance Certification Data

electric vehicles as having zero CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions as well as zero fuel consumption. 80 FR 40331. We think that this is the correct approach to best stimulate the market. [EPA-HQ-OAR-2014-0827-1164-A1 p.100]

**Organization:** Environmental Defense Fund (EDF)

Fully electric local delivery trucks are also viable today. Pepsi operates more than 250 of these trucks,<sup>164</sup> including 176 Smith Electric trucks.<sup>165</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.37-38]

164 National Renewable Energy Laboratory fact sheet, Project Startup: Evaluating the Performance of Frito Lay's Electric Delivery Trucks (April 2014). Available at: <http://www.nrel.gov/docs/fy14osti/61455.pdf>

165 Smith Electric website at: <http://www.smithelectric.com/customer-stories/fritolay/>

**Organization:** BYD Motors

The majority of electric vehicles will be deployed in the vocational vehicle segment of the rule. It is BYD's belief that the proposed stringency level for vocational vehicles, in and of itself, will not result in fleets investing the time and capital necessary to bring advanced technologies to market. Therefore, BYD supports either increased stringency levels and/or more rapid implementation. [EPA-HQ-OAR-2014-0827-1182-A1 p.2]

The conservative target in the agencies' preferred alternative can be met purely with conventional technology and therefore misses an opportunity to fully capitalize on the oil and emission reductions that our electric trucks offer. BYD proposes that the stringency of the vocational vehicle standard should be increased to at least 20% to help ensure the investments needed for moving beyond incremental improvements to conventional technology and to promote the adoption of advanced alternative powertrain vehicles. [EPA-HQ-OAR-2014-0827-1182-A1 p.2]

**Organization:** Center for Biological Diversity

We are encouraged to see that the Proposed Rule has significantly expanded the technologies that were included in the standards for vocational vehicles beyond those in Phase 1, but there are still important technologies that have been omitted. As the agencies note, vocational vehicles will benefit greatly from use of strong hybrid powertrains. But technology is progressing rapidly: all-electric vocational vehicles are quite literally around the corner. The recent CALSTART program, a program of the California Energy Commission, has promoted low-GHG medium and heavy-duty vehicles in various capacities.<sup>37</sup> One is an all-electric, non-cabled bus with hands-free rapid charging.<sup>38</sup> Furthermore, the California Air Resources Board is actively working on a zero-emission bus rule, and a number of demonstration buses are already on the road.<sup>39</sup> Notably, commercialization is predicted for 5 years from now – before the start date for implementation of the Proposed Rule.<sup>40</sup> Electric buses are not limited to California: there are close to 30 lines across the United States that currently use electric-propulsion buses.<sup>41</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.9]

Buses are not the only vocational vehicles that benefit from battery electric technology. There are over 500 battery electric medium- and heavy-duty vehicles in California and about a 1000 nation-wide.<sup>42</sup> These as well as plug-in electric hybrid vocational vehicles are being used by a number of major companies, including United Parcel Service (“UPS”) and FedEx. These fleets have provided ample demonstration

that electrification is a viable option for a wide range of vocational vehicles. Thus, the technology-forcing nature of the statutes requires the agencies to include all-electric options for vocational vehicles in setting the stringency of the medium- and heavy-duty truck standards. [EPA-HQ-OAR-2014-0827-1460-A1 p.10]

**Organization:** California Air Resources Board (CARB)

While a BEV does not require an engine, exhaust system, or emission controls, it does require the addition of other components such as an electric motor, various electronics, and a battery pack. Of these, the battery pack comprises the vast majority of the cost. Because of the battery pack, BEVs currently have a substantial net incremental cost. The incremental cost is the cost of the BEV over and above the cost of a comparable conventionally-fueled vehicle. U.S. EPA and NHTSA present the incremental costs (2012 dollar) of EVs, and projects how it anticipates these costs will change in the foreseeable future. [EPA-HQ-OAR-2014-0827-1265-A1 p.96]

While U.S. EPA and NHTSA's anticipated cost reduction approach on the part of the balance-of-components seems reasonable, CARB staff believes that significantly greater cost reductions will be realized in the future due to declining battery costs. Over the last several years, battery costs have declined substantially, and ongoing efforts on the part of academia and industry continue to reduce costs through materials changes, manufacturing improvements, and cost reductions associated with increased volumes, and are projected to continue to do so. CARB staff believes that U.S. EPA and NHTSA's cost projections overestimate the likely costs of these vehicles in the post 2020 timeframe because of the significant reductions in anticipated battery costs. [EPA-HQ-OAR-2014-0827-1265-A1 p.96-97]

CARB staff believes that medium- and heavy-duty BEVs have a significant role to play in the near future, especially for vehicles operating in the optimal duty cycle identified for BEVs (defined routes, lots of starts and stops, high idle time, and lower average speeds). A variety of medium- and heavy-duty BEVs are now available for purchase, including shuttle buses, school buses, and transit buses, and demonstration vehicles are in use in drayage, garbage collection, and other applications. While CARB staff agrees that BEVs are not yet suitable for long-haul trucking, more localized urban opportunities for BEVs abound. CARB staff is currently pursuing battery electric and fuel cell electric requirements for buses and last mile delivery trucks, and will continue to pursue the maximum feasible BEV penetration in other applications. For more information, please see CARB's battery and fuel cell electric technology assessment, which will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. [EPA-HQ-OAR-2014-0827-1265-A1 p.97]

CARB disagrees with US EPA and NHTSA's comment that electric trucks will not be widely commercially available in the timeframe of the proposed rule, particularly with respect to urban and miscellaneous vocational vehicles. U.S. EPA and NHTSA cite cost as one of the key factors in this determination. While CARB staff agrees that higher up-front capital costs will be a significant deterrent to zero emission truck and bus deployment in the coming decade, California is taking steps to address this challenge. [EPA-HQ-OAR-2014-0827-1265-A1 p.97]

California must meet several air quality, climate, and petroleum reduction targets in the 2030 timeframe that will require a broad transformation of our light-, medium- and heavy-duty fleets to utilize zero- and near-zero-emission technologies. In recognition that this transformation will not come simply or cheaply, California is investing hundreds of millions of dollars annually to develop and deploy zero-emission vehicle technologies. Plug-in hybrid and zero-emission passenger car sales in our State have increased dramatically in the past five years, from a few hundred in 2010 to over 200,000 sold as of mid-2015. California Governor Jerry Brown's Executive Order B-16-2012 sets a target of deploying 1.5 million

zero-emission vehicles by 2025, including zero-emission trucks and buses, and California's Zero-Emission Vehicle Action Plan identifies implementation strategies and milestones for achieving this goal. [EPA-HQ-OAR-2014-0827-1265-A1 p.97-98]

While the heavy-duty sector will be much more challenging than the light-duty sector, we are implementing key strategies needed to shift trucks and buses to utilize hybrid and zero-emission technology where practical. California's Sustainable Freight Transport Initiative: Pathways to Zero- and Near-Zero Emissions Discussion Document recognizes that in order to meet our public health mandates, climate goals, and economic needs, the transition to a less-polluting, more efficient, modern freight transport system is a preeminent policy objective for the State of California – and will continue to be so for several decades to come. It will require us to make steady and continual progress in moving both domestic and international cargo in California more efficiently, with zero emissions everywhere feasible, and near-zero emissions with renewable fuels. [EPA-HQ-OAR-2014-0827-1265-A1 p.98]

California Senate Bill 1204 (Lara, Chapter 524, Statutes of 2014) establishes the California Clean Truck, Bus and Off-Road Vehicles and Equipment Technology Program to fund development, demonstration, pre-commercial pilot, and early commercial deployment of zero- and near-zero-emission technologies. In June 2015, CARB approved a \$350 million funding plan for fiscal year 2015-16 utilizing GHG Reduction Fund and AQIP monies. The GHG Reduction Fund provides an ongoing source of funding which California can invest in zero- and near-zero-emission transportation solutions. Previous year's investments have resulted in over 2,000 hybrid and zero-emission heavy-duty vehicles now deployed in California, mostly in delivery truck vocations. [EPA-HQ-OAR-2014-0827-1265-A1 p.98]

We believe the NPRM should recognize California's critical need for, and commitment to, accelerated deployment of zero-emission heavy-duty vehicle technologies. We anticipate California will address capital cost and other barriers to zero-emission truck and bus deployment through a robust strategy portfolio of targeted incentives, complementary regulations, and other approaches. CARB staff believes that zero-emission trucks and buses will likely begin to be widely commercially available in California in the Phase 2 timeframe, particular in urban and local delivery vocations. Given that California represents about ten percent of the nation's truck and bus market, this is not an insignificant development, even in the context of a federal Phase 2 program.

Other States and localities are also recognizing the need for zero-emission truck and bus technologies to meet more stringent eight-hour ozone standards and local air quality and health goals. New York State and the City of Chicago, for example, have followed California's lead by implementing similar funding programs to accelerate deployment of zero-emission truck and bus technologies. While we expect California will lead the nation in making zero-emission truck and bus technologies a reality, we also anticipate, much like other states have "opted in" to California's light-duty passenger car zero-emission vehicle program, our heavy-duty zero-emission vehicle program and strategies may also be a model for other states. We recommend that U.S. EPA and NHTSA recognize California's needs for, and commitment to, deployment of zero-emission heavy-duty vehicles in the 2025 to 2030 timeframe, with the expectation for significant zero-emission truck and bus deployment in the urban vocational and miscellaneous vehicle vocations. [EPA-HQ-OAR-2014-0827-1265-A1 p.99]

CARB staff believes the NPRM is overly pessimistic regarding the future of heavy-duty FCEVs. CARB believes that zero-emission technologies will be able to demonstrate greater applications, range, durability, and reliability by 2021. CARB staff is currently developing a fuel cell electric technology assessment, which will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. In developing the fuel cell electric technology assessment, CARB staff has concluded heavy-duty FCEVs have the potential to become a prime candidate for zero-emission transportation, especially for vehicle

types that travel long distances. It is reasonable to expect that fuel cell electric technology will likely be transferred to other heavy-duty applications in the near future, which will help foster broader commercialization. [EPA-HQ-OAR-2014-0827-1265-A1 p.100]

Fuel cell electric buses are already in the early commercialization stage today and have demonstrated robust service records. As detailed in Attachment 4 – Active and Planned Fuel Cell Electric Vehicles Demonstrations,<sup>41</sup> various demonstrations of heavy-duty FCEVs have been funded through federal, state, and local programs. Fuel cell electric transit buses have been demonstrated worldwide over the last two decades, with promising results.<sup>42</sup> Currently, there are 24 (of which 18 are in California) demonstrated fuel cell electric buses and 22 (of which 8 are in California) planned demonstrations fuel cell electric buses in the U.S.<sup>43</sup> In addition, there are 45 (of which 22 are in California) fuel cell electric trucks that are currently being demonstrated or are planned to be demonstrated in the U.S.<sup>44</sup> To encourage further development of fuel cell electric technology in other heavy-duty on-road applications, a number of agencies including the U.S. Department of Energy, California Energy Commission, and South Coast Air Quality Management District have recently and are currently funding heavy-duty fuel cell electric demonstration projects, including demonstrations involving electric drayage trucks. CARB will make available approximately \$25 million for near-zero- and zero-emission drayage trucks and at least \$25 million for zero-emission trucks and buses in 2015. By 2021, CARB staff expects heavy-duty FCEVs will be in commercial or pre-commercial phases, depending on the vocation. However, as new technology is often more expensive, it is important to provide adequate incentives to the market at the early stage. In California, we have and will be utilizing a variety of financial incentives along with regulatory programs. We urge U.S. EPA and NHTSA to consider a similar strategy to increase the volume of heavy-duty FCEVs, reduce their cost, and establish corridor fueling networks. CARB is interested in working collaboratively with U.S. EPA and NHTSA on this effort. [EPA-HQ-OAR-2014-0827-1265-A1 p.100-101]

**Organization:** California Air Resources Board (CARB)

**Comment – Current and future status of all BEV; standards should assume some use of all EVs**

In the NPRM, U.S. EPA and NHTSA confirm that BEVs have advantages over their conventionally-fueled counterparts in terms of efficiency, torque, regenerative braking opportunities, and low noise characteristics, but also notes that they are limited by weight, range, and cost. Because of the high cost and developing nature of this technology, U.S. EPA and NHTSA do not project that fully electric vocational vehicles will be widely commercially available in the time frame of the proposed rules, and the proposed standards are not based on any level of adoption of this technology. Yet U.S. EPA and NHTSA do indeed project some use of these technologies as is noted “While the agencies have not premised the proposed Heavy-Duty Phase 2 tractor standards on hybrid powertrains, FCEVs, or BEVs, we also foresee some limited use of these technologies in 2021 and beyond.” (page 40253 of the NPRM) In acknowledging the projected use of BEVs but not including their use in setting appropriate emission standards, U.S. EPA is leaving potential emission benefits on the table. CARB staff believes that the GHG standards should incorporate limited penetration rates for these advanced technologies, particularly for vocational vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.49]

While CARB staff agrees with U.S. EPA and NHTSA’s assessment of the advantages and limitations of current medium- and heavy-duty EVs, CARB staff is significantly more optimistic about the potential penetration of BEVs into the market during the Phase 2 timeframe. CARB staff believes that the current status of heavy-duty zero-emission vehicles is more advanced than U.S. EPA and NHTSA project. In the NPRM, U.S. EPA and NHTSA state “[W]e have not found any all-electric heavy-duty vehicles that have certified by 2014. As we look into the future, we project very limited adoption of all-EVs into the

market.” (page 40159 of the NPRM) “In our assessment, we have observed that the few all-electric heavy duty vocational vehicles that have been certified are being produced in very small volumes in MY2014.” (page 40331 of the NPRM) “[T]he agencies do not project fully electric vocational vehicles to be widely commercially available in the time frame of the proposed rules. For this reason, the agencies have not based the proposed Phase 2 standards on adoption of full-electric vocational vehicles.” (page 40304 of the NPRM) CARB staff believes these assessments are not as optimistic as the status of the technology indicates. [EPA-HQ-OAR-2014-0827-1265-A1 p.49-50]

In our medium- and heavy-duty BEV technology assessment, CARB staff investigated the current status of the technology. We specifically looked at transit bus applications, school bus applications, medium-duty trucks and shuttle buses (8,501-14,000 lbs GVWR) and heavy-duty trucks (>14,000 lbs GVWR). We found that battery all-electric transit buses are commercially available, with over 2,600 of battery all-electric buses worldwide. New orders are placed regularly. Urban transit buses are an ideal application for battery all-electric heavy-duty vehicles because they operate on fixed routes of normally short distances, perform frequent stop and start driving which is needed for regenerative braking, maintain low average speeds which helps to preserve the battery power, and return to a general base or facility at the end of the day which enables overnight charging. Electric transit buses are currently available from BYD, New Flyer, and Proterra, while Nova’s new electric bus model is in demonstration. CARB is developing advanced transit fleet requirements, which will be predicated on the widespread use of electric transit buses. CARB staff believes that the Phase 2 GHG standards should assume the penetration of electric transit buses into the nationwide fleet. [EPA-HQ-OAR-2014-0827-1265-A1 p.50]

School buses are not yet as commercially available as transit buses. The TransTech SSTe type A school bus is available for purchase, however, and Lion, a Canadian company, has recently released the eLion type C school bus. Electric school buses have the potential for significant market penetration in the next 5 to 10 years, well within the timeframe of the Phase 2 GHG regulations. CARB has funded three electric school bus demonstrations to date, starting in fiscal year 2011/12 and those projects have been completed, with buses now transporting children daily. The final reports from these projects are posted on CARB’s Air Quality Improvement Program (AQIP) Advanced Technology Demonstration Project webpage at: <http://www.arb.ca.gov/msprog/aqip/demo.htm>. [EPA-HQ-OAR-2014-0827-1265-A1 p.50]

There are hundreds of BEVs in the medium-duty (8,501-14,000 lbs GVWR) vocational category already operating on California’s roads; such vehicles are in the early commercialization stage. Vehicles in this category are being utilized in an optimal duty cycle for BEVs, urban delivery, and have CARB incentives to promote adoption. For example, to reduce the incremental costs of zero-emission vehicles, CARB has been providing financial incentives to fleets statewide through programs such as California’s Hybrid and Zero-Emission Truck and Bus Voucher Incentives Project (HVIP). Since HVIP’s launch in 2010, CARB has provided over \$10 million to funding nearly 400 heavy-duty BEVs.<sup>23</sup> CARB staff expects widespread penetration of BEVs into some parts of the market place in the next 5 to 10 years. Therefore, CARB staff believes it would be appropriate to assume some market penetration of BEVs in this class in the timeframe of the Phase 2 GHG regulations. [EPA-HQ-OAR-2014-0827-1265-A1 p.50-51]

Expanding BEV technology into additional applications in the heavy-duty truck segment (other than buses) will require further developments in battery technology and lower vehicle component costs overall. It is not expected that BEVs will penetrate into the long-haul trucking market in the next several decades without significant advances in battery energy density and BEV recharging technologies. CARB staff agrees it is reasonable to presume no significant market penetration in the regulatory timeframe for long haul class 7 and 8 tractors. There are electric drayage trucks in demonstration phases, as well as electric refuse trucks, but CARB staff agrees it is likely that commercial BEV penetration in these applications will be limited during the next decade. [EPA-HQ-OAR-2014-0827-1265-A1 p.51]

However, CARB staff believes it is appropriate to push technology development. Electric vocational vehicles have been demonstrated effectively; stringent emission requirements would further promote their use. CARB staff encourages U.S. EPA and NHTSA to continue to evaluate appropriate different technologies and approaches that can achieve substantial emission reductions. Over the past decade, heavy duty fleets have made substantial investments to adopt modern, lower-emitting vehicles. Today, as noted above, zero-emission vehicles such as battery electric and fuel cell electric buses are in the early commercialization phase. Demonstrations are underway across the State in a wide array of heavy-duty applications including drayage trucks, delivery trucks, and school buses. State incentives are in place that are encouraging the development and adoption of these technologies, increasing production volumes, fostering innovation, and reducing costs. For more information, please see CARB's battery and fuel cell electric technology assessment that is currently in development and will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. [EPA-HQ-OAR-2014-0827-1265-A1 p.51]

While CARB staff acknowledges that the present populations of medium- and heavy-duty vocational BEVs are low, these numbers are expected to increase significantly in the Phase 2 timeframe. For example, CARB staff plans to propose purchase zero-emission requirements for last-mile delivery vehicles in 2020, which will significantly increase demand for these vehicles. Yet U.S. EPA and NHTSA's proposed emission standards are not based on the inclusion of any zero-emission vehicles under either Alternative 3 or the more accelerated Alternative 4. To assume no penetration in the selected Alternative does not reflect market trends and results in a loss of potential GHG emission reductions by setting the emission standard less stringent than would be appropriate with the inclusion of these vehicles. CARB staff notes that even with the higher upfront capital cost of EVs, the anticipated savings in operation and maintenance costs allows payback of the initial investment and significant market penetration for medium- and heavy-duty vehicles operating in an "optimum" BEV duty cycle (defined routes, lots of starts and stops, high idle time, and lower average speeds) can occur in the Phase 2 timeframe. Therefore, CARB staff recommends that U.S. EPA and NHTSA set emission standards that are based on the inclusion of an electric vocational vehicle penetration rate of at least 1 percent, which is a third of the rate projected for Alternative 5 in the NPRM. [EPA-HQ-OAR-2014-0827-1265-A1 p.52]

**Organization:** California Air Resources Board (CARB)

In the NPRM, U.S. EPA and NHTSA confirm that BEVs have advantages over their conventionally-fueled counterparts in terms of efficiency, torque, regenerative braking opportunities, and low noise characteristics, but also notes that they are limited by weight, range, and cost. Because of the high cost and developing nature of this technology, U.S. EPA and NHTSA do not project that fully electric vocational vehicles will be widely commercially available in the time frame of the proposed rules, and the proposed standards are not based on any level of adoption of this technology. Yet U.S. EPA and NHTSA do indeed project some use of these technologies as is noted "While the agencies have not premised the proposed Heavy-Duty Phase 2 tractor standards on hybrid powertrains, FCEVs, or BEVs, we also foresee some limited use of these technologies in 2021 and beyond." (page 40253 of the NPRM) In acknowledging the projected use of BEVs but not including their use in setting appropriate emission standards, U.S. EPA is leaving potential emission benefits on the table. CARB staff believes that the GHG standards should incorporate limited penetration rates for these advanced technologies, particularly for vocational vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.49]

While CARB staff agrees with U.S. EPA and NHTSA's assessment of the advantages and limitations of current medium- and heavy-duty EVs, CARB staff is significantly more optimistic about the potential penetration of BEVs into the market during the Phase 2 timeframe. CARB staff believes that the current status of heavy-duty zero-emission vehicles is more advanced than U.S. EPA and NHTSA project. In the

NPRM, U.S. EPA and NHTSA state “[W]e have not found any all-electric heavy-duty vehicles that have certified by 2014. As we look into the future, we project very limited adoption of all-EVs into the market.” (page 40159 of the NPRM) “In our assessment, we have observed that the few all-electric heavy duty vocational vehicles that have been certified are being produced in very small volumes in MY2014.” (page 40331 of the NPRM) “[T]he agencies do not project fully electric vocational vehicles to be widely commercially available in the time frame of the proposed rules. For this reason, the agencies have not based the proposed Phase 2 standards on adoption of full-electric vocational vehicles.” (page 40304 of the NPRM) CARB staff believes these assessments are not as optimistic as the status of the technology indicates. [EPA-HQ-OAR-2014-0827-1265-A1 p.49-50]

In our medium- and heavy-duty BEV technology assessment, CARB staff investigated the current status of the technology. We specifically looked at transit bus applications, school bus applications, medium-duty trucks and shuttle buses (8,501-14,000 lbs GVWR and heavy-duty trucks (>14,000 lbs GVWR). We found that battery all-electric transit buses are commercially available, with over 2,600 of battery all-electric buses worldwide. New orders are placed regularly. Urban transit buses are an ideal application for battery all-electric heavy-duty vehicles because they operate on fixed routes of normally short distances, perform frequent stop and start driving which is needed for regenerative braking, maintain low average speeds which helps to preserve the battery power, and return to a general base or facility at the end of the day which enables overnight charging. Electric transit buses are currently available from BYD, New Flyer, and Proterra, while Nova’s new electric bus model is in demonstration. CARB is developing advanced transit fleet requirements, which will be predicated on the widespread use of electric transit buses. CARB staff believes that the Phase 2 GHG standards should assume the penetration of electric transit buses into the nationwide fleet. [EPA-HQ-OAR-2014-0827-1265-A1 p.50]

School buses are not yet as commercially available as transit buses. The TransTech SStE type A school bus is available for purchase, however, and Lion, a Canadian company, has recently released the eLion type C school bus. Electric school buses have the potential for significant market penetration in the next 5 to 10 years, well within the timeframe of the Phase 2 GHG regulations. CARB has funded three electric school bus demonstrations to date, starting in fiscal year 2011/12 and those projects have been completed, with buses now transporting children daily. The final reports from these projects are posted on CARB’s Air Quality Improvement Program (AQIP) Advanced Technology Demonstration Project webpage at: <http://www.arb.ca.gov/msprog/aqip/demo.htm>. [EPA-HQ-OAR-2014-0827-1265-A1 p.50]

There are hundreds of BEVs in the medium-duty (8,501-14,000 lbs GVWR) vocational category already operating on California’s roads; such vehicles are in the early commercialization stage. Vehicles in this category are being utilized in an optimal duty cycle for BEVs, urban delivery, and have CARB incentives to promote adoption. For example, to reduce the incremental costs of zero-emission vehicles, CARB has been providing financial incentives to fleets statewide through programs such as California’s Hybrid and Zero-Emission Truck and Bus Voucher Incentives Project (HVIP). Since HVIP’s launch in 2010, CARB has provided over \$10 million to funding nearly 400 heavy-duty BEVs.<sup>23</sup> CARB staff expects widespread penetration of BEVs into some parts of the market place in the next 5 to 10 years. Therefore, CARB staff believes it would be appropriate to assume some market penetration of BEVs in this class in the timeframe of the Phase 2 GHG regulations. [EPA-HQ-OAR-2014-0827-1265-A1 p.50-51]

Expanding BEV technology into additional applications in the heavy-duty truck segment (other than buses) will require further developments in battery technology and lower vehicle component costs overall. It is not expected that BEVs will penetrate into the long-haul trucking market in the next several decades without significant advances in battery energy density and BEV recharging technologies. CARB staff agrees it is reasonable to presume no significant market penetration in the regulatory timeframe for long haul class 7 and 8 tractors. There are electric drayage trucks in demonstration phases, as well as electric



refuse trucks, but CARB staff agrees it is likely that commercial BEV penetration in these applications will be limited during the next decade. [EPA-HQ-OAR-2014-0827-1265-A1 p.51]

However, CARB staff believes it is appropriate to push technology development. Electric vocational vehicles have been demonstrated effectively; stringent emission requirements would further promote their use. CARB staff encourages U.S. EPA and NHTSA to continue to evaluate appropriate different technologies and approaches that can achieve substantial emission reductions. Over the past decade, heavy duty fleets have made substantial investments to adopt modern, lower-emitting vehicles. Today, as noted above, zero-emission vehicles such as battery electric and fuel cell electric buses are in the early commercialization phase. Demonstrations are underway across the State in a wide array of heavy-duty applications including drayage trucks, delivery trucks, and school buses. State incentives are in place that are encouraging the development and adoption of these technologies, increasing production volumes, fostering innovation, and reducing costs. For more information, please see CARB's battery and fuel cell electric technology assessment that is currently in development and will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. [EPA-HQ-OAR-2014-0827-1265-A1 p.51]

While CARB staff acknowledges that the present populations of medium- and heavy-duty vocational BEVs are low, these numbers are expected to increase significantly in the Phase 2 timeframe. For example, CARB staff plans to propose purchase zero-emission requirements for last-mile delivery vehicles in 2020, which will significantly increase demand for these vehicles. Yet U.S. EPA and NHTSA's proposed emission standards are not based on the inclusion of any zero-emission vehicles under either Alternative 3 or the more accelerated Alternative 4. To assume no penetration in the selected Alternative does not reflect market trends and results in a loss of potential GHG emission reductions by setting the emission standard less stringent than would be appropriate with the inclusion of these vehicles. CARB staff notes that even with the higher upfront capital cost of EVs, the anticipated savings in operation and maintenance costs allows payback of the initial investment and significant market penetration for medium- and heavy-duty vehicles operating in an "optimum" BEV duty cycle (defined routes, lots of starts and stops, high idle time, and lower average speeds) can occur in the Phase 2 timeframe. Therefore, CARB staff recommends that U.S. EPA and NHTSA set emission standards that are based on the inclusion of an electric vocational vehicle penetration rate of at least 1 percent, which is a third of the rate projected for Alternative 5 in the NPRM. [EPA-HQ-OAR-2014-0827-1265-A1 p.52]

A 1 percent penetration for zero-emission vocational vehicles in 2024 is reasonable, given that, as detailed above, zero-emission vocational vehicles are already on the road in California (9 years ahead of 2024), and all-electric transit buses and delivery vehicles are in the early commercialization stage. Given the long lead time of the Phase 2 regulation, CARB staff believes it is reasonable to include zero-emission advanced technology vehicles in setting the stringency of the standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.55-6]

CARB staff believes the NPRM is overly pessimistic regarding the future of heavy-duty FCEVs. CARB believes that zero-emission technologies will be able to demonstrate greater applications, range, durability, and reliability by 2021. CARB staff is currently developing a fuel cell electric technology assessment, which will be posted at <http://www.arb.ca.gov/msprog/tech/report.htm> when available. In developing the fuel cell electric technology assessment, CARB staff has concluded heavy-duty FCEVs have the potential to become a prime candidate for zero-emission transportation, especially for vehicle types that travel long distances. It is reasonable to expect that fuel cell electric technology will likely be transferred to other heavy-duty applications in the near future, which will help foster broader commercialization. [EPA-HQ-OAR-2014-0827-1265-A1 p.100]

Fuel cell electric buses are already in the early commercialization stage today and have demonstrated robust service records. As detailed in Attachment 4 – Active and Planned Fuel Cell Electric Vehicles Demonstrations,<sup>41</sup> various demonstrations of heavy-duty FCEVs have been funded through federal, state, and local programs. Fuel cell electric transit buses have been demonstrated worldwide over the last two decades, with promising results.<sup>42</sup> Currently, there are 24 (of which 18 are in California) demonstrated fuel cell electric buses and 22 (of which 8 are in California) planned demonstrations fuel cell electric buses in the U.S.<sup>43</sup> In addition, there are 45 (of which 22 are in California) fuel cell electric trucks that are currently being demonstrated or are planned to be demonstrated in the U.S.<sup>44</sup> To encourage further development of fuel cell electric technology in other heavy-duty on-road applications, a number of agencies including the U.S. Department of Energy, California Energy Commission, and South Coast Air Quality Management District have recently and are currently funding heavy-duty fuel cell electric demonstration projects, including demonstrations involving electric drayage trucks. CARB will make available approximately \$25 million for near-zero- and zero-emission drayage trucks and at least \$25 million for zero-emission trucks and buses in 2015. By 2021, CARB staff expects heavy-duty FCEVs will be in commercial or pre-commercial phases, depending on the vocation. However, as new technology is often more expensive, it is important to provide adequate incentives to the market at the early stage. In California, we have and will be utilizing a variety of financial incentives along with regulatory programs. We urge U.S. EPA and NHTSA to consider a similar strategy to increase the volume of heavy-duty FCEVs, reduce their cost, and establish corridor fueling networks. CARB is interested in working collaboratively with U.S. EPA and NHTSA on this effort. [EPA-HQ-OAR-2014-0827-1265-A1 p.100-101]

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41 See Attachment 4 for Active and Planned Fuel Cell Electric Vehicles Demonstrations. [Attachment 4 can be found on p.27-36 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

42 (NREL, 2015c) Eudy, Leslie, and Matthew Post, “Zero Emission Bay Area (ZEBA) Fuel Cell Bus Demonstration Results: Fourth Report,” National Renewable Energy Laboratory, July 2015, <<http://www.nrel.gov/docs/fy15osti/63719.pdf>>.

**Response:**

Given the high up-front costs and the developing nature of this technology, the agencies do not project that it is feasible or reasonable for fully electric heavy-duty vocational vehicles to be widely commercially available without heavy subsidies in the time frame of the final rules. The comment by EDF that Pepsi operates a small number of zero-emission vehicles is not evidence that the technology is cost-effective, commercially available, or technically feasible for a particular subcategory. Nor does this comment indicate what the projected future adoption rate should be. This comment simply presents evidence that a fleet owner is willing to test the vehicles on a demonstration basis. The commenter did not mention whether Pepsi took this risk in the absence of monetary subsidies, or what level of satisfaction Pepsi has had with the maintenance on these vehicles.

For these reasons, the agencies have not based the Phase 2 standards on adoption of full-electric vocational vehicles. Although we agree that some vocational applications may see attractive long term cost scenarios for electric trucks or buses when considering maintenance savings, we do not have sufficient information to project a market adoption rate for any specific subcategory. Further, although our final cost analysis does include maintenance savings from reduced oil changes for engine-off idle reduction technologies, we have not quantified the maintenance savings of a full electric vehicle compared to a conventional diesel. We appreciate the comments that provided information of this nature,

and we expect that better dissemination of this information could lead to further adoption of this technology in the market.

The agencies take the point that it is appropriate to create regulatory incentives for use of these advanced electrification technologies. As described above in Section 1.4.1 and in the Preamble in Section I.C.1.(b), we have adopted an advanced technology credit multiplier applicable to both BEVs and FCEVs, in response to comment. In addition, to the extent these technologies are brought to market in the time frame of the Phase 2 program, there is currently a certification path for these chassis from Phase 1, as described in Section V.D of the Preamble, in EPA's regulations at 40 CFR 1037.150 and NHTSA's regulations at 49 CFR 535.8.

### **6.3.6.2 *Electrified Accessories***

**Organization:** Autocar, LLC

Electric Components. Autocar submits that there is potential for certain chassis components to be powered by the electrical system rather than the engine; however, we do not have access to research or data proving that electrifying components such as cooling fans and A/C compressors would lead to an improvement in fuel economy in a Low-speed/Frequent-stop Vehicle. [EPA-HQ-OAR-2014-0827-1233-A1 p.15]

#### **Bosch**

**Highly Efficient Alternators** - Bosch proposes that recognition of the benefits of efficient electrical charging systems (specifically alternators) should be included in the regulation. Bosch proposes creation of a standard component-level test for alternators to determine their efficiency, and establishment of a minimum efficiency level that must be attained, in order for an off-cycle credit to be applied. [EPA-HQ-OAR-2014-0827-1466-A2 p.11]

**Organization:** American Automotive Policy Council

#### MAC Efficiency in Class 7, Class 8, and Vocational Truck Regulations

EPA included fuel savings from improved air conditioner credits in setting the standards for Class 7 and Class 8 heavy trucks, as well as vocational vehicles: "Compared to 2017MY air conditioners, air conditioners with improved efficiency compressors will reduce CO<sub>2</sub> emissions by 0.5 percent." (80 Federal Register 40221). The difficulty of the standards was increased over time due to the forecast phase-in of these improved MAC systems (80 Federal Register 40228). [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

For regulatory compliance, an improvement factor of 0.5% is given to vehicles with "high-efficiency" air conditioner compressors, defined as either electric compressors or improved mechanical compressors. High-efficiency compressors are an input variable in the GEM model which results in a 0.5% fuel consumption reduction, thereby de facto giving Class 7, Class 8 and vocational trucks the benefit of a pre-defined and pre-approved off-cycle fuel consumption credit for these compressors (80 Federal Register 40631). (Note: reference to 86.1868-12(h)(5) in the NPRM appears to be incorrect since that section covers improved evaporators and condensers whereas the correct reference would be to compressors with reduced reheat 86.1868-12(h)(1)). [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

Clearly, the agencies recognize the environmental benefits that can be achieved from vehicle air conditioner efficiency improvements, and has included incentives within this NPRM for Class 7, Class 8 and vocational truck regulations to achieve these benefits through a simple pre-defined credit.

**Organization:** California Air Resources Board (CARB)

**Comment - Emission credits for electrified accessories for vocational vehicles**

U.S. EPA and NHTSA have not included electrified accessories as a component of the GEM model for vocational vehicles and instead propose to only allow manufacturers to apply for off-cycle credits for the technology. CARB staff sees electrified accessories as a viable technology to improve emissions in the vocational sector and believes it should be included in the overall stringency standards and GEM model. As stated in the NPRM, electrified accessories can result in a 2 to 4 percent fuel consumption benefit in vocational applications. CARB's recently released report on heavy-duty drivetrain and vehicle efficiency backs these findings up, suggesting a 1 to 3 percent benefit from electrified accessories. This technology is feasible as it has already been demonstrated in various applications. With the long lead time of the Phase 2 regulation, CARB staff believes that the production volumes for electrified accessories can substantially increase if pushed by regulatory action, raising the production volumes and significantly lowering the costs, which will make this technology a cost-effective approach to reduce CO2 emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.48]

U.S. EPA and NHTSA are proposing vocational stringencies of 16 percent fuel consumption improvement by 2027. Electrified accessories could allow the proposed stringencies to be significantly tightened in certain vocational applications and should be included in the final rule. By only allowing off-cycle credits for electrified accessories, U.S. EPA and NHTSA are leaving out fuel reduction benefits from a technology that will be readily available in the Phase 2 timeframe. [EPA-HQ-OAR-2014-0827-1265-A1 p.48]

The NPRM and CARB's Technology Assessment<sup>25</sup> notes that electrified accessories can deliver a 1 to 3 percent fuel consumption benefit in vocational applications; however, U.S. EPA and NHTSA are currently only allowing off-cycle credits for this technology. As U.S. EPA and NHTSA's Phase 1 rule did not consider electrified accessories either, this full 1 to 3 percent benefit can be obtained in the Phase 2 rulemaking. CARB staff recommends a fuel consumption benefit of 2 percent be applied to electrified accessories. CARB staff also notes that not every vocational application will be suited to best use this technology, therefore, CARB staff recommends a conservative penetration rate of 50 percent in the final MY stringency.

**Response:**

Although we did not propose to allow pre-defined credit for electrified accessories on vocational vehicles as was proposed for tractors, we agree with commenters that this is appropriate for vocational vehicles. Although the agencies are projecting that some electrified accessories will be necessary as part of the development of stop-start idle reduction systems for vocational vehicles, we did not propose to account for any efficiency improvements due to this electrification, only the improvements from turning the engine off. The final vocational vehicle standards are predicated in part on adoption of electrified accessories in all subcategories, where a pick list is available for manufacturers to choose applicable technologies and to enter a fixed improvement value in GEM.

In addition to the comments provided by ICCT, the agencies are relying on the TIAX 2009 technology report, CARB's Driveline Optimization report, and the 2010 NAS report to assign fixed improvement

values for specific components for which we were able to quantify an improvement due to electrification. Because there are numerous mechanical components on a HD vehicle that could be electrified and the information from commenters and available literature does not generally identify the incremental improvement from each component, the pick list is short. Because the GEM algorithm for determining the fuel benefit of stop-start idle reduction does not account for any e-accessories, vehicles certified with stop-start are also eligible to be certified using an improvement value in the “Other” column. By MY 2027 the projected adoption rate is 15 percent of electrified accessories that achieve one percent improvement, applicable in all subcategories excluding custom chassis. Although we believe some components could be electrified for some custom chassis, we do not have sufficient information to estimate an incremental cost associated with electrifying the more complex systems on custom chassis such as buses, or to project a specific adoption rate for this type of improvement.

### 6.3.6.3 E-PTO

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

We would like to see consideration and adoption of electric power-take-off (e-PTO) hybrids for certain vocational segments. These e-PTO technologies can provide more than 10-14% additional savings, provided they are accommodated with a hybrid-PTO test procedure, since their benefits cannot be captured in a powertrain test. Consider including e-PTO hybrids in the compliance package for appropriate vocational segments. This would support a stronger vocational vehicle standard for 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.19]

**Organization:** Gaines, Linda

In my judgement, the proposed metrics are inappropriate. My main concern is that work trucks like buckets are being rated on a g/t-mi basis, when their main product is work at a site rather than goods movement. A more appropriate measure would evaluate emissions per hour of actual work, depending on the type of equipment. Work trucks undergo many up-fits before they are put into use, and these can impact the base engine’s fuel economy. For instance, the truck may be up-fitted as a plug-in hybrid with a battery (charged from the grid) that not only powers the bucket, but also supplies power during driving, thus reducing fuel consumption on the road as well as during work at a site. The proposed regulations do not recognize this type of actual fuel-economy improvements; the same truck could alternatively be equipped with a bucket to be run by idling the main engine, emitting significantly more CO2. The proposed regulations would not distinguish between these very different trucks. It would be desirable to provide an incentive for efficiency improvements that can be added onto work trucks. [EPA-HQ-OAR-2014-0827-1357-A1 p.1]

**Organization:** Natural Resources Defense Council (NRDC)

In the vocational vehicle market, there is a significant opportunity for fuel consumption and carbon pollution reductions from the application of hybrid systems, both as part of the drivetrain and for use as power-takeoff (PTO) devices in non-driving applications, such as when bucket trucks are moving workers and refuse trucks are gathering and compressing garbage. NRDC recommends that the Phase 2 standards stringency incorporate the benefits from PTO application and use during vehicle certification where the certifying manufacturer can show that the appropriate PTO technologies will be applied to the vehicle. The agencies should also account for the PTO use in calculations of potential strong hybrid penetration. A PTO device integrated to a hybrid drivetrain could improve the cost-effectiveness of a strong hybrid application. The improved cost-effectiveness of the full system would lead to higher market penetration

of hybrid and PTO systems overall and justify strengthening the vocational vehicle standards. [EPA-HQ-OAR-2014-0827-1220-A1 p.5-6]

**Organization:** Environmental Defense Fund (EDF)

Many vocational truck configurations are excellent candidates for these technologies, and are being applied on vocational trucks today. Odyne, a Wisconsin-based manufacturer of electric and hybrid electric propulsion systems for heavy trucks, currently produces a truck that promises annual fuel savings of up to 50% for class 7 trucks with extensive use of the power take-off mode. This currently available solution can cut fuel consumption by 1,750 gallons per year.<sup>161</sup>

161 See <http://www.odyne.com/benefits/reduced-fuel-cost.html>

**Organization:** Union of Concerned Scientists (UCS)

The agency's effectiveness estimate comes from an assessment of hybrid effectiveness over the GEM duty cycles using a powertrain test. In contrast, the NGO effectiveness estimate considers real world operation. This is an especially important distinction because two of the classes of vehicle with which both the agencies and the NGO community have identified as a primary application of hybrids (refuse trucks and bucket trucks) use a significant fraction of fuel operating power-take-off (PTO) devices. The agency did not consider hybrid or electric PTO operation when assessing the fuel savings potential of hybridization. This has a significant impact on the effectiveness of hybridization. [EPA-HQ-OAR-2014-0827-1329-A2 p.19]

Hybrid PTO effectiveness. Vehicles with a hybrid or electric PTO (ePTO) do not use the powertrain test but a separate "Hybrid PTO" test procedure. This would significantly change the assumed effectiveness of a hybrid refuse or bucket truck. According to UCS analysis (Attachment A), ePTO would provide additional effectiveness of 10.1 percent for multipurpose vehicles and 14.4 percent for urban vehicles. [EPA-HQ-OAR-2014-0827-1329-A2 p.19]

It seems likely that many of the Urban Heavy-Duty vocational vehicles EPA and NHTSA have identified as being hybridized in the timeframe of this rule will also have hybrid PTO operation. According to the Vehicle In Use Survey (VIUS), 16.4 percent of light-heavy-, 38.2 percent of medium-heavy-, and 66.4 percent of heavy-heavy-duty vehicles have a PTO system (United States Census Bureau 2004). According to our population assumptions, this yields a total fraction of vehicles with PTO of nearly 195,000. Applying the fractions above just to the hybrids already assumed by EPA, combined with the increased effectiveness for ePTO-enabled hybrids listed above, would increase the overall hybrid effectiveness from between 22.9 and 25.6 percent up to 24.2 to 32.7 percent, depending on vehicle class and type. [EPA-HQ-OAR-2014-0827-1329-A2 p.19 and p.21]

Changes to hybrid penetration. Incorporating the fuel economy benefit of the PTO operation will also affect the uptake of these vehicles. Real world operation of refuse trucks has been shown to exceed 40% effectiveness over its conventional powertrain equivalent, and by including only the test equivalent effectiveness, the agencies have underestimated the overall cost-effectiveness, and therefore penetration, of hybrids. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

Using the increased effectiveness of the ePTO-enabled hybrids but matching the same marginal cost-per-effectiveness (\$/%) improvement of the agencies analysis for multipurpose and urban hybrids would increase the penetration from 18 percent up to between 19 and 23 percent, again depending on vehicle class and type. [EPA-HQ-OAR-2014-0827-1329-A2 p.21]

**Organization:** Edison Electric Institute

### **E-PTO Systems Have Entered Into Mainstream Procurement and Offer Significant Petroleum and Greenhouse Gas Emissions Savings that Should Be Recognized in the Phase 2 Program**

In section V.C.1.c.iv of the proposed Phase 2 Program, EPA and NHTSA seek “comment and data relating to the population and energy storage capacity of plug-in e-PTO systems.”<sup>35</sup> In response, EEI offers the following comments: [EPA-HQ-OAR-2014-0827-1327-A2 p.15]

- e-PTO systems have entered into mainstream procurement: [EPA-HQ-OAR-2014-0827-1327-A2 p.15]
  - EEI member companies committed to the Fleet Electrification Initiative reported purchasing approximately 350 e-PTO systems for their 2015 procurement plans, all in the Class 4-8 categories, with the majority in Class 5.<sup>36</sup>
  - At least one of our member companies now purchases e-PTO systems for all applicable work truck applications.
- e-PTO systems offer significant fuel and greenhouse gas savings: [EPA-HQ-OAR-2014-0827-1327-A2 p.15]
  - As EEI notes in its whitepaper *Electric Transportation: Utility Fleets Leading the Charge*, e-PTO systems directly displace petroleum with grid-sourced electricity at a rate of approximately 0.8 to 1.2 gallons of fuel per hour of idling.<sup>37</sup>
- e-PTO systems make business sense today: [EPA-HQ-OAR-2014-0827-1327-A2 p.15]
  - Given the fuel savings mentioned above, e-PTO systems can deliver payback periods well within the useful life of the vehicle; the EEI white paper assumes a 5-year payback in a Class 5 application and a 7-9 year payback in a class 7 application.
  - Beyond the fuel savings, e-PTO systems offer a number of additional benefits including: reduced maintenance costs due to reduced engine hours, quiet operation that allows trucks to work in noise restricted locations, and eliminating the need for a worksite electric generator due to exportable power capability.
- e-PTO systems are available from multiple vendors in a variety of capacities: [EPA-HQ-OAR-2014-0827-1327-A2 p.15-16]
  - e-PTO systems without drivetrain integration are available from Terex and Altec e-PTO systems with drivetrain integration (more commonly referred to as a “plug-in hybrid” configuration) are available from Odyne, Eaton and Allison Transmissions
  - To use one example, the Jobsite Energy Management System (JEMS) from Altec is available in 6 kWh, 10 kWh, 15 kWh, and 18 kWh capacities
  - Include e-PTO systems among the technologies used in the standard setting for vocational vehicles [EPA-HQ-OAR-2014-0827-1327-A2 p.16]

**Organization:** Odyne Systems LLC

*Estimate of annual sales of hybrid systems on vocational trucks with a PTO, with ROI of 3 years in 2021 and ROI of 2 years in 2027*

An estimated 145,000 PTOs were installed on medium and heavy duty vocational trucks in both 2012 and 2013 as described earlier. Odyne used the same number of PTO sales as an estimate in 2021 and 2027. Based upon an ROI of 3 years and 2 years, the sales of hybrid systems should be significantly higher in 2021 and 2027 compared to current hybrid sales that have significantly longer ROI. Other desirable operating characteristics including reduction in CO<sub>2</sub>, reduction in NO<sub>x</sub>, quiet stationary operation of

equipment due to keeping the engine off during PTO use, and better acceleration should help improve user demand. [EPA-HQ-OAR-2014-0827-1239-A1 p.16]

Odyne estimates that approximately 7,500 units capable of 50% or greater GHG emission reductions in 2021 could be sold based upon the system prices shown in table 2, which equates to approximately 5% of the overall PTO market of 145,000 units for medium and heavy duty vocational trucks. [EPA-HQ-OAR-2014-0827-1239-A1 p.16]

Odyne estimates that approximately 15,000 units capable of 50% or greater GHG emission reductions in 2027 could be sold based upon the system prices shown in table 3, which equates to approximately 10% of the overall PTO market of 145,000 units for medium and heavy-duty vocational trucks. [EPA-HQ-OAR-2014-0827-1239-A1 p.16]

[Table 3, 'Estimated Sales Volume Based on Price, ROI and Market Size', can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1239-A1]

**Organization:** Odyne Systems LLC

Odyne believes that by not building the proposed standard methodology for vocational vehicles on the use of hybrid PTO mode (anti-idle technology), the EPA could miss out on a significant opportunity to increase full workday fuel efficiency for vocational vehicles. The segment of the vocational chassis market using Power Take-offs (PTOs) is significant. Odyne and other industry estimates put the annual PTO-enabled vehicle market at between 145,000-195,000 annually, with the potential of upwards of 15% of those vehicles being enabled with an e-PTO. [EPA-HQ-OAR-2014-0827-1239-A1 p.5-6] [[This comment can also be found in EPA-HQ-OAR-2014-08267-1372, pp.231-232.]]

For draft rule effectiveness and market penetration projections, by subjecting hybrid e-PTO enabled vehicles to a separate test outside of the powertrain, this drastically reduces overall technology effectiveness as assumed by EPA of the vehicle. According to analysis done by the Union of Concerned Scientists, e-PTO would provide additional effectiveness of 10.1% for multipurpose vehicles and 14.4% for urban vehicles. For Urban Heavy-Duty Vehicles that EPA assumes will be hybridized within compliance periods of this rule, Odyne would imagine a large portion of these vehicles having PTO operation. Additional analysis done by UCS shows that when incorporating additional effectiveness from e-PTO operation in hybrids would improve overall hybrid effectiveness from 22.9-25.6% up to 24.2-32.69%, depending on vehicle class and type. For market penetration, including the assumed effectiveness improvements described above would increase market penetration for multipurpose and urban hybrids from 18% up to 19-23%, again depending on vehicle class and type<sup>1</sup>. [EPA-HQ-OAR-2014-0827-1239-A1 p.6]

*Estimated Annual PTO Market*

Odyne is pleased to provide additional information to the EPA regarding the number of new medium and heavy duty vocational vehicles produced with installed power take-offs. [EPA-HQ-OAR-2014-0827-1239-A1 p.7]

Medium and Heavy duty work trucks are defined by Odyne as vocational trucks over 14,000 pounds GVWR that drive to one or more worksites and operate equipment that receives power from the truck at the worksite. Work trucks typically use Power take-offs (PTOs) and idling engines (prime mover diesel engines in most cases) to deliver power to equipment, but may also use independently operating engine driven generators to supply electricity to tools or other equipment. Equipment maybe mounted to the



truck, including but not limited to aerial bucket lifts, cranes, digger derricks, compressors, air handling systems, pumps, refuse compactors, hydraulically powered dump bodies, etc. The PTOs deliver power from the engine to truck mounted equipment. [EPA-HQ-OAR-2014-0827-1239-A1 p.7]

The number of PTOs installed annually on medium and heavy duty trucks represents a significant portion of the number of vocational trucks sold annually that operate in both a driving mode and a stationary worksite mode with at least one engine typically idling. Some trucks may power truck mounted equipment by using an additional truck mounted engine, often a generator. Odyne recommends that the fuel consumption and GHG emissions of additional vehicle mounted engines should be included in regulations so that all technologies are evaluated equally and operators are not incentivized to use less efficient options that fall outside of regulations. [EPA-HQ-OAR-2014-0827-1239-A1 p.7-8]

The number of medium and heavy duty vocational trucks sold with PTOs is large and presents an excellent opportunity to deploy cost effective technology to reduce GHG emissions. [EPA-HQ-OAR-2014-0827-1239-A1 p.8]

**According to Odyne estimates, there are an estimated 145,000 Vocational medium and heavy-duty work trucks sold yearly with an installed PTO.** [EPA-HQ-OAR-2014-0827-1239-A1 p.8]

According to the National Truck Equipment Association (NTEA) 2013 Annual Manufacturers Shipments Survey, Power Take-off (PTO) shipments totaled approximately 277,000 units for both 2012 and 2013<sup>2</sup>. [EPA-HQ-OAR-2014-0827-1239-A1 p.8]

Of the total number of PTOs shipped per the survey, Odyne worked with the NTEA and used U.S. Census Bureau, Vehicle Inventory and Use Survey (VIUS) data to estimate the total PTOs installed on new class 4–8 vocational trucks. [EPA-HQ-OAR-2014-0827-1239-A1 p.8]

Odyne used the following methodology to estimate that approximately 145,000 PTOs are installed on new vocational trucks in the U.S. annually: [EPA-HQ-OAR-2014-0827-1239-A1 p.9]

Based upon discussions with the NTEA, not all of the 277,000 PTOs that were shipped by PTO manufacturers in both 2012 and 2013 were installed on new class 4 – 8 vocational trucks sold in the U.S. In order to estimate the number of PTO units installed on new class 4 – 8 vocational trucks in the U.S., Odyne reviewed data from the most recent U.S. Census Bureau, Vehicle Inventory and Use Survey (VIUS) working with the NTEA. The NTEA estimates that approximately 85% of PTO units sold per the NTEA survey were sold in the U.S. Odyne multiplied the 277,279 units reported to be shipped in 2013 from the survey by 0.85 resulting in an estimated 235,687 PTO units that are sold in the U.S. Based on conversations with the NTEA, approximately 2/3 of the PTOs shipped were installed on new trucks, the remaining 1/3 were estimated to be used as service replacement PTO units. Odyne then multiplied the 235,687 estimated PTO units sold in the U.S. by 2/3 to arrive at an estimated 157,125 PTO units installed on new vehicles in the U.S. The installed units are distributed among a variety of vocational vehicles in different weight classes. In order to estimate the number of PTO units installed annually on new medium and heavy duty vocational trucks, Odyne used data from the most recent U.S. Census Bureau<sup>3</sup>. According to the Census Bureau survey, approximately 93% of PTOs in use are installed on class 4 – 8. Using that ratio, Odyne then multiplied the 157,125 PTOs estimated to be installed on new trucks in the U.S. by 0.93, arriving at an estimated 146,342 PTO units installed in 2013 on new Class 4 – 8 vocational vehicles. Finally Odyne rounded the total of 146,342 down to 145,000 units. The average number of PTO's installed yearly will vary depending upon the number of Class 4 – 8 vocational trucks sold annually, the intended use of those vehicles and other factors. [EPA-HQ-OAR-2014-0827-1239-A1 p.9-10]

In real world applications of vocational vehicles deployed with Odyne hybrid technology, we have seen fuel efficiency improvements of 46% in driving alone, and 64% in fuel savings when accounting for the average full workday; including driving, idling, and hybrid power take off (PTO) activities. Based on testing paid for by the U.S. Department of Energy and the state of California, Odyne technology currently delivers up to 64% lower CO<sub>2</sub> and 95% lower NO<sub>x</sub> emissions (based on a customer's full workday, depending on vehicle configuration and duty cycle) than non-hybrid medium and heavy duty trucks meeting current standards. Additional independent laboratory testing showed 51% and 41% reductions in CO<sub>2</sub> and 71% and 80% reductions in NO<sub>x</sub> (based on average full workday, specific vehicle configuration and duty cycle). Odyne believes co-benefits beyond fuel efficiency improvements and greenhouse gas reductions, like Odyne technologies verified ability to reduce NO<sub>x</sub> emissions, should be valued in the Phase Two rulemaking, especially given potential future regulatory actions from EPA and current developments from CARB on NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1239-A1 p.3-4] [This comment can also be found in EPA-HQ-OAR-2014-08267-1372, pp.229-230.]

Odyne has conducted internal market penetration and payback projections for its hybrid system based on the full workday. Of a potential between 145,000 to 195,000 PTO-enabled vehicles sold annually (range represents Odyne and other stakeholder estimates), we project an average system cost of \$10,000 and ROI of 2 years by 2027, Odyne technology could capture upwards of 15% of the marketplace. Details on assumptions made to reach these projections are included in the below section "Rule Methodology Assumptions." [EPA-HQ-OAR-2014-0827-1239-A1 p.4]

Analysis of data from the U.S. Department of Energy Project regarding the use of Plug-In Hybrid Systems on Medium and Heavy Duty Vocational Vehicles showed that the average required Power and Energy of the hybrid system needed to deliver a 50% reduction in GHG emissions for the applications in the project was less than 10 kWh of energy at the worksite.<sup>4</sup> Approximately 5 kWh was consumed to provide an average of 2.8 hours of all electric PTO operation and the remainder provided energy for reduced fuel consumption during driving and for idle reduction. In total, 10 kWh of energy from the battery system provided an average of over 1.7 hours of operation without idle and 2.8 hours of engine off time operating equipment, for a total of 4.5 hours of engine off savings. Power measurements during testing and field operation showed that average electrical power requirements to meet the 50% reduction in GHG emissions were 20 kW of sustained electrical power from the electrical motor for time periods beyond 2 minutes and peak power of up to 31 kW for short periods during hybrid driving and stationary modes, typically less than 2 minutes in duration. [EPA-HQ-OAR-2014-0827-1239-A1 p.10-11]

/4/ U.S. Department of Energy project entitled Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation Program, with reference project number DOE FOA-28, award number EE0002549 and South Coast Air Quality Management District (SCAQMD) contract number 10659. Please contact Mark Kosowski at EPRI (mkosowski@epri.commailto:mkosowski@epri.com> ) or John Petras at Odyne Systems, LLC ( john.petras@odyne.commailto:john.petras@odyne.com> ) for additional information about the DOE project.

The power and energy requirements to deliver a 50% reduction in GHG emissions for vocational work trucks operating in a driving mode and a worksite stationary mode in the DOE project were typically lower than the power and energy requirements required for similar savings in GHG emission for duty cycles composed of all driving. Most of the vocational vehicles monitored were observed to have very high idle times related to worksite operations. [EPA-HQ-OAR-2014-0827-1239-A1 p.11-12]

Using the measured requirements of power and energy determined from the data provided by 1Hz telematics units on over 100 operational plug-in hybrid systems on medium and heavy duty vocational trucks, Odyne developed high-level component specifications that would match the power and energy

requirements needed to attain the high GHG reductions and then worked with industry input to approximate the cost of the system in 2020 and beyond. [EPA-HQ-OAR-2014-0827-1239-A1 p.12]

Projected component costs in 2020-2021 are shown in Table 2 below of a system that is capable of providing savings of 12 to 15% of driving fuel consumption and a 100% savings in fuel consumed during stationary operation of truck mounted equipment at worksites, resulting in a total savings of over 50% for typical duty vocational duty cycles with truck mounted equipment. Daily fuels savings would be expected to be over 4 gallons, which is similar to the results attained in the U.S. DOE project. [EPA-HQ-OAR-2014-0827-1239-A1 p.12]

[Table 1, 'Higher Voltage System year: 2021', can be found on p.12-13 of docket number EPA-HQ-OAR-2014-0827-1239-A1]

### *Charge Depletion Versus Sustaining Testing*

The current test procedure 40 CFR 1037.510/540 is a charge sustaining procedure. This procedure could be sufficient for a HEV application, but not for a PHEV application. In Odyne's PHEV application we do not charge the system all the way back to full in the field and handle charging primarily with plug-in charging from the power grid. Odyne would recommend that the test procedures used in a final rule account for scenarios with a charge depleting battery system, to be recharged from the grid in off hours, results in real world overall fuel efficiency increases. We also recommend that the test procedure allow flexibility to alter the test procedure as needed to account for the type of system/technology and its typical workday (i.e. – drive cycle, duty cycle, application load, dyno/PEMS, etc.). [EPA-HQ-OAR-2014-0827-1239-A1 p.24]

### **Response:**

Although the primary program does not simulate vocational vehicles over a test cycle that includes PTO operation, the agencies are adopting a revised hybrid-PTO test procedure. See 76 FR 57247 and 40 CFR 1037.540. Recall that we regulate vocational vehicles at the incomplete stage when a chassis manufacturer may not know at the time of certification whether a PTO will be installed or how the vehicle will be used. Chassis manufacturers may rarely know whether the PTO-enabled vehicle will use this capability to maneuver a lift gate on a delivery vehicle, to operate a utility boom, or merely to keep it as a reserve item to add value in the secondary market.

The work by NREL to characterize idle behavior of PTO-equipped vehicles indicates that for about 10 percent of workdays analyzed (165 of 1570 work days), zero PTO use was recorded. Further, for about half of the work days, PTO utilization was one hour or less. Although these data are exclusively for trucks working in utility applications, we would expect this subset to represent vehicles with a high likelihood of using the PTO and an operating profile most likely to benefit from adoption of technologies that can reduce PTO fuel use. In considering the difficulty of identifying these vehicles at the incomplete stage as well as the available duty cycle information, we have concluded it would not be reasonable to require every vocational vehicle to certify over a standard test procedure with a PTO cycle in it.

Thus, we are not basing the final standards on use of technology that reduces emissions in PTO mode. In cases where a manufacturer can certify that a PTO with an idle-reduction technology will be installed either by the chassis manufacturer or by a second stage manufacturer, the hybrid-PTO test cycle may be utilized by the certifying manufacturer to measure an improvement factor over the GEM duty cycle that otherwise applies to that vehicle. In addition, the delegated assembly provisions will apply (see Section I.F.2 of the Preamble and Section 1.4.4 of this response to comments).

The agencies agree with commenters that a charge-depleting test cycle is more appropriate where the technology is essentially a plug-in hybrid. The calculations recognize fuel savings over a portion of the test that is determined to be charge-sustaining as well as a portion that is determined to be charge-depleting for systems that are designed to power a work truck during the day and return to the garage where recharging from an external source occurs during off-hours. We partnered with DOE-NREL to characterize the PTO operation of nearly 100 trucks with over 1,000 total operating days, and our final regulations include a utility factor table based on these data for use in determining the effectiveness of a hybrid PTO system. Manufacturers wishing to conduct testing as specified may apply for off-cycle credits derived from e-PTO or hybrid PTO technologies. See RIA Chapter 3 for a discussion of the revisions to the PTO test cycle.

### **6.3.7 Tire Pressure Systems**

**Organization:** Autocar, LLC

Tire Pressure Monitoring. Autocar believes there is potential for increased fuel efficiency if automatic tire pressure monitoring systems are developed for use in Low-speed/Frequent-stop Vehicles. Although current technology is designed for safety and reduced tire replacement cost (which also has a positive environmental impact), future technology could be effective in maintaining optimum tire pressure. [EPA-HQ-OAR-2014-0827-1233-A1 p.15]

**Organization:** Tirestamp, Inc.

It should be noted that automatic tire inflation systems plumbed through the axle are currently available only for trailers. ATIS for trucks, tractors, and buses must be plumbed externally. Due to their high maintenance and propensity for damage, they are not of interest to U.S. fleets. Advanced TPMS integrated with telematics are ideal for these vehicles. [EPA-HQ-OAR-2014-0827-1255-A1 p.4]

**Organization:** Rubber Manufacturers Association (RMA)

Providing efficiency benefits to only ATIS technology neglects the benefits of correctly using TPMS. In addition, both ATIS and TPMS should carry the same benefit in terms of CO<sub>2</sub> and fuel consumption reduction. TPMS can also provide the applications to the other Class 2b – 6 medium- and heavy-duty vehicles encompassed in the proposed Phase 2 fuel efficiency standards, in addition to the overall tire performances. [EPA-HQ-OAR-2014-0827-1304-A1 p.30]

**Organization:** Cline (representing AIR CTI)

Then Tire Pressure Maintenance is the minimum that is must be fitted and regulated. The pressures must be set to optimize the truck and trailer. Central Tire Inflation is required on trucks that travel empty regularly, like dump trucks, bulk grain trucks, tankers, low loaders. When empty, semi trailers are currently dangerous. Brake balance, significant overly braked, and ridiculously over inflated tires create a condition that jack knives are probable. Any truck working off highways needs CTI too. Either will eliminate almost every blow out and alligators that litter our highways, if we're lucky, or kill, if not. [EPA-HQ-OAR-2014-0827-0803-A2 p.5]

**Organization:** Volvo Group

In setting vehicle stringencies, the agencies have predicated the standards for tractors on adoption of Automatic Tire Inflation Systems (ATIS), while giving no consideration to Tire Pressure Monitoring Systems (TPMS). [EPA-HQ-OAR-2014-0827-1290-A1 p.23][This comment can also be found in section 4.3 of this comment summary]

All commercial vehicle operators are well aware of the increased fuel consumption, maintenance costs, downtime, and safety concerns associated with operating a heavy vehicle with under-inflated tires. These concerns have been much more significant given the volatile diesel prices, the pricing pressure on fleets due to an unstable economy and consolidation within the industry, the continued ratcheting of safety regulations, and the rising costs of liability, all within the last decade. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

In Section 2.4.3.3 of the RIA the agencies noted that “although most fleets understand the importance of keeping tires inflated, it is likely that a substantial proportion of trucks on the road have one or more underinflated tires.” Their evidence of this assertion are two studies, one industry survey conducted by checking pressures at a truck stop in 2002, and another study conducted by the Federal Motor Carrier Safety Administration (FMCSA) in 2003. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

The agencies have based their lack of credit provisions for TPMS on this outdated data, as well as their assertion that TPMS requires user interaction to re-inflate a tire to the appropriate pressure and therefore a driver “may” continue to operate a vehicle with underinflated tires, even to their final destination. However, in light of continually increasing pressures on fleets to reduce total costs of operation in order to be profitable, Volvo Group disagrees that two studies dating from 12 to 13 years in the past are truly relevant in the decision making process of today’s fleets. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

In addition, given the poor reliability of past ATIS systems, we are skeptical of supplier’s claims of current or future reliability improvements to these systems. Fleets are even more skeptical than truck OEMs, as an ATIS air leak results in increased fuel consumption due to a compressor cycling more frequently and also in potentially significant downtime of the vehicle, even more so than a tire blowout. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

To incentivize truck operators to maintain tire pressure on vehicles equipped with a TPMS system, fleets have the ability to monitor fuel consumption remotely, including the ability to identify causes for increased fuel consumption. This capability is expected to motivate drivers to properly maintain tire pressure on TPMS equipped vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

For these reasons Volvo Group believes that the agencies should provide the same 1% efficiency credit for TPMS as given to ATIS. Volvo Group does not believe this inclusion should be included in the baseline efficiency assumptions or result in a stringency increase, as these systems are an alternative to ATIS, are not credited today, and the evolution of the remote tracking systems has only recently made them more likely to result in a positive corrective action. [EPA-HQ-OAR-2014-0827-1290-A1 p.23]

**Organization:** Bendix Commercial Vehicle Systems, LLC

TPMS is already available as a factory installed option at all the major truck/tractor OEMs (including Daimler, Kenworth, Navistar, Mack, Peterbilt and Volvo) as well as trailer, bus, and motorcoach manufacturers.

**Organization:** American Trucking Associations (ATA)

TPMS have not historically been included in the EPA's SmartWay program since the agency had no way to determine the effect these systems have on fuel economy unless each requesting fleet provided a clear description of how it would respond to alerts. This information was necessary so that the EPA could calculate the resulting fuel savings. However, much has transpired since the inception of the SmartWay Program. The Federal Motor Carrier Safety Administration ("FMCSA") has studied TPMS since 2006. It found that these systems accurately reported inflation pressure values within 2 to 3 psi of the measured value and accurately warned of low pressure within 2 to 3 psi of the expected threshold. In 2007, the performance and durability of TPMS was examined in a field test using transit buses. This study found that TPMS-equipped buses did not experience increased average tire pressure due to diligent tire pressure maintenance and the location of the TPMS display is essential to impact tire maintenance practices, fuel economy, and tire life. [EPA-HQ-OAR-2014-0827-1243-A1 p.14]

Due to the advances that have been made in TPMS 2.0 systems and the impact they have on fuel economy and greenhouse gas emissions, the Tire & Wheel (S.2) Study Group of ATA's Technology and Maintenance Council ("TMC") requests that TPMS 2.0 systems, tire pressure monitoring systems that are integrated with telematics, be included in the technology options provided under Phase 2. Without inclusion of this technology, there will be no system available in the TMC standard to address tire inflation pressure for powered vehicles since ATISs that are plumbed inside an axle (a market requirement by US fleets) are currently only available for trailers and an advanced technology that can seriously impact GHG emissions will be overlooked. [EPA-HQ-OAR-2014-0827-1243-A1 p.15]

Certain tires loads, especially on heavy-hauls, have working tire pressures exceeding the capabilities of on-board compressors. Additional on-board compressor tanks can cost \$800 and add an additional 150 pounds of weight. Consideration should be given to exempt certain trailers from using ATIS and instead allow the use of TPMS as previously discussed. [EPA-HQ-OAR-2014-0827-1243-A1 p.24]

**Response:**

The agencies did not propose to base the vocational vehicle standards on the performance of tire pressure monitoring systems (TPMS). However, we received comment that we should consider this technology. In addition to similar comments related to tractors and trailers, RMA commented that TPMS can also apply to the class 2b – 6 vehicles, and if the agencies add TPMS to the list of recognized technologies, that this choice should also be made available to class 2b-6 vehicles. Bendix commented that TPMS is a proven product, readily available from a number of truck, bus, and motorcoach OEMs. Autocar commented that TPMS is useful for refuse truck applications. Tirestamp said that TPMS is ideal for trucks and buses that are unable to apply ATIS due to difficulties plumbing air lines externally of the axles. The agencies find these comments to be persuasive. As a result, we are finalizing vocational vehicle standards that are predicated on the performance of TPMS in all subcategories, including all custom chassis except emergency vehicles and concrete mixers. Available information indicates that it is feasible to utilize TPMS on all vocational vehicles, though systems for heavy vehicles in duty cycles where the air in the tires becomes very hot must be ruggedized so that the sensors are protected from this heat. Such devices are commercially available, though they cost more. To account for this in our analysis, we have projected a lower adoption rate for TPMS in Urban vehicles than for Regional or Multipurpose vehicles, rather than by increasing the overall estimated cost and applying an equal adoption rate.

The agencies did not propose to base the vocational vehicle standards on the performance of automatic tire inflation systems (ATIS), otherwise known as central tire inflation (CTI). However, we did receive comment indicating that it is feasible for some vocational vehicles to use this technology. Air CTI commented that central tire inflation is not only feasible but enhances safety on vehicles such as dump trucks and heavy haul vehicles that need higher tire pressures under certain driving conditions, such as

when loaded, but need lower tire pressures when running empty or operating off-road. Tirestamp commented that ATIS can be plumbed externally for trucks and buses, but such systems have a propensity for damage and Autocar has provided information about how much extra weight this plumbing adds to the chassis. ATA commented that some onboard air pressure systems may not be able to pressurize tires sufficiently for very heavy vehicles. The primary vocational vehicle standards are not predicated on any adoption of this because the agencies do not have sufficient information about which chassis will have an onboard air supply for purposes of an air suspension or air brakes. ATIS would logically only be adopted for vehicles that already need an onboard air supply for other reasons. Comments received for custom chassis were supportive of standards predicated on ATIS for buses with air suspensions. These comments are again persuasive. As a result, we are basing the optional standards for refuse trucks, school buses, coach buses, and transit buses in part on the adoption of ATIS. Although many motor homes have onboard air supply for other reasons making ATIS technically feasible, it is sufficiently costly that it is not practically feasible. Furthermore, for the same reasons stated above about the disadvantages of installing external plumbing for ATIS on some trucks and buses, we have determined it is not feasible for emergency vehicles or concrete mixers. Nonetheless, we are allowing vocational vehicles including all custom chassis to obtain credit for the performance of ATIS through a GEM input.

We are assigning a fixed improvement in GEM for use of TPMS in vocational vehicles of one percent for Regional vehicles including motor coaches and RV's (the same as for tractors and trailers) and 0.9 percent for Multipurpose, Urban, and other custom chassis vocational vehicles, recognizing that the higher amount of idle is likely to reduce the overall effectiveness for these vehicles. We are assigning a fixed improvement for ATIS of 1.2 percent for Regional vehicles including motor coaches and RV's (the same as for tractors and trailers) and 1.1 percent for Multipurpose, Urban, and other custom chassis vocational vehicles, recognizing that the higher amount of idle is likely to reduce the overall effectiveness for these vehicles. (The difference in estimated effectiveness for TPMS and ATIS reflects the degree of driver involvement necessary for TPMS). These values will be specified as GEM inputs in the column designated for tire pressure systems.

### **6.3.8 Axle Technologies**

**Organization:** Daimler Trucks North America LLC

**Axle Driveline Inputs** - On whether the agencies should allow this choice. (Drive axle ratio would be a user input). Agreed, make the drive axle a user input. 80 FR 40323. [EPA-HQ-OAR-2014-0827-1164-A1 p.62]

On whether we should require GEM to be run twice, once with each axle ratio, where the output over the highway cycles would be used from the run with the lower axle ratio, and the output over the transient cycle would be used from the run with the higher axle ratio. GEM should be run twice as the EPA suggested, once with each axle ratio, where the output over the highway cycles would be used from the run with lower axle ratio, and the output over the transient cycle would be used from the run with the higher axle ratio. 80 FR 40323. [EPA-HQ-OAR-2014-0827-1164-A1 p.62]

**Axle Packages** – The agencies assume 75% penetration in vocational vehicles of advanced axle lubricant formulations and request comment any vocational vehicle applications for which use of advanced lubricants would not be feasible. 80 FR 40320. Advanced lubricants for most 'normal' vocational applications would likely provide sufficient coverage against axle damage. However we don't have knowledge yet for severe vocational applications. Extreme conditions and vehicle applications like artic oil field vehicles may need special fluids. Therefore, we agree with the agencies' proposal not to assume

full penetration of advanced axle lubricant formulations, but we do not know that 75% is the right penetration rate. [EPA-HQ-OAR-2014-0827-1164-A1 p.97]

**Organization:** Lubrizol Corporation

Higher-performing lubricants will play an important role in helping the OEMs comply with the Phase 2 Rule. Indeed, as shown in Figure 1 below, many of the technologies and strategies that will be used by the OEMs will require HPLs to operate cleanly, efficiently, and without compromising equipment performance and durability. [EPA-HQ-OAR-2014-0827-1325-A1 p.2][This comment can also be found in section 1.4.2 and 4.3 of this comment summary] [Figure 1 can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1325-A1]

**Organization:** GILLIG LLC

Transit buses don't have tandem drive axles so the improvement options for Single Drive axle in a 6x2 and Part Time single drive axle in a 6x2 are not applicable to transit buses. More testing is required before we will know if Low Friction Axle Lubricant, another technology improvement option, is viable for transit for the same reasons. Transit bus duty cycles have a high number of stops and starts and significant retarder/backside gear loading making lubricant viscosity at all temperatures very important to gear and bearing life. To that point, transit bus end users expect 300k miles without a major axle overhaul.

**Organization:** Volvo

Relative to vocational 6x2 deployment, there are two key issues that preclude use of 6x2 axle configurations. First, the vast majority of vocational vehicles use leaf springs rather than air springs. Axle load shifting, essential to a functional 6x2 system, is accomplished via regulating the pressure in air springs and is therefore infeasible when using leaf springs. Second, the vast majority of HHD vocational trucks and tractors spend some time off-road. Less than 2% of Volvo Groups annual volume of HHD straight trucks and vocational tractors are used solely on-highway, with the remaining percentage spending some time off-road. In a HHD vocational application with any off-road operation the inability to shift load makes a 6x2 axle configuration unacceptable unless the system is a part-time 6x2 with a disconnect. Currently, such systems under development disconnect the inter-axle driveshaft, to gain efficiency by bypassing the inter-axle differential. It is unclear how much benefit this type of system would provide unless there were multiple disconnects (i.e. at the inter-axle driveshaft, and at each differential output or wheel end) since, without multiple disconnects, the internals of the non-driven axle would still rotate and cause churning and frictional losses at likely the same levels as a driven axle. There is no currently available system with this type of multiple disconnect architecture and it is unclear whether this is a part of any major axle manufacturers' technical roadmaps. We are very concerned however, that such a system would be very costly, heavy, fraught with reliability and durability problems, and would require significant development rendering it infeasible in the vocational HHD Regional subcategory. [EPA-HQ-OAR-2014-0827-1290-A1 P.29]

**Organization:** Oshkosh Corporation

The two axle-related improvements discussed in the NPRM are a switch from 6x4 to 6x2 configurations, and improved efficiency from advanced lubricants.

While we have no data to either support or reject the potential for axle lubricant improvements, there is a definite objection to expecting a shift to 6x2 configurations. This checkbox will not work for most vocational trucks that spend part of their life in off road environments, such as job sites, landfills, power



line paths, et cetera. The axle configuration is a customer-specified option, not a design selection by the manufacturer. In our experience, customers do not specify a 6x4 configuration unless they need it for mobility at job sites, emergency scenes, or for pushing snow. [EPA-HQ-OAR-2014-0827-1162-A2 p.4]

**Response:**

In response to persuasive comment on the proposal to assign a fixed 0.5% improvement for use of low friction axle lubricants, the agencies are adopting a separate axle efficiency test procedure that manufacturers may perform to measure axle gear efficiency improvements. These test results may be entered into GEM for an improved efficiency over the test cycles. Our market adoption rate for this technology has decreased since proposal down to 30% in MY 2027, indicating that we expect axle suppliers to only offer high-efficiency axles for their most high production volume products, especially those that can serve both the tractor and vocational market. Therefore, we believe it is unlikely that high-efficiency axles will be adopted in custom chassis applications. See responses to UCS comments above in Section 6.2.3.1 for specific adjustments that have been made relative to axles on custom chassis. If a custom chassis vehicle is certified to the primary program standards using full GEM, the alternate axle efficiency GEM inputs will be available.

The agencies proposed to base the HHD vocational vehicle standard on some use of both part time and full time 6x2 axles. In response to persuasive comment on the application of the permanent 6x2 configuration for vocational vehicles, we are predicating the final vocational vehicle standards in part on use of the part-time 6x2 (axle disconnect) for vehicles in the primary program using full GEM. The disconnect configuration is one that keeps both drive axles engaged only during some types of vehicle operation, such as when operating at construction sites or in transient driving where traction especially for acceleration is vital. In response to comments, the final regulations require that the input and output of the disconnectable axle must be mechanically disconnected from the drive shaft and the wheels to qualify. Instead of calculating a fixed improvement as at proposal, the agencies have refined GEM to recognize this configuration as an input, and the benefit will be actively simulated over the applicable drive cycle. Effectiveness based on simulations with EPA axle files is projected to be as much as one percent for HHD Regional vehicles. Based on CBI information from axle suppliers, we are confident this technology will be commercially available in the time frame of this rulemaking.

In response to ACEEE comments and other stakeholder feedback about axle configurations on coach buses, we are establishing a baseline for these vehicles in the custom chassis program with permanent 6x2 axle. To the extent that any motor homes and coach buses with GVWR over 33,000 lbs are built with two rear axles, either the axle disconnect or permanent 6x2 could potentially be applied as technologies because these vehicles generally operate on paved roads and may not need the traction of a 6x4. However we have not included this in the technology package for motor homes because incurring the costs associated with this technology did not appear justified for RV's based on the information before us.

In response to comments about two-speed axles, the agencies are adopting regulations to instruct a manufacturer to enter the ratio that is expected to be engaged for the greatest driving distance. The regulations also include a provision where in unusual circumstances, a manufacturer may ask to submit weighted average results of multiple GEM runs to represent special technologies that no single GEM run can accurately reflect.

### **6.3.9 Weight Reduction**

**Organization:** PACCAR

PACCAR is also supportive of the weight savings approach that is included in the NPRM for vocational vehicles. [EPA-HQ-OAR-2014-0827-1204-A1 p.31]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Review Lightweighting in GEM** [EPA-HQ-OAR-2014-0827-1274-A1 p.8]

Lightweighting – There are opportunities to further expand the options for lightweighting. Specifically, MEMA recommends an adjustment to the GEM calculations for fully loaded applications, given that 1000 lb. of lightweighting in a vocational application can result in over 3 percent GHG emissions avoidance through reduced trips. (Emissions avoidance due to lightweighting can be easily calculated by dividing the weight reduction by the payload, then multiplying by the fully loaded service time, or, for a vocational application,  $0.5 \times 1,000/15,000$ ). Thus, this benefit should be accounted for appropriately in the GEM. [EPA-HQ-OAR-2014-0827-1274-A1 p.8]

**Organization:** American Iron and Steel Institute

Regarding vocational vehicles, the agencies propose Phase 2 weight reduction technologies with specific values for material type, but also do not indicate the derivation of this data. All of these values serve a regulatory purpose by allowing a credit for different vehicle components, based on the type of vehicle involved. They also implicitly apply a deficit to any materials or components that are not listed, or listed incorrectly. Therefore, like the weight reduction options for trailers, EPA must supply a basis for these values in the record for this rulemaking or it cannot incorporate them within a final rule. EPA's currently proposed weight reduction values cannot be finalized given the lack of supporting technical analysis regarding their calculation. In addition, EPA should review the research material we have submitted for the docket with respect to the weight and performance benefits of lightweight steel components. While much of this analysis involves components utilized in the LDV sector, we believe that comparable components and parts in medium- and heavy-duty vehicles would demonstrate similar results. EPA should therefore utilize this information to substantially adjust upward its estimates of the benefits of lightweight steel components in Table V-29 of the draft proposed regulations. In the alternative, AISI would recommend that EPA and NHTSA eliminate all weight reduction technology crediting for component parts. As described above, the component parts for which it is proposed that GEM assign a weight reduction benefit lack a sufficient technical basis in the record for this rulemaking. Values contained in Table V-29 are not representative of realistic mass reductions. Among other deficiencies, the table values do not scale weight reduction to the actual size of the part making them inherently arbitrary in a rulemaking that covers a wide range of truck sizes, uses and GVWR. Thus, while we first believe that EPA and NHTSA should incorporate life cycle analysis and adjust weighting accordingly, if this path is not taken by the agencies, the only reasonable result should be to eliminate the weight reduction inputs in their entirety. [EPA-HQ-OAR-2014-0827-1275-A1 p.15]

**Organization:** National Ready Mixed Concrete Association (NRMCA)

Finally, the proposal fails to accurately take into account heavy-duty, class 8, straight truck weight challenges, such as concrete mixer trucks. [EPA-HQ-OAR-2014-0827-1146-A1 p.2]

**Organization:** Newell Coach Corporation

Weight reduction benefits would be negligible given our GVWRs while costs would be high. Credits from other manufacturers may not be available or, if available, be extremely expensive given the cost of technology required for compliance. [EPA-HQ-OAR-2014-0827-1319-A1 p.1]

**Organization:** Allison Transmission, Inc.

EPA and NHTSA must consider the weight of vehicle components in a consistent manner. The weight of hybrid systems should be accounted for, including the weight differentials for different types of hybrids. [EPA-HQ-OAR-2014-0827-1284-A1 p.3]

### **EPA and NHTSA Should Account For Weight of Hybrid Systems**

EPA and NHTSA have proposed to continue the weight reduction approach contained in the Phase 1 rule under which fixed weight reductions are prescribed for using certain lightweight materials in vehicle components. A fixed weight increase is also proposed for natural gas-fueled vehicles to reflect the weight increase associated with natural gas tanks. In order to be consistent in EPA's and NHTSA's regulatory approach, however, the agencies must also assess and incorporate consideration of weight with regard to hybrid vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.61-62]

Vocational vehicles exhibit a wide variation in weight when looking at differences based on the powertrain. To illustrate this point, data from two transit bus manufacturers were compared based on powertrain differences. For the New Flyer Xcelsior, the weight increase of going from a diesel to a hybrid, and going from diesel to CNG range from 2500-3000 lb. Going from a diesel to EV is 5000 lb. Gillig, on the other hand, downsizes the engine when going from a diesel to a hybrid, so effectively; there is no weight increase with the hybrid. [EPA-HQ-OAR-2014-0827-1284-A1 p.62]

[Tables, 'Vehicle weights in pounds' and 'GILLIG Low floor BRT', can be found on p.62 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

Since buses are unique in their design and duty cycle when compared to other vocational vehicles, other truck hybrid powertrains shown in RIA Table 2-49 were evaluated based on weight. All systems have at least a 300 lb. weight penalty up through Class 5. Class 6-7 is estimated to be at least 800 pounds. The data also suggests that hydraulic hybrids are heavier than battery electric systems. The hydraulic hybrids in Class 2b-5 are 500-750 lb. heavier and the Class 6-7 system is 1650 lb. heavier than a conventional powertrain. [EPA-HQ-OAR-2014-0827-1284-A1 p.62]

[Table, 'Hybrid system weight comparisons for trucks', can be found on p.63 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

Based on this data, Allison recommends that EPA include a weight penalty for hybrids and electric vehicles in an equivalent manner as was proposed for natural gas vehicles. Allison also recommends that if an engine is downsized through the use of technology, then this is recognized as a weight savings which would offset the additional weight of the hybrid system. [EPA-HQ-OAR-2014-0827-1284-A1 p.63]

### **Transmission Housing Weight Reduction Values In Widespread Use Should Be Eliminated**

The agencies have requested comment as to whether any lightweight vocational vehicle comments are in such widespread use that they should be excluded from the list of components for which GEM could be used to assign an improvement value. In this regard, Table V-29 Proposed Phase 2 Weight Reduction Technologies for Vocational Vehicles includes a weight reduction for transmission cases to go to either high strength steel or aluminum. The baseline vocational vehicle includes an automatic transmission for all sub-categories except for HHD Regional. Automatic transmissions already include an aluminum case. Allison recommends that the weight savings for the transmission housing, and clutch housing be eliminated for these subcategories because the aluminum configuration has been standard for many years. [EPA-HQ-OAR-2014-0827-1284-A1 p.64]

**Organization:** GILLIG LLC

Also in the GEM predefined modeling parameters for all vocational vehicles, 50% of any weight reduction claimed is added as additional capacity back into the payload. Transit buses don't have a typical payload like other vocational vehicles might, they haul people and only so many people physically fit on a transit bus. Any weight reductions claimed for transit buses should be credited fully to the vehicle for CO2 reduction and fuel economy gains unlike other vocational vehicles. [EPA-HQ-OAR-2014-0827-1156-A1 p.2]

**Organization:** School Bus Manufacturers Technical Council

In regards to weight reduction for school buses there are some things to consider. School buses are very different than other motor vehicles in that they are subject not only to Federal Motor Vehicle Safety Standards (such as FMVSS 220 – School bus rollover protection specific to only school buses) but also to individual State Specifications. Many of these state specifications require certain construction standards and many state specifications dictate the material used and in some cases even require minimum material thickness for different areas of the vehicle. [EPA-HQ-OAR-2014-0827-1287-A1 p.1]

In addition to specific materials and construction standards some states have performance standards above and beyond the federal standards. Some examples of performance standards in addition to FMVSS include: Kentucky's side intrusion standard and Colorado's body racking load standard. These additional and varying requirements above and beyond FMVSS could create some very unique challenges to reduce the vehicle weight and still meet the desired performance standards. [EPA-HQ-OAR-2014-0827-1287-A1 p.1-2]

**Organization:** Daimler Trucks North America LLC

**School Buses and Implementation of Lightweight Materials** - There are certain vehicle categories that cannot necessarily use lighter materials (plastic or aluminum in lieu of steel) because of state requirements that limit the material to be used. School buses would fall into this category and would not benefit from these credits. School buses are governed by certain states as to which material can be used for certain components. Some states will require the use of steel and also determine the minimum thickness for a particular component. One example is from the state of North Carolina as referenced from the following document "North Carolina School Bus and Activity Bus Specifications" (November 14, 2013), which states on page 40: "Construction – It is the intent of these specifications to describe a Type – C school bus that shall be basically of all steel construction or of some other material which has at least equivalent strength of all steel construction as certified by the bidder" (emphasis added). We recommend the agencies remove the need of lightweight materials for school buses and adjust the emission target accordingly. [EPA-HQ-OAR-2014-0827-1164-A1 p.53]

**Organization:** Daimler Trucks North America LLC

**Weight Reduction For Rotating Components** – The agencies request comment on whether the HD Phase 2 program should recognize that weight reduction of rotating components provides an enhanced fuel efficiency benefit over weight reduction on static components. As opposed to just carrying around weight from a static component, objects that rotate require energy for that rotation and should be treated accordingly. [EPA-HQ-OAR-2014-0827-1164-A1 p.51]

· **Weight Reduction Packages in Widespread Use** - The agencies request comment on whether any lightweight vocational vehicle components are in such widespread use that we should exclude them

from the list of components for which a GEM improvement value would be available. We think that the agencies captured a large number of inputs and perhaps captured all of them, without going too far to list components that are in widespread use. Quite the opposite, we think that the agencies should continue the practice established in Phase 1 where, if a manufacturer has a lighter component for which the manufacturer wishes to get weight reduction credits, the manufacturer should simply make a showing that the component is lighter than the agencies' baseline in order to get credits. 80 FR 40311. [EPA-HQ-OAR-2014-0827-1164-A1 p.51]

· **Weight Reduction Inputs** - The agencies request comment on all aspects of weight reduction approaches including potential weight increases as a byproduct of technology application. 80 FR 40324. We think that it is appropriate for the agencies to factor into account weight increases that are a byproduct of technologies. For example, with waste-heat recovery, the increased engine efficiency is eroded through increased vehicle weight, and the agencies must factor this into account—particularly in standard setting. In a confidential setting, we can give numbers from Super Truck for an estimate of a waste heat recovery system. Similarly, with hybridization, the addition of batteries and motors will, all else equal, add weight to the vehicle. (Clearly if the hybrid system allows for removal of, for instance, the alternator, then the hybrid may be weight neutral. But the fact that omission of parts does not get weight credit reinforces the flawed nature of the agencies' weight reduction proposal). In any case, the agencies overestimate hybrid benefits without including this weight penalty in the regulations. [EPA-HQ-OAR-2014-0827-1164-A1 p.51]

**Organization:** ABC Bus Companies, Inc.

Motorcoaches have been mandated to implement Phase 1 Emission Standards, as well as ADA wheel chair lift and wheel chair passenger restraint systems, ambulatory passenger seat belt Standards, just to name a few. These mandated Standards have significant weight penalties and no allowances have been made by Federal or State highway agencies of infrastructure limits to the motorcoach industry. Weight penalties of Phase 2 have yet to be determined. These changes, along with Phase 1 changes, should receive consideration from the National Highway System as related to weight standards, which are not lumped in with truck weight standards. [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

**Organization:** Oshkosh Corporation

The seventh and last checkbox involves weight reduction. For applications like concrete or refuse, less weight is already a huge market driver. The plan suggests a switch to aluminum rims as a most likely possibility, but front discharge concrete mixers and fire apparatus already use 100 percent aluminum rims.

Another suggestion involves redesigning structural components using higher strength steel, but the inherent thinner material are more rapidly degraded by corrosion and exacerbate a major problem in the trucking industry already caused by the increased use of liquid de-icing agents.

**Organization:** National Waste & Recycle Association

Structural needs: Durability is an essential requirement for refuse trucks. The frame of the truck body must be strong enough to withstand the pressures exerted internally when the compaction unit is operating. In addition, a refuse truck must be durable enough to travel on a wide variety of roads including residential and commercial streets, arterial highways, dirt or gravel roads in rural areas and alleys that may or may not be paved. Road quality can range from newly constructed to badly pot-holed. Roads can be slick or dry depending on weather conditions. Some refuse trucks are even pressed into duty as snow plow trucks. [NHTSA-2014-0132-0071-A1 p.3]

Nonetheless, the truck must be able to travel these roads, collect its material and take it to a transfer station or landfill for garbage, a materials recovery facility for recyclables or a compost facility for yard waste. The heavy weight of a refuse truck is caused in part, by the need to meet these severe and varying operational realities. As a result, refuse trucks have limited opportunities for weight reduction through the use of lighter weight materials. [NHTSA-2014-0132-0071-A1 p.3]

**Organization:** National Waste & Recycle Association

We are also disappointed that the agencies fail to recognize the impact of federal weight law on refuse trucks. A refuse truck starts out empty and fills up. Due to the unique characteristics of the refuse truck, the Federal truck weight laws impose a limited allowable “payload” for refuse. Unfortunately a number of the options to reduce fuel consumption that are promoted by the agencies increase the empty weight of the truck and therefore decrease the payload and will result in additional trucks on the road. To make matters worse, NHTSA proposed increasing the weight of an empty refuse truck by 200 pounds in a Federal Register proposal released ten days after the publication of this greenhouse gas and fuel efficiency proposal. [NHTSA-2014-0132-0071-A1 p.2]

Most importantly, new technologies add to the curb weight of the truck. A hybrid power train can add as much as 3000 pounds to the curb weight of a refuse truck. The fuel tanks and other equipment for alternate fuels add a smaller, but still significant amount of weight, as noted in Table V-29, page 40325. [NHTSA-2014-0132-0071-A1 p.4]

#### The unique impact of Federal truck weight regulations on refuse trucks

Under Federal law (see U.S. Code Title 23, chapter 1, subchapter 1, Section 127) commercial motor vehicles are subject to Federal size and weight regulations. Long haul tractor trailers, for instance, can have a gross weight of 80,000 pounds on the national highway system. Solid waste industry vehicles, however, have a much lower weight limit because of their shorter wheelbase. [NHTSA-2014-0132-0071-A1 p.5]

The shorter wheelbase is an absolute necessity in order to meet the level of maneuverability demanded by waste collection operations. These trucks must negotiate narrow alleys, residential cul-de-sacs and tight areas within commercial and industrial sites. They must be able to place large containers in very precise locations. In some cases such as compactor/containers, the placement tolerance is as little as several inches. Yet this short wheelbase, combined with a need to avoid excessive flexural effects on bridges caused by heavy, clustered, concentrated axle loads, also leads to very strict truck weight requirements under Federal law. [NHTSA-2014-0132-0071-A1 p.5]

Under the Federal Bridge Formula B, 51,000 pounds is the legal weight limit on the national highway system for 3 axle waste industry collection vehicles. While some states have higher weight limits that were “grandfathered” into the Federal law when it was first enacted in 1956, they are the exception, not the rule. The practical reality is that the national highway system is so extensive and grandfathers are so limited, that the legal weight limit for the vast majority of the solid waste fleet is approximately 51,000 pounds, even though their rated weight capacity is considerably higher. [NHTSA-2014-0132-0071-A1 p.5]

As a result, whenever additional weight is added to the empty weight of a solid waste collection truck, whether as a result of additional emission control equipment, a hybrid power train to improve fuel efficiency, tanks and other unique equipment necessary to use alternative fuels such as compressed or liquid natural gas in place of diesel fuel, or equipment such as brake retarders used to improve braking

performance, the empty weight of the truck is increased and the payload weight of the truck is decreased. Additional collection trucks will be needed, more fuel will be consumed and more emissions created. [NHTSA-2014-0132-0071-A1 p.5]

Meeting truck weight laws is an operational and legal imperative for the solid waste industry. We realize that neither EPA nor NHTSA have regulatory authority over truck weight limits. Yet, the Phase 2 proposal shows a great deal of faith in the ability of refuse trucks to find weight savings. See, for instance, page 40301, left paragraph “The agencies project that refuse trucks, construction vehicles, and weight-limited regional delivery vehicles could reasonably apply material substitution for weight reduction.” The proposal goes on to say that “a reduction of 200 lbs may offer a fuel efficiency improvement of approximately 1 to 2 percent.” [NHTSA-2014-0132-0071-A1 p.5]

This industry has worked tirelessly with our suppliers to reduce the weight of our trucks with the hope of increasing their productivity under existing truck weight laws. However, we would note that on July 23, ten days after the Phase 2 proposal was printed in the Federal Register, NHTSA released in the Federal Register a proposal concerning “Rear Impact Protection, Lamps, Reflective Devices, and Associated Equipment, Single Unit Trucks” (see Federal Register, July 23, 2015, pages 43663 – 43694). According to the agency, the proposed addition of rear underguard protection would add a “minimum to average increment weight” of 169 – 210 pounds (see Table 2, page 43673). In other words, if adopted, this new safety requirement would wipe out the potential fuel savings from weight reduction estimated by the agencies in this proposal. Needless to say, we are frustrated by the conflicting signals sent by the agencies in regard to the most desirable weight of a refuse truck. [NHTSA-2014-0132-0071-A1 p.5-6]

**Organization:** Autocar, LLC

In addition to clean-engine technology, Autocar has adopted other methods to achieve fuel efficiency and therefore reduce emissions, while meeting the particular vocational needs of its customers. For example, Autocar provides the most weight-efficient configurations in its class to reduce fuel consumption while allowing larger payloads (which therefore, require fewer trips to a landfill or transfer station). For the customer teams that drive and maintain our products, Autocar provides extensive training tools for operators, technicians and managers to ensure that emissions components function as designed and remain compliant with emissions regulations. Consistent with EPA and NHTSA’s advocacy for use of available technologies, Autocar is releasing new telematics and tire inflation monitoring technology, and continues weight reduction initiatives through improved body integration and use of alternative materials; these initiatives have been embraced in our niche markets. [EPA-HQ-OAR-2014-0827-1233-A1 p.6]

**Organization:** National Ready Mixed Concrete Association (NRMCA)

In the proposal, EPA and NHTSA suggest weight reduction as a viable method<sup>9</sup> to meet the proposal’s requirements. While NRMCA does not disagree with this approach, NRMCA objects to its feasibility as applied to ready mixed concrete trucks. Due to the reality of the necessary configuration of trucks hauling ready mixed concrete, combined with current regulations from numerous other United States regulatory bodies, weight poses a very unique and continuing challenge to the industry. [EPA-HQ-OAR-2014-0827-1146-A1 p.4] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.242-243.]]

The necessity for manufacturing a ready mixed concrete truck with the lowest possible weight has existed as a market force since the inception of the federal bridge formula for truck weight restrictions on federal-aid highways. Manufacturing a light-weight mixer truck that meets all regulatory compliance thresholds and can still haul a full load remains a constant challenge of innovation and creativity. The proposal makes assumptions about heavy-duty truck weights in order to make suggestions about how weight

reduction can be applied to meeting the proposal's requirements. These assumptions, in the case of ready mixed concrete trucks are incorrect and miss the reality of a mixer truck's true tare and payload weights by thousands of pounds. For example, the maximum weight allowed on federal-aid highways is 80,000 lbs. spread over a calculated number of axles. However, due to structural design and specialized equipment installed on mixer trucks for handling such a heavy product, under federal weight limits a typical ready mixed concrete truck ends up weighing considerably less than the allowable threshold. The realities of truck weight regulations leave little extra room for carrying payload. According to EPA's and NHTSA's assumptions these tolerances are roughly 3,000 to 6,000 lbs. lighter<sup>10</sup> than what is true for mixer truck weights. [EPA-HQ-OAR-2014-0827-1146-A1 p.4-5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.243.]]

In addition to the federal weight tolerances, structural designs and necessary specialized industry equipment, along with previous emission regulation requirements that have added weight to mixer trucks, the overall acceptable weight of mixer trucks has reached its limit. Not to mention, this current weight of mixer trucks includes and takes into account the weight changes needed to comply with Phase I and all of the alternative material suggestions mentioned in the Phase II proposal. All of these weight considerations have pushed ready mixed concrete producers to running mixer trucks, in many cases, with a .002% margin of weight threshold. Meaning, under such weight conditions, a truck merely getting dirty will put it over legal weight limits and risk non-compliance. [EPA-HQ-OAR-2014-0827-1146-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.243-244.]]

Furthermore, the nature of hauling and delivering ready mixed concrete gives way to various driving conditions, road conditions, weather conditions and construction site conditions. Due to such realities, mixer trucks are designed to meet this inevitable rough and tough wear and tear atmosphere. Such a design requires materials that can handle these stresses and keep trucks moving; these materials invariably add weight to a ready mixed concrete truck. [EPA-HQ-OAR-2014-0827-1146-A1 p.5] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.244-245.]]

Many of the methods EPA and NHTSA suggest in both Phase I and Phase II for complying with the proposal are already being implemented by the industry, and numerous other suggestions in Phase II are simply not practical for mixer trucks, leaving technology that has yet to be invented or perfected the method the industry most likely will have left at its disposal for complying with Phase II. To this end, NRMCA recommends that EPA and NHTSA, instead of pushing weight reductions, advocate for increased weight tolerances in amounts large enough to offset the weights of new equipment and technology that will be employed for compliance with Phase II. NRMCA would like to remind EPA and NHTSA that such a precedent already exists for auxiliary power units and idling-reduction technology in many states. [EPA-HQ-OAR-2014-0827-1146-A1 p.5-6] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.245 and p.246.]]

The consequence of adding more weight to mixer trucks for Phase 2 compliance results in achieving the opposite goal of Phase 2. Simply put, if the industry is forced to reduce payload in order to meet low weight tolerances, the industry will then be forced to use more trucks, making more trips to deliver the same amount of ready mixed concrete. More trips means increased emissions, increased fuel consumption, more trucks sitting in traffic, and longer hours for industry drivers. [EPA-HQ-OAR-2014-0827-1146-A1 p.6] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp. 245-246.]]

**Organization:** Aluminum Association

The Aluminum Association is committed to producing high quality, accurate information for OEMs as well as the EPA and other regulatory agencies on the benefits of aluminum lightweighting in the



transportation sector. Mass reduction using aluminum has emerged as a proven and cost effective technology for achieving improved road vehicle fuel economy and CO2 emissions performance and in the past 40 years aluminum use in light and heavy-duty vehicles has increased steadily. In the truck and trailer market specifically, aluminum use has nearly doubled since the recession of 2009 and is trending back toward record levels last seen in the late 1990s and early 2000s. Growth in the use of aluminum in the truck and trailer market has been accommodated utilizing existing production capacity, and where needed, with the addition of new capacity, and the aluminum industry has consistently demonstrated the ability to match supply with demand, including the previous growth of aluminum demand in the aerospace, packaging, and auto transportation sectors. In the auto transportation sector for example, the aluminum industry has publicly announced over 1.5 billion pounds of capacity expansion to come on line by 2018 to support that industry's growth. The long lead times in the proposed rule that require ultimate compliance in the 2027 model year also provide ample opportunity for the alignment of aluminum product supply with any potential for increased demand due to the implementation of lightweighting opportunities in the truck and trailer market. [EPA-HQ-OAR-2014-0827-1260-A1 p.1-2][This comment can also be found in section 4.3 of this comment summary]

The aluminum industry is also continuously improving its product offering to the heavy truck and trailer transportation market to maximize the benefits of using aluminum in lightweighting applications. Recently, these have included – [EPA-HQ-OAR-2014-0827-1260-A1 p.2]

- Alcoa's introduction of the 'ULTRAx Ultra-ONE' forged aluminum wheel – This wheel is 47% lighter than a comparably sized steel wheel and weighs in at only 40 pounds, thus enabling its potential to save over 1400 pounds in Class 8 service. [EPA-HQ-OAR-2014-0827-1260-A1 p.2]
- Alcoa's introduction of a new aluminum alloy, 'Magna-Force' which is up to 17% stronger than the 6061 alloy it replaces in transportation applications. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Novelis' introduction of the 'Advanz' 7000 series next generation high strength aluminum alloy designed to enhance vehicle lightweighting and safety. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Sapa's development and introduction of new aluminum extrusion applications in a variety of tractor componentry including sleeper cabs, seat frames, entry steps/deck plates, and aerodynamic fairings. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]
- Rio Tinto's commissioning of their enhanced state-of-the-art aluminum smelting facility in Kitimat, BC operating solely on clean, renewable, hydropower and using efficient AP40 pot technology to supply aluminum to transportation and other markets in North America and around the world. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

The industry is also pursuing new aluminum joining methods that will enable increased integration of aluminum and non-aluminum components into next generation vocational and heavy-duty vehicles. All the activities noted above continue the aluminum industry's long history of working with transportation market manufacturers throughout the supply chain to develop vehicle efficiency improvement solutions and that work will continue and become ever more important under the recently proposed Phase 2 standards. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

Lightweighting is well-recognized in the proposed rule as a means to increase trucking efficiency and there are three primary ways that this occurs – [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

1) It lowers rolling resistance, which means it takes less energy to start the vehicle moving and then overcome the friction of its contact with the road, [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

2) It allows carriers to add more cargo to each truck, which reduces the number of trucks on the road and/or trips that need to be made, and, [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

3) It facilitates the adoption of other efficiency technologies, such as trailer tails and side skirting, as it can negate the concerns about the added weight of those technologies. [EPA-HQ-OAR-2014-0827-1260-A1 p.3]

**Response:**

The agencies are predicating the final vocational vehicle standards in part on use of material substitution for weight reduction. The agencies have created a menu of vocational chassis components with fixed reductions in pounds that may be entered in GEM when substituting a component made of a more lightweight material than the base component made of mild steel. The pre-defined weight reduction values may be found in the regulations at 40 CFR 1037.520. We are adopting as proposed a GEM allocation of half the weight reduction to payload and half to reduced chassis weight.

It is unclear whether the comment from MEMA is asking the agencies to allow manufacturers to get credit for fleet owners loading vehicles fully instead of applying the default payloads that are not fully loaded values. In order to allow use of non-standard payloads in a regulatory context such as GEM, the agencies would have needed to give notice and take comment on recognition of technologies for improving freight efficiency beyond the control of the vehicle manufacturer. These are out of scope of this rulemaking. However, when a manufacturer replaces a conventional component with one made of a lighter material, GEM calculates a benefit by increasing the payload of the vehicle as well as removing weight from the chassis. See Section 2.2 for responses to comments on how GEM allocates weight reduction inputs.

The menu of components with pre-defined weight reduction credit includes fewer items than proposed, in response to comments from Allison that aluminum transmission cases and clutch housings are standard for automatic transmissions. We have considered the comments from Meritor on the appropriate weight reduction value for use of high strength steel brake drums, and the values in the lookup tables at 40 CFR 1037.520 have been updated accordingly for both tractors and vocational vehicles. See Section 4.3 of this RTC for more discussion of those comments. The value for light weight wheels has increased since proposal based on compelling comment from the Aluminum Association (See Section 5.4). In response to the AISI comments with concerns that the values in the vocational weight reduction lookup table are not justified, we have adjusted the values for some components. We were unable to find any data in the supporting documents submitted as part of public comment from AISI that could support changing any of the values in the regulatory weight reduction lookup tables for Phase 2 vocational vehicles. Instead, we have relied on technical feedback from expert members of the Aluminum Transportation Group.<sup>193</sup> We interpret the AISI comments as generally desiring greater weight reduction values for high-strength steel components on LHD and MHD vocational vehicles, as well as generally desiring less disparity between values for similar components made of aluminum. We had great uncertainty at proposal in our approach of scaling down weight reduction values from the HHD tractor values adopted in Phase 1 to all weight classes of vocational vehicles. Because of this uncertainty, we had deviated from the recommendations of the expert members of the Aluminum Transportation Group to propose conservatively small improvement values for components on LHD and MHD vehicles. After reconsidering those early recommendations in light of comments, we believe we had been overly conservative in some respects and have thus adopted revised values in the final regulations that we believe are responsive to AISI comments with respect to

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<sup>193</sup> See email in the docket dated March 2015 with attached vocational lightweighting table.

cross-members and frame rails. The manufacturers have the option of requesting off-cycle credits for lightweighting technologies that are not included in 40 CFR 1037.520. To clarify Daimler's comment, what we are allowing through this process is not a demonstration of the amount of weight by which the new component is lighter than the agencies' baseline. Rather, the demonstration includes the weights of both a baseline component and a lightweighted component.

The projected improvements due to weight reduction factored into the stringency of the final rules are changed from proposal, where we believed lightweight components would be adopted more narrowly. The final rules project that as many as 50 percent of vocational vehicles can apply aluminum wheels (or reduce an equivalent weight) by MY2027. The agencies project that all vocational vehicles in the primary program can reasonably apply this level of material substitution for weight reduction. Our projected adoption rate is revised upward from the proposed adoption rate of less than 10 percent because the technology package is smaller (fewer pounds removed than the proposed 400 lbs) and aluminum wheels are widely feasible. We agree with commenters that concrete mixers and refuse trucks are very weight-sensitive applications, and to a large extent have already lightweighted their chassis as much as practicable. Upon consideration of the comments, the only custom chassis vehicle type for which we are predicating standards on lightweighting is transit buses. Where a manufacturer has already applied lightweighting in its current fleet, it will be eligible to enter an improved weight value in Phase 2 GEM for use of components that are on our final menu in the regulations, and this menu is fully available for custom chassis as well. Our Phase 2 vocational vehicle baseline configurations assume that no lightweight materials are used, because the Phase 1 program did not recognize this technology. In response to Gillig's comment that weight reduction should be allocated fully to a lighter chassis for transit buses and not to increased payload due to the number of passengers not being dependent on chassis weight, we agree in concept; however, this is a feature we were unable to program in GEM. Nonetheless, manufacturers of transit buses will get full credit for any weight reduced because the value entered in GEM will cause both the numerator to be reduced and the denominator increased. Thus, although the method of calculation may not reflect real world bus payloads, the end result gives fair and full credit for this technology.

In response to Daimler's comment requesting recognition of an enhanced fuel efficiency benefit for weight reduction of rotating components over weight reduction on static components, the agencies were unable to program this feature in GEM given the available information. In order to assign an appropriate value, we would need to know the geometry of the component and whether it had any gearing between it and the road. We would also need to know the absolute weight of the component, not just the relative improvement as is done today. We would also need to change the method of allocating reduced weight to the chassis and the payload, since the enhanced benefit would only apply to the chassis and not to the payload. Manufacturers may instead apply for off-cycle credit for such technologies.

In response to comments asking for revisions to the regulations regarding weight penalties for certain technologies, we are adopting a final program that differs from what we proposed. The agencies are not finalizing a weight penalty for any components since this would require detailed information on conventional and light-weight vehicle components to establish a baseline and the weight reduction potential for each component. The agencies also are not providing a default weight reduction value to transmission type due to the variety of transmissions in the vocational market today. Although we are not requiring a weight penalty in GEM at the time of certification for any technology, the agencies have accounted for increased weight due to projected adoption of some technologies (i.e. for vocational vehicles we accounted for added weight in subcategories where hybrid systems are projected) as part of our inventory modeling with the MOVES model.

### **6.3.10 Other Technologies**

**Organization:** CALSTART

Pick List for Vocational Segments. Another flexibility mechanism that is needed in the vocational space, and for which there is precedence already in the rule structure, is the use of a defined “pick list” or menu of technologies that can be included in the GEM model. Such lists exist and are called out for Class 7 and 8 but limitedly at best for vocational. We are aware of, and support, the major manufacturers of Class 2B and 3 vehicles who will be proposing the use of and some specific technologies for a “pick list” in these segments. Some of the technologies they are leveraging from light duty include high efficiency lighting, engine heat recovery, active aerodynamic improvements, active engine warm up and engine start-stop. We would strongly encourage and request the agencies to allow for the broader development of such “pick lists” for other vocational segments. Indeed, this might be another approach to technologies such as those mentioned earlier (work site idle) to be more easily included. An OEM could more easily take credit for the later stage inclusion of such technologies if such a streamlined list was available, and it would further motivate suppliers and chassis OEMs to connect on this issue. [EPA-HQ-OAR-2014-0827-1190-A1 p.7]

That said, because of the comprehensive nature of the rule and the limited timeline for study and response, such a formal list has not yet been created or coordinated. CALSTART would be very willing to assist with assembling or identifying such a list during the work to complete the final rule language. Technologies might include such varied approaches as post transmission hybridization, work site idle reduction, fuel-saving trash compaction strategies, etc. [EPA-HQ-OAR-2014-0827-1190-A1 p.7]

However, we are also concerned with information we have heard that implies such a pick list is “locked” and cannot easily change or be updated during the rule timeline. Given the pace of technology innovation, and the long time horizon of the proposed rule (still functioning more than a decade from today), we strongly urge the agencies to build in flexibility in the form of simplified provisions for regularly updating or adding to the pick lists, without having to reopen the rule itself. We are concerned that without such an ability to be periodically updated with new technologies, and only allowing what is known today, the rule is further constrained from including innovation. We realize there are other ways to bring in innovative technology, such as “off cycle” credits, but that can involve lengthy, costly and often specialized testing that can be significant barriers to small manufacturers and suppliers, who are often the ones bringing new capabilities forward. [EPA-HQ-OAR-2014-0827-1190-A1 p.7-8]

**Organization:** Volvo Group

Need the ability to certify off-cycle technologies to assure compliance if the EPA’s technology and penetration assumptions are not correct.

**Organization:** Enevo Inc.

Enevo provides logistics solutions to the refuse management industry using sensors to report the fullness level of commercial refuse dumpsters and public space containers. Refuse hauling collection routes can be optimized based on the sensor data, so containers are collected at or near full. Enevo has managed to increase efficiency of refuse hauling routes by 30-50% in the cities we operate in. [EPA-HQ-OAR-2014-0827-1285 p.1]

Enevo is a strong proponent of operating truck fleets in a more efficient manner and is in favor of the Phase II greenhouse gas and fuel efficiency standards for medium and heavy-duty trucks. We encourage the EPA and fleet operators to look beyond the truck for additional fuel savings. Routing optimization and logistics software is available for both delivery and collection routes for various types of commercial

fleets. These innovative technologies are able to determine the most efficient route based on real-time inputs and help navigate the driver to their destination. Less idle time, less time on the road and better use of trucks will contribute to overall emissions reduction. We would like to see provisions for these types of technologies included in the standards. [EPA-HQ-OAR-2014-0827-1285 p.2]

**Organization:** Bosch

**eHorizon** - we support the inclusion of 3-5% credit for Electronic Horizon (eHorizon), technology, depending on the algorithm developed by the end customer. [EPA-HQ-OAR-2014-0827-1466-A2 p.9]

As currently designed, eHorizon systems consist of an integrated hardware and software module installed in heavy commercial vehicles to mitigate fuel consumption. State-of-the-art eHorizon hardware and Horizon data from highly accurate 3D maps (provided by Bosch) demonstrate on average a reduction in fuel consumption of 4% during normal driving, along with a proportional reduction in GHG together with eHorizon algorithm (developed by the OEM) to generate an ideal driving pattern for a given route. [EPA-HQ-OAR-2014-0827-1466-A2 p.10]

Algorithms (developed by the OEM) calculate this ideal pattern using map data along with data from the vehicle's engine and transmission control units (from Bosch), then instruct the vehicle's cruise control system to adjust speed and gear switching to navigate the desired route in the most efficient way. A vehicle equipped with the eHorizon module is able to recognize, for example, changes in altitude and road curvature and make early adjustments to the driving pattern in anticipation of these changes which results in fuel savings and reductions in GHG. [EPA-HQ-OAR-2014-0827-1466-A2 p.10]

Simulations conducted by Bosch in the EU supports the finding of 4% average fuel savings with a maximum 5% savings noted, with annual GHG emission reduction of 4.5 tons and 7.5 tons respectively. Real data results from Bosch customers using large multi-axel trucks (40 tons) equipped with eHorizon technology shows saving of up to 5% in fuel. [EPA-HQ-OAR-2014-0827-1466-A2 p.10]

Methods employed to reduce gasoline engine CO<sub>2</sub> output in passenger cars and light trucks should apply similarly in the MD class. For instance, the application of direct injection and turbo charging combined with downsizing has already been shown to be effective when applied in the light truck market. In addition, the implementation of high speed transmissions in the MD segment (i.e., 8-10 speed automatic) increases the opportunities for gasoline engines to run at the most efficient load points. Due to the high cost of development of these specialized transmissions, it may be that some incentive is required to move the market towards this solution. [EPA-HQ-OAR-2014-0827-1466-A2 p.11]

We further suggest an adaptable approach that incentivizes the transfer of new technologies designed for light duty vehicles into MD/HD vehicles. [EPA-HQ-OAR-2014-0827-1466-A2 p.11]

**Organization:** California Air Resources Board (CARB)

The flexibility provisions for class 4-8 vehicles include off-cycle credit provisions. Several technological approaches have been identified that would seem to merit inclusion, whether incorporated as a line-item in GEM or through available off-cycle credits. Solar controls are not specifically listed as they are for class 2b/3, but the RIA clearly states (page 2-47 of the RIA) they could be considered for credits if the effectiveness can be suitably demonstrated. CARB believes this is a reasonable approach. Because of the uncertainties surrounding estimates of effectiveness of solar control approaches in the heavy-duty fleet, it is appropriate to require demonstration of benefit in a specific case before granting credits for vehicles in these vehicle classes. See CARB docket letter dated December 3, 2014<sup>59</sup> for a thorough discussion of

issues involved in determining appropriate solar control credits for heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.153]

**Response:**

We agree with commenters suggesting that some technologies can be pre-defined for credit in GEM. Where we have been able to define a fixed improvement value along with a qualifying definition for the technology as improved over a known baseline, we are making this available for certification of Phase 2 vocational vehicles, such as is described in Section 6.3.6.2 for electrified accessories, in Section 6.3.7 for tire pressure systems, and Section 6.3.10.1 for aerodynamic fairings.

For technologies where we have not been able to accurately ascertain a pre-defined credit amount, manufacturers may request and demonstrate eligibility for off-cycle credits. In response to requests to develop a streamlined path for off-cycle technology approval, we are not making fundamental changes from the proposal at this time; however, we remain open to working with stakeholders to look for ways to simplify the process. (The pre-defined list, itself, of course represents a significant simplification of the off-cycle process). Just as some technologies that were considered off-cycle for Phase 1 are being adopted as primary technologies in Phase 2, the agencies may revise the regulation in a future rulemaking to create a more direct path to recognize technologies currently considered off-cycle. For example, although we are including specific provisions to recognize electrified power steering pumps and air conditioning compressors, recognizing other types of electrified accessories would require the manufacturer to go through the off-cycle process. However, it is quite possible that the agencies could gather sufficient data to allow us to adopt specific provisions in a future rulemaking to recognize other accessories in a simpler manner. Please see Section 1.4.2 for complete responses to our comments on off-cycle credits, and see Section 2.1 for responses to comments about future changes to GEM.

We are not able to recognize route optimization software in this rulemaking. This type of technology is outside of the regulatory framework of this HD National Program.

Please see Section 4.3 for the agencies' response to comments on solar load management technologies.

**6.3.10.1 Aerodynamics**

**Organization:** American Automotive Policy Council

**Phase 2 GEM 2b-5 Fixed Aerodynamics Improvement Credits**

The Phase 2 2b-5 GEM model is structured such that there is little to no opportunity to reduce aerodynamic loads beyond the 2017MY baseline of 5.4 m<sup>2</sup>CdA. See GEM user instructions page 17, table 8 & 9 for details. Given the importance of aerodynamic horsepower relative to the 55 mph and 65 mph fuel consumption in GEM, AAPC recommends that an aerodynamic improvement option be added to the Phase 2 GEM picklist with a scalable g CO<sub>2</sub>/ton-mile improvement based upon the aerodynamic package installed on the vehicle. [EPA-HQ-OAR-2014-0827-1238-A1 p.34]

The graph below illustrates CO<sub>2</sub> saving in gCO<sub>2</sub> / ton-mile vs Aerodynamic HorsePower reduction relative to the '17MY 2b-5 vocational baseline on the 55, 65, and ARB cycles. [EPA-HQ-OAR-2014-0827-1238-A1 p.34] [Graph of CO<sub>2</sub> saving can be found on p.34 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

Given that aerodynamic improvements upwards or in the range of 10 – 20 horsepower are possible on the 55mph and 65 mph cycles, AAPC suggests a scalable aerodynamic credit based on 1 HP Aerodynamic Reduction for LHD and MHD vocational vehicles per the following table: [EPA-HQ-OAR-2014-0827-1238-A1 P.35] [Table of aerodynamic reduction can be found on p.35 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

**Organization:** Environmental Defense Fund (EDF)

The vehicle standard should be strengthened by incorporating more appropriate advanced aerodynamic improvements on vehicles that travel at high speeds.

**Organization:** Daimler Trucks North America LLC

**Aerodynamics for Vocational Vehicles** - The agencies request comment on 1) allowing a manufacturer to obtain an improved GEM result for vocational vehicles by certifying that a final vehicle configuration will closely match one of the configurations on which the agencies' testing was conducted, and where the improvement would be based on installation of specific aerodynamic devices for which the agencies have pre-defined effectiveness through this testing program, and 2) this potential approach to providing credits for aerodynamic aids to vocational box trucks. 80 FR 40303. We think that, given the agencies' approach of regulating truck manufacturers (i.e., manufacturers of chassis cabs for vocational vehicles as opposed to the final stage manufacturers), it would be inappropriate to regulate or reward aerodynamic treatments on vocational vehicles. In other words, the regulated entities do not install the truck bodies (e.g., the boxes of box vans); a large number of secondary manufacturers do. Therefore, truck manufacturers would have to take out delegated assembly contracts with this large number of secondary manufacturers, which would be a burden on truck manufacturers and would not be related to our business of building chassis cabs; it would be inserting us into a different business. If the agencies want to regulate parts installed by body builders, then the agencies should regulate body builders. And the agencies can do so with more authority than we vehicle manufacturers can. [EPA-HQ-OAR-2014-0827-1164-A1 p.60-61]

**Organization:** California Air Resources Board (CARB)

Research done at NREL shows that improved aerodynamics on vocational vehicles can result in significant fuel consumption reductions as high as 8 percent during cruise cycles.<sup>24</sup> CARB staff recommends that a value of 3.5 percent be included in the vehicle stringency for regional vocational vehicles and 1 percent for multipurpose vocational vehicles due to aerodynamic devices. These values are in line with the observed fuel consumption benefit that front fairings and skirts achieved on the Urban Dynamometer Driving Schedule (UDDS) test cycle and CARB staff transient test during the NREL study, cycles similar to that of what Phase 2 proposes to use to simulate regional and multipurpose vocational vehicles, respectively. CARB staff notes that the vocational subcategory contains a vast range of regional and multipurpose vehicles and that while most regional vehicles will benefit from these technologies, not all vehicles (such as urban vocational) will be able to take advantage of the improved fuel efficiency of improved aerodynamics. Based on this fact and the research done at NREL, CARB staff believes that almost all regional vocational vehicles can benefit from aerodynamics, whereas only about half of the multipurpose subcategory can benefit from the aerodynamic devices, and is recommending penetration rates of 90 percent for regional vehicles and 50 percent for multipurpose vehicles. Vocational aerodynamic improvements are discussed further below under the comment entitled "Vocational aerodynamics: credit for aerodynamic devices on vocational box trucks." [EPA-HQ-OAR-2014-0827-1265-A1 p.55]

The NPRM requests comment on the approach to provide credits for aerodynamic devices on vocational box trucks. The Phase 1 standards did not address the aerodynamic characteristics of vocational vehicles; instead, vocational vehicles were assumed in the GEM model to have default aerodynamic characteristics, and manufacturers did not have the opportunity to obtain credits for installation of aerodynamic devices on vocational vehicles. The Phase 2 proposal still includes only default aerodynamic characteristics for vocational vehicles in GEM, but does allow manufacturers to apply for credit for some aerodynamic improvements to some vocational vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.56]

CARB staff appreciates and supports U.S. EPA and NHTSA offering vocational aerodynamic credits to manufacturers in Phase 2; however, we recommend the proposed Phase 2 standards be modified to include actual aerodynamic characteristics for the vocational vehicles that travel most at high speeds (the regional and multipurpose subcategories), and we recommend aerodynamic improvements for these vocational vehicles be included when setting the Phase 2 standards. CARB funded work to support Phase 2 development assessing various aerodynamic drag reduction technologies and proving their ability to reduce fuel consumption. Aerodynamic devices such as skirts and fairings are readily available in the marketplace for vocational vehicles; hence, there is no issue of technological feasibility. Not including potential aerodynamic improvements for these vocational vehicles, which spend much of their operation at high speeds where aerodynamics are important, represents a significant missed opportunity. As discussed further below, aerodynamic improvements to regional vocational vehicles could yield up to an 8 percent CO<sub>2</sub> and fuel consumption reduction on some duty cycles, and 6 percent in real world operation. Considering that U.S. EPA and NHTSA took into account improvements such as low friction axle lubricants that get only a 0.5 percent benefit when setting the proposed standards, it seems inappropriate to ignore potential aerodynamic improvements in standard setting. [EPA-HQ-OAR-2014-0827-1265-A1 p.56-57]

If U.S. EPA and NHTSA are unwilling to modify the Phase 2 standards for regional and multipurpose vocational vehicles to include aerodynamic improvements, at a minimum, CARB staff recommends allowing generation of aerodynamic improvement credits more broadly than proposed. As the proposal is currently structured, such credits are allowed only in extremely narrow circumstances and CARB staff believes the credits would offer little if any incentive for manufacturers to actually pursue such aerodynamic improvements. [EPA-HQ-OAR-2014-0827-1265-A1 p.57]

The discussion below provides information on the following topics:

- Availability of aerodynamic improvements for vocational vehicles;
- Data on potential fuel consumption reductions achievable via use of aerodynamic improvements;
- Potential additional Phase 2 GHG reductions if vocational aerodynamics were included; and
- Why vocational aerodynamic credits should be offered more broadly than proposed.

#### Availability of aerodynamic improvements for vocational vehicles

The aerodynamics of vocational vehicles can be improved either through changes to the shape of the vehicle during manufacture or through addition of aerodynamic devices such as skirts after manufacture. [EPA-HQ-OAR-2014-0827-1265-A1 p.57]

As CARB staff has shared with U.S. EPA, at least one heavy-duty vocational truck manufacturer, Ford Motor Company (Ford), the second largest U.S. manufacturer of class 3 trucks, is interested in improving



aerodynamics of vocational vehicles. Ford has investigated potential drag reduction and fuel consumption reduction achievable via improvements to some of their customers' vocational box trucks and has shared that data with U.S. EPA and CARB staff. [EPA-HQ-OAR-2014-0827-1265-A1 p.58]

CARB staff also gathered information regarding aerodynamic devices and their applicability to vocational vehicles through literature reviews and stakeholder discussions. We contacted vocational aerodynamic technology manufacturers, including Deflektor, Freightwing, Ridge Corporation, SOLUS, Vorblade, Wabash Composites, Air Flow Deflector, Nose Cone, Laydon Composites, Fleet Engineers, Transtex, etc. Most of them produce devices, specifically skirts, for use on trailers. However, many indicated their devices could be customized to fit on vocational vehicles, and some have sold devices for use on these types of vehicles. For example, Freightwing and Ridge Corporation, who sell side skirts for box trucks intended to achieve a 2 to 4 percent reduction in fuel use, indicate their skirts can be used on any box truck as long as equipment underneath, such as storage boxes, lifts, etc., does not interfere and there is adequate space between axles. [EPA-HQ-OAR-2014-0827-1265-A1 p.58]

We also contacted vocational fleets, including Waste Management, Aramark, Cintas, U-haul, and Pepsi/Frito Lay, to learn about their experience in using trucks with aerodynamic controls. Some had purchased vocational trucks with aerodynamic controls for their fleets. For example, Pepsi/Frito Lay reported that in the field their aerodynamic improvements had given them 1 to 1.5 percent fuel savings. In its class 3 Sprinter truck design, Frito Lay changed the box geometry, added side skirts, and a front lip. In its class 6 trucks, it installed nose cones. [EPA-HQ-OAR-2014-0827-1265-A1 p.58]

#### Data on potential fuel consumption reductions achievable via use of aerodynamic improvements

CARB staff gathered available data on the drag and fuel consumption reductions achievable via aerodynamic improvements to vocational vehicles. For example, we obtained data from Auto Research Center, a research facility in Indianapolis that provides various test services including but not limited to wind tunnel testing and computational fluid dynamics. Auto Research Center met with us and discussed their current fuel economy efforts specific to vehicle aerodynamics. Auto Research Center tested an aerodynamic technologies package that included various aerodynamic devices such as side skirts, fairings, and others for a class 5 box truck. The box truck was tested in a wind tunnel with data recorded at yaw angles of 0, 3, and 6 degrees. The resulting percentage fuel economy savings at 55 mph were 2.5 percent with top fairing, 1.3 percent with side skirts, 0.5 percent with wheel covers, and 2.2 percent with smooth underfloor. We shared this data with U.S. EPA staff in June 2015. [EPA-HQ-OAR-2014-0827-1265-A1 p.58-59]

After gathering available data, we concluded there was a paucity of data concerning the effectiveness of aerodynamic technologies for vocational vehicles. To help fill the gap, CARB contracted with U.S. Department of Energy's NREL to perform coastdown and on-road test runs with and without aerodynamic devices such as skirts, front and rear fairings, and wheel covers to quantify their potential benefits for class 6 and class 4 box trucks. A report describing NREL's findings is attached. The most important findings are summarized below: [EPA-HQ-OAR-2014-0827-1265-A1 p.59]

- All devices except wheel covers showed a benefit: There were six coastdown test configurations: 1) baseline, no aerodynamic device, 2) wheel covers, 3) front fairing, 4) chassis skirts, 5) front fairing and skirts, and 6) front fairing and skirts and wheel covers. All test configurations, except adding just wheel covers, indicated a statistically significant change in total road load force in the 45–68 mph range. Front fairings and chassis skirts were the most effect devices tested, with both showing improvements on the order of 6 percent individually for total road load force. When front fairings and skirts were tested together, the improvement increased to 8 to 10 percent. [EPA-HQ-OAR-2014-0827-1265-A1 p.59]

- Emission benefits up to 8 percent, depending on duty cycle: To determine the significance of their aerodynamic devices in real world operation of vocational vehicles, NREL applied their test results to a variety of test cycles commonly used for vocational vehicles. As shown in the chart below, for vocational cycles that contain a significant portion of high speed driving, the potential benefits of aerodynamic devices can be significant, up to 8 percent. [EPA-HQ-OAR-2014-0827-1265-A1 p.59]

[Figure 3 can be found on p.60 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

CARB staff appreciates that U.S. EPA and NHTSA referenced the data from CARB and NREL testing in the Phase 2 proposal. We encourage U.S. EPA and NHTSA to utilize other vocational aerodynamic data that they have obtained from other sources (e.g., Ford and Auto Research Center data), which will help particularly in the class 3 to 5 categories. [EPA-HQ-OAR-2014-0827-1265-A1 p.60]

The potential emission reductions from use of aerodynamic devices on vocational vehicles are significant and – in CARB staff’s opinion – too large to ignore in Phase 2. To estimate the potential impact of vocational aerodynamics on actual vocational vehicle emissions, we made an estimate of this impact in two ways. First, we used actual duty cycle data from NREL’s Fleet DNA (a database of commercial fleet vehicle operating data) for 553 days of driving data from 36 delivery trucks and, as shown in Table 12 below, and detailed in the attached spreadsheets, found that these trucks could achieve more than a 5 percent reduction in fuel consumption via use of aerodynamic devices.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.60]

[Table 12 can be found on p.61 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

Next, we modeled potential reductions for vocational vehicles modeled in CARB’s EMFAC database. Using duty cycles for medium heavy-duty out-of-state and in-state trucks with GVWR less than or equal to 26,000 lbs, we arrived at similar results to those for the NREL fleet DNA data, potential fuel consumption reductions of about 6 percent.<sup>28</sup> Given that the total reductions from vocational vehicles for the proposed Phase 2 program are only 16 percent, ignoring potential fuel consumption and emission reductions of 6 percent is clearly a significant and regrettable missed opportunity. [EPA-HQ-OAR-2014-0827-1265-A1 p.61]

#### Why vocational aerodynamic credits should be offered more broadly than proposed

U.S. EPA and NHTSA have proposed that credits for aerodynamic improvements be available to manufacturers only of trucks whose configuration and dimensions are essentially identical to those CARB and NREL tested and only for aerodynamic devices of identical weight to those tested. U.S. EPA and NHTSA neglected to consider other relevant data submitted to them during development of the Phase 2 standards (including data from Ford and Auto Research Center, mentioned above). [EPA-HQ-OAR-2014-0827-1265-A1 p.61]

In addition, the proposed method is overly restrictive and will inappropriately limit the vehicles that could receive any credit for using vocational devices to ones essentially identical to the two trucks CARB and NREL tested. We believe this restriction would make the aerodynamic credit provisions unlikely to be used widely, or at all, by vocational vehicle manufacturers. We also believe this restriction ignores the physical reality that devices such as skirts are likely to provide fuel economy benefits for trucks of a variety of frontal areas, lengths, and shapes. Although as discussed above CARB staff recommends that aerodynamic improvements be included when setting the standards for vocational vehicles and in GEM, should U.S. EPA and NHTSA decline to do that, at minimum, we recommend allowing credit for all class 3 to 7 straight trucks with a van or box shaped body. [EPA-HQ-OAR-2014-0827-1265-A1 p.62]

CARB staff believes the data available show convincingly that aerodynamic devices can reduce fuel consumption and GHG emissions from vocational vehicles and believes credit for such devices should be offered more broadly, not just to trucks identical to the two we tested. Especially given the diversity of vocational vehicles offered in the market, it would not be feasible to perform testing on every possible vehicle, coupled with every aerodynamic device, nor would such testing be a good use of scarce public agency resources. NREL concluded, “as long as the box sits above the rear wheels without a wheel well, there will likely be a spot for chassis skirts, and as long as the box extends above the front cab, there will likely be an opportunity for a front fairing. These devices may vary in size and aerodynamic benefit for different platforms, but the benefit likely has a closer tie to vehicle shape and body style rather than a specific weight class or dimension.”<sup>29</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.62]

Elsewhere in the Phase 2 rulemaking, U.S. EPA and NHTSA use similar logic to what we are proposing to justify how aerodynamic data for 53-foot dry vans can be translated to vans and box trailers in lengths different than 53 feet (page 40261 of the NPRM and 40 CFR 1037.501(g)). Putting aerodynamic devices (i.e., skirts) on vocational trucks is similar to putting skirts on trailers, and hence it is unclear why U.S. EPA and NHTSA did not apply this same logic to vocational aerodynamics. [EPA-HQ-OAR-2014-0827-1265-A1 p.62]

CARB staff also believes U.S. EPA and NHTSA are overly restrictive in limiting credit to devices of equivalent weight to those tested. We recommend allowing credit for aerodynamic devices of differing weights because their weight varies for various types of vehicles and brands of devices. We recommend that U.S. EPA and NHTSA follow an approach for vocational aerodynamic devices similar to the approach they describe on pages 40280 to 40281 of the published NPRM for trailer aerodynamic devices. Under that approach, device manufacturers could certify their aerodynamic devices, then chassis manufacturers, including secondary manufacturers, can install the aerodynamic devices and obtain credits without having to retest for every individual vehicle. The approach also lays out the procedures for combining the effects of several devices. [EPA-HQ-OAR-2014-0827-1265-A1 p.62]

To facilitate application of the test data available to a broader variety of vehicles, we recommend U.S. EPA and NHTSA consider use of a percent delta coefficient of drag x area (CdA) instead of a flat CdA. CARB staff recommends using a ratio approach by applying a percent CdA change, not an m2 CdA. For example, if we tested a vocational truck and found that a skirt could reduce CdA 6 percent, then a smaller or bigger truck could apply that same percent change to their CdA. We encourage U.S. EPA and NHTSA to consider this ratio approach. [EPA-HQ-OAR-2014-0827-1265-A1 p.62-63]

**Organization:** Union of Concerned Scientists (UCS)

The agencies have identified the “delegated assembly” pathway as applicable to manufacturers of aerodynamic devices—this means that chassis manufacturers can work with any of a number of aerodynamic device manufacturers to get credit for the use of these devices in the right application. The agencies have also submitted to the docket research that indicates the potential for up to 5.4 percent improvement for light and medium heavy-duty vehicles that utilize aerodynamic devices. Since there is a clear pathway for the inclusion of this cost-effective technology and evidence of its effectiveness, it should be included in assessing the feasible level of reductions in the timeframe of this rule. [EPA-HQ-OAR-2014-0827-1329-A2 p.22-23]

We have estimated the cost of the full aerodynamic package identified by agencies for Light and medium heavy-duty vehicles to cost just under \$2,500 (Table 7). This is lower than a previous estimate of \$3,000 (TIAX 2009) but is consistent with the trend in trailer aerodynamic devices (Sharpe and Roeth 2014). [EPA-HQ-OAR-2014-0827-1329-A2 p.23]

However, because this package reflects differential costs greater than the average compliance pathway for Class 3-7 vocational vehicles, it is clear that these technologies would only be applied to a subset of vehicles for which the technology is cost-effective. According to VIUS, 6.2 percent of Class 3-7 vocational vehicles travel greater than 36,000 miles annually, averaging 52,657 miles. This average value is more than twice the average for vocational vehicles overall, and these high mileage vehicles all would qualify as “regional” vocational vehicles. The 5.1- to 5.4-percent additional improvement beyond what the rule would achieve in 2027 would save these high mileage vocational vehicles hundreds of dollars in fuel per year. At low fuel prices (\$2.50/gallon), applying aerodynamic devices to a high mileage regional Class 3-7 vocational vehicle in 2027 would still have a payback of under 5 years, discounting future savings at 5 percent. At \$3.50/gallon, that payback drops to between 2.5 and 3.5 years for Class 3-7 regional vehicles—and this is assuming today’s prices for aerodynamic technology. These 6.2 percent of Class 3-7 vehicles represent 25 percent of the regional vocational fleet of light and medium heavy-duty vehicles. Incorporating the improvements from aerodynamic devices applied to these vehicles would increase the overall stringency for vocational vehicles by 0.3 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.23]

[Table 7, 'Cost of Vehicle Aerodynamic Devices', can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

**Response:**

The agencies did not propose to include aerodynamic improvements as a basis for the Phase 2 vocational vehicle standards. However, we did request comment on an option to allow credits on a very limited basis for use of aerodynamic devices such as fairings. We found public comments from AAPC compelling in terms of adopting this as an optional credit. Because the method we are adopting for recognizing this technology in GEM scales conservatively, we are able to accommodate comments from AAPC and CARB requesting that aerodynamic reductions be recognized for a broader range of vehicles than was proposed.

Based on testing supported by CARB, the agencies have developed a list of specific aerodynamic devices with pre-defined improvement values (in delta  $C_D A$  units). See Chapter 2.9.4.1 of the RIA and the NREL report submitted by CARB.<sup>194</sup> In response to comments, we are allowing a wider range of vehicles to be eligible to use this option (and thus expanding credit opportunities, as suggested in the comments). The final regulations specify that Regional vocational vehicles in any weight class may use this option, as long as the frontal area and vehicle length are larger than the specified minimum (see 40 CFR 1037.520(m)). By basing the size restrictions on minimum values rather than a narrow range of dimensions as was proposed, the final approach to this credit option is also better aligned with the approach used in the trailer program. As discussed in the RIA Chapter 2.10.2.1.2.6, the performance of aerodynamic devices on shorter trailers tends to be poorer than performance on longer trailers. As part of the trailer analysis, the devices (such as skirts) were sized appropriately for the vehicles, so that longer trailers had proportionately longer skirts. While we would expect this trend to also hold for vocational vehicles, we do not have data on longer vehicles and therefore we are setting final improvement values that are valid for vehicles at least as large as those tested, where we can be confident the rules don't over-credit the use of pre-defined devices on larger/longer configurations.

Due to the small number of configurations and technologies tested, a fixed change in  $C_D A$  is being adopted for only three devices. Although we reviewed the wind tunnel data from ARC and Ford, we were unable to make use of these other data sources in the final regulations. The data from ARC included combined wind tunnel results for packages of aerodynamic improvements on a single vehicle and were not device-specific. The Ford data were from wind tunnel testing of single devices as well as combined packages of devices on two vehicles, neither of which are similar to the vehicles tested by CARB. The Ford vehicles are smaller than the ones tested by CARB and the fairings are comparatively smaller with corresponding effectiveness values. Although we are not adopting pre-defined improvement values for devices and vehicles based on the data from Ford, we do consider the Ford data to be corroborative of the approach being adopted.

Manufacturers using this credit provision may enter the specified delta  $C_D A$  as an input to GEM for eligible vehicles, and the simulation will determine the effectiveness over the drive cycle. Using this approach, we do not need to set a scaled benefit for different sizes of vehicles. When a vehicle weight class and subcategory are entered, a default chassis mass, payload, and  $C_D A$  are simulated in GEM. When the pre-defined delta  $C_D A$  is entered as an input, the simulation returns a resulting improved performance specific to the given chassis configuration. Using this approach, GEM will logically return a smaller improvement for larger vehicles. If a percent  $C_D A$  improvement value were used as requested by CARB instead of delta  $C_D A$ , then the simulated effectiveness on larger vehicles would likely not diminish, and could even increase. This is because if GEM computed a given percent improvement of the larger default  $C_D A$  that is in GEM for a heavier vehicle, the change in  $C_D A$  would be greater. This would not be a conservative approach, and when extrapolating beyond test data, the agencies prefer to

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<sup>194</sup> See Attachment 1 of public comments from CARB, "Aerodynamic Drag Reduction Technologies Testing for Heavy-Duty Vocational Vehicles, July 2015, NREL/TP-5400-64610, Docket ID EPA-HQ-OAR-2014-0827-1267

be conservative. Manufacturers wishing to receive credit for other aerodynamic technologies or on other vehicle configurations may seek credit by conducting A to B testing as specified in the regulations at 40 CFR 1037.527. Although in actual operation the added weight of aerodynamic fairings may reduce the operational benefits of these technologies when driving at low speeds, the agencies are not applying any weight penalty as part of the certification process for vocational aerodynamic devices.

The final Regional composite duty cycle in GEM for vocational vehicles has a weighted average speed of 38 mph, increased from the average speed at proposal due to a heavier 56 percent composite weighting of the 65 mph drive cycle. The agencies have learned from the NREL duty cycle analysis that vocational vehicles with operational behavior of a regional nature accumulate more miles at highway speeds than previously assumed. Using GEM simulation results, the agencies estimate the fuel efficiency benefit of improving the  $C_{DA}$  of a Class 6 box truck by  $0.6 \text{ m}^2$  (approximately 11 percent from a default  $C_{DA}$  of  $5.4 \text{ m}^2$ ) at approximately five percent over the Regional composite test cycle. This same delta  $C_{DA}$  simulated in GEM on a class 8 Regional vocational vehicle results in an overall improvement of less than four percent because the default  $C_{DA}$  in GEM for class 8 vocational vehicles is  $6.86 \text{ m}^2$  so the change in  $C_{DA}$  is only nine percent.

We disagree with many of the requests and assertions in CARB's comments. First, we disagree that there is no issue of technical feasibility for applying aerodynamic fairings just because they are commercially available. Feasibility for rulemaking purposes must consider barriers to application such as compatibility with a chassis configuration. CARB's comments include information gained from conversations with suppliers who noted that skirts can be used on any box truck as long as equipment underneath, such as storage boxes, lifts, etc., does not interfere and there is adequate space between axles. These are real world barriers to adoption of this technology that must be considered. Further, where a box truck chassis has a cab-over-engine design, some front fairings could interfere with tilting the cab forward as needed to perform engine maintenance.

We similarly disagree with CARB's assertion that almost all Regional vocational vehicles can apply this technology. UCS suggests that six percent of class 3-7 vocational vehicles could see real world benefits from use of aerodynamic devices, based solely on the VIUS survey of miles travelled (estimated by UCS to be 25 percent of LHD and MHD Regional vehicles). The agencies would need more specific fleet information than this before projecting technology adoption rates. For example, if the devices we are considering are bolt-on fairings rather than integrated redesigns, then eligible vehicles would be those with chassis to which such fairings may be reasonably affixed. Coach buses (motorcoaches) are clear examples of vehicles that would certify as Regional. However the typical bus design has low side clearance chassis that often house under-carriage luggage compartments. Thus, bolt-on side skirts as considered for box trucks would seem infeasible for these buses. Another example of a vehicle that has frequently been characterized as having a Regional drive cycle is a drayage tractor. These typically haul marine containers to and from rail yards using specialized chassis that are often owned by the shipping company. These unusual boxes on unusual chassis may be incompatible with any of the aerodynamic fairings considered by commenters. Before an adoption rate for a technology can be projected for purposes of regulatory standard-setting, information about the fraction of the fleet that is compatible with the technology must be available, and commenters have not provided this information; nor have the agencies been able to develop such information.

We agree with CARB that the Phase 2 program includes many technologies that seem to offer small improvements, such as axle lubricants. We have included many technologies in the vocational vehicle technology packages that have high initial costs, and some will have smaller improvements in efficiency than others. Although we have pointed to one possible pathway, we have set the performance-based Phase 2 standards in a way that enables manufacturers to select the mix of technologies that will be most suitable for their products. Using the cost estimate provided by UCS (\$2,500) and an estimated

effectiveness between four and six percent, the use of aerodynamic devices would likely fall in a range of cost-effectiveness similar to ATIS for Regional vocational vehicles. ATIS is a technology that we are also not projecting as part of standard-setting (except for custom chassis where more details are known about the vehicles). All of the above reasons have led the agencies to conclude that aerodynamic improvements should not be factored into the stringency of the Phase 2 program, and should be made available only as an optional credit at this time.

In response to Daimler's concerns regarding delegated assembly, we agree that by regulating vocational vehicles at the incomplete stage when a chassis manufacturer may not know what type of body will be fitted on the chassis, this is a possible barrier to adoption of aerodynamic improvements. As described in the NPRM, we are requiring chassis manufacturers employing this option to provide assurances to the agencies that these devices will be installed as part of the certified configuration, even if the installation is completed by another entity. We expect that this option will only be chosen by manufacturers that can overcome these market barriers, which is another reason why it is not considered as part of stringency. We received many comments on the requirements for secondary manufacturers as they apply for vocational aerodynamics as well as other technologies that may be specified by a chassis manufacturer but installed later. See Section 1.4.4 for responses to delegated assembly comments.

## **6.4 Exemptions and Exclusions**

### **6.4.1 Small Businesses and Small Volume Producers**

**Organization:** Innovus Enterprise LLC

*Additional Comments:* On page 40295, there is a discussion about chassis manufacturers, small volume manufacturers and small businesses and a request for comments on alternate approach and sales volume threshold. We can say this: There is often a convolution of the terms "small volume" and "small entity." There are cases where a large manufacturer, with resources normally far exceeding that of the small business, is as a small volume producer, offered flexibility on compliance issues. We are of the opinion that only small volume producers who also qualify as a small entity be the thrust for regulatory flexibility. [EPA-HQ-OAR-2014-0827-1116-A1 p.7]

A request for comment was posed asking for a means to determine what would constitute the correct quantity that amounts to "small volume." We suggest using a formula based on a percentage of market sales in that particular industry; industry being the particular one that a certificate is sought. Actually, it seems the same question is posed every time small volume flexibility is posed - what is the correct or fair quantity? We have developed such a formula and parameters for a program which could apply to all small volume conditions throughout the CAA program. We can share this with the Agency and further discuss if they are interested. [EPA-HQ-OAR-2014-0827-1116-A1 p.7]

On page 40545, paragraph (x) *Custom Chassis Manufacturers*, a request is made for suggestions as to a low volume exception. We are fully supportive of this exemption for small entity/small volume custom chassis manufacturers. We feel that a volume of 200 vehicles per year could be adequate since it is consistent with the other like categories. Additionally, we think there could also be some qualifying factor such as: The exemption is warranted when the feasibility to employ fuel saving and emission reduction technologies are beyond the capability of the small entity to reasonably engineer. Or, the vehicles operate in a manner essentially making them incompatible with fuel saving and emission reduction technologies. The recordkeeping, reporting and labeling could follow along the line of that in 1037.631. [EPA-HQ-OAR-2014-0827-1116-A1 p.7]

**Organization:** Association for the Work Truck Industry (NTEA)

## **Emergency Vehicles**

We agree with the concept of differing standards for emergency vehicles. This small population of vehicles is critical to society. Ensuring their continued operation is a legitimate public safety issue. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

**Organization:** Truck & Engine Manufacturers Association (EMA)

EMA supports the proposed less stringent requirements for emergency vehicles, which requirements would focus on the use of low rolling resistance tires. The unique performance requirements and applications for emergency vehicles make it infeasible to implement the full Phase 2 program for those vehicles. However, EPA should expand the definition of emergency vehicles beyond just ambulances and fire trucks. EMA also requests that the agencies establish simplified consistent labeling requirements for emergency vehicles (just as for non-emergency vehicles), including through the elimination of requirements for emissions control identifiers. [EPA-HQ-OAR-2014-0827-1269-A1 p.45]

**Organization:** Volvo Group

It is unclear why motor homes, cement mixers, and emergency vehicle chassis could be certified to a family not requiring use of GEM, while this option would not be available for other Custom Chassis types.

Single weight class assumptions are not correct, as some Class 8 Motor Coaches are completed as Motor Homes and thus a manufacturer could not average between the two if they were certified to Class 7.

**Organization:** E-ONE

Gliders are an important product in the emergency vehicle industry. An emergency vehicle, while critical to saving lives in the event of an emergency; typically does not drive very many miles over the lifetime of the vehicle. The industry standard of the lifetime of an emergency vehicle is 10 to 20 years in which an emergency vehicle may only have traveled 10-50,000 miles, although it is not uncommon for an emergency vehicle of 30+ years of service to have the same amount of miles. E-ONE has found that the durability of engines in class 8 emergency vehicles far surpass the longevity of the chassis that they power, this can be attributed to the extreme environment that these vehicles have to endure. Having the ability to purchase a glider allows municipalities with limited financial resources capable of maintain a fleet that is required to save lives. [EPA-HQ-OAR-2014-0827-1185-A1 p.1]

**Organization:** Fire Apparatus Manufacturers' Association (FAMA)

## **Emergency Vehicle Proposal**

FAMA supports the language in the Phase II proposal concerning emergency vehicles that limits regulation of emergency vehicles to the Phase I levels. This approach works in the best interest of both the users of emergency vehicles (fire fighters, EMTs, etc....) and members of the public who become recipients of the services rendered using emergency vehicles. [EPA-HQ-OAR-2014-0827-1163-A1 p.1]

**Organization:** Navistar, Inc.



Navistar supports the proposed requirements for emergency vehicles, which essentially vocational vehicles. The unique performance requirements and applications for emergency vehicles make it infeasible to implement the full Phase 2 program for those vehicles and we support this establishment of this unique segment. Navistar also requests that the agencies establish simplified labeling requirements for emergency vehicles (just as for non-emergency vehicles) as noted above in the discussion of Labelling. [EPA-HQ-OAR-2014-0827-1199-A1 p.40-41]

1275

**Organization:** Allison Transmission, Inc.

### **Low Volume Exemption Should Allow for Deployment of Advanced Technologies**

The agencies have requested comment on whether different standards and simplified compliance procedures should apply to custom chassis manufacturers. Allison generally supports flexibility in implementing Phase 2 standards in order to recognize the varied nature of the MD/HD market -- there are many specialized vehicles that may be “purpose-built” to perform certain tasks. The limited number and specialized nature of such vehicles means that there would be marginal environmental gains from regulating such vehicles on a comparable basis to higher volume production vehicles. In addition, excessive burdens could inhibit innovation driven by some low-volume manufacturers. [EPA-HQ-OAR-2014-0827-1284-A1 p.49]

### **EPA and NHTSA Should Consider Limited, Low-Volume Exemption**

Allison believes that providing a less stringent standard for small volume chassis manufacturers is appropriate. Allison further believes the basis for this flexibility should be to allow small volume manufacturers the ability to continue operations until they grow to a size where applying more stringent standards is appropriate. Using the Phase 1 rule as a guide, a sales volume strategy similar to the Phase 1 three year rolling average of vocational tractor sales would be a reasonable approach (it is assumed the threshold would be different). [EPA-HQ-OAR-2014-0827-1284-A1 p.50]

Allison does not favor additional lead time as the only solution for flexibility for small volume manufacturers. In our experience, the challenge for small volume manufacturers is typically a lack of resources. If a small manufacturer lacks the resources (or ability to add resources) to address increasingly stringent standards, the situation is unlikely to change simply based on allowing an additional one or two years for compliance. Instead, additional lead time coupled with less stringent standards represents a balanced approach to addressing this issue. [EPA-HQ-OAR-2014-0827-1284-A1 p.50]

The low overall volume of custom chassis manufacturers may inhibit their ability to benefit from averaging, banking and trading (“ABT”) systems. ABT systems work to provide flexibility if a manufacturer has a number of different vehicles which may underrun or exceed regulatory standards. In a low volume scenario, a specialty vehicle manufacturer simply may not be able to generate enough credits within the time period required. In such a situation, a theoretical recourse would be to purchase credits for compliance, but realistically, such might be unavailable since larger companies may desire to retain such credits for their own future compliance or be otherwise reluctant to sell such credits to a smaller competitor. [EPA-HQ-OAR-2014-0827-1284-A1 p.50]

In addition, EPA and NHTSA should consider the additional testing burden that might result from small volume manufacturers creating different types of vehicles which may not have all attributes measurable through GEM, thus necessitating powertrain testing in order to demonstrate compliance or generate

credits. This additional testing would result in relatively higher costs per vehicle for the smaller volume manufacturer. In order to accommodate such vehicles – and additionally to allow for further innovation in vehicle construction -- EPA and NHTSA should allow for a limited period of time whereby vehicles incorporating new advanced technologies (independent of the type of manufacturer) can be sold under a low volume exemption. [EPA-HQ-OAR-2014-0827-1284-A1 p.50]

### **EPA and NHTSA Should Consider Low-Volume Phase-In**

The agencies should additionally consider providing for a limited period of time (e.g., 18 months) and a limited volume (e.g. 500 vehicles) as a “phase-in” period for low-volume manufacturing of advanced technology, during which time less stringent standards would apply. Under this concept, once the time or volume limit was reached, the phase-in period would end and full compliance with the emission and fuel efficiency standards established by the final rule would be required. [EPA-HQ-OAR-2014-0827-1284-A1 p.50]

This flexibility should be allowed for all manufacturers, regardless of size or type since the object of the phase-in period is to encourage innovation. Allowing for a phase-in period would improve the ability of the marketplace to explore innovative technologies - and potentially large gains in emissions and fuel efficiency performance - while limiting any potentially negative impacts on GHG emissions and fuel use. The concept should not be confused with the simplified compliance procedures proposed for low volume manufacturers. While these procedures are helpful, they do not fully address the multiple barriers to entry faced by new technology. [EPA-HQ-OAR-2014-0827-1284-A1 p.50-51]

#### **Organization:** School Bus Manufacturers Technical Council

For the years of 2010-2014, the average number of large school buses produced each year was 26,368 units. Given the reasons stated above and the relatively small volume of school buses produced each year, we respectfully request that the agencies consider allowing school buses to meet some of the less stringent standards as being proposed for emergency type vehicles. [EPA-HQ-OAR-2014-0827-1287-A1 p.2]

#### **Organization:** Autocar, LLC

Autocar is a small business that should be exempt from Phase 2. In 2011, the agencies determined that its small size justified a deferral from compliance from the Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 1 regulations (“Phase 1”) for Autocar. The relevant facts remain the same, and Autocar’s size, volume and product lines continue to justify an exemption or different standards for its vehicles.[EPA-HQ-OAR-2014-0827-1233-A1 p.2]

The estimated costs and payback for compliant technologies may inhibit industry adoption. Autocar does not have access to data that would enable the Company to confirm assumptions and calculations of incremental cost and payback for compliant technology for vocational vehicles in 2021, 2024 and 2027. Assuming that the calculated costs per truck (for most Low-speed/Frequent-stop Vehicles) of \$1,998 in 2021, \$3,332 in 2024 and \$7,422 in 2027 are accurate for those vehicles, the costs are too high and would likely discourage the adoption of compliant technology. The proposed payback of 6-7 years may not be compelling to customers typically maintaining refuse and sweeper trucks in service for the 7-12 years recognized by the agencies at 80 Fed. Reg. 40286. Vocational truck buyers will view their estimated costs and payback as unfair when compared to the lower costs and shorter payback for non-vocational truck buyers. Truck owners will likely choose to defer purchases and extend the lives of old

non-compliant trucks, rather than spending more to purchase new compliant trucks, threatening or delaying the effectiveness of the GHG regulations. [EPA-HQ-OAR-2014-0827-1233-A1 p.9][This comment can also be found in section 13.2.4 of this comment summary]

The agencies' analysis of, and reasons for, exempting small volume manufacturers of emergency vehicles also applies to small volume manufacturers of Low-speed/Frequent-stop Vehicles. Similar to the rationale the agencies provided in granting the exceptions for small manufacturers of emergency vehicle chassis, the agencies should similarly grant exceptions for small manufacturers of refuse truck, street sweeper and other Low-speed/Frequent-stop Vehicle chassis. [EPA-HQ-OAR-2014-0827-1233-A1 p.13]

Manufacturer Diversity. Custom chassis manufacturers are a diverse group, even within particular truck markets. For example, in the North American refuse truck chassis market, Autocar generally competes with two very different manufacturers. As noted in Section 1.1, Autocar has less than 300 employees, one plant and annual production of roughly 2,000 refuse trucks and 500 other trucks. Autocar's two competitors also produce approximately 1,500-2,500 refuse trucks per year, but in contrast to Autocar, they are large, publicly-held, worldwide corporations with thousands of employees, multiple plants, multiple brands and annual production of tens of thousands of other trucks.<sup>9</sup> Both of Autocar's major competitors build and install their own engines, and at least one of them also builds and installs proprietary transmissions in its own trucks. [EPA-HQ-OAR-2014-0827-1233-A1 p.13]

4.2.2 Compliance Burden. The compliance requirements of the Proposed Regulations would impose burdens disproportionately high for a company that assembles small volumes of customized chassis and no other product lines. The ability to benefit from averaging would be limited or non-existent, as would be the ability to spread compliance costs across many vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.13]

4.2.3 Reliability Requirements. Like emergency vehicles, refuse trucks perform a public health function and therefore require a high level of reliability. Refuse trucks manage America's solid waste stream and transport many recyclable materials. Some refuse trucks even serve double-duty as snow plows. Refuse trucks serve a critical, "24/7" function in our society, and must continue to be made available and affordable in the market. [EPA-HQ-OAR-2014-0827-1233-A1 p.13]

4.2.4 Performance Requirements. Further, the refuse industry requires a high level of performance and durability. Refuse trucks travel on residential and commercial streets, highways, dirt and gravel roads and paved and unpaved alleys. The truck must be sturdy enough to carry a widely-variable payload and to withstand the pressures exerted when the compaction unit is operating. The purpose-built features of refuse trucks, such as the high steel content (and resulting weight), high-traction tires and high PTO-running time limit the opportunities for GHG emissions reductions. These high-performance aspects present technological feasibility issues beyond other vocational vehicles, and the severe duty cycles of these vehicles (discussed above in Section 2.3) create constraints in terms of vehicle design and application of technology. [EPA-HQ-OAR-2014-0827-1233-A1 p.13-14]

4.2.5 Averaging. As discussed above in Section 2.4, certain GHG and fuel saving technologies can be applied, but Low-speed/Frequent-stop Vehicles are so different from other vocational vehicles that keeping them in the same averaging sets as other vocational vehicles is not appropriate. Accordingly, a separate standard, evaluated from a baseline specific to these vehicles, is warranted. Further, with all of the standards being predicated on averages, an assembler of just a few types of vehicles may be disproportionately impacted by its vehicles' actual standards being at the far end of the spectrum from the averages. [EPA-HQ-OAR-2014-0827-1233-A1 p.14]

4.2.6 Low Volume → Low Impact. According to the International Council on Clean Transportation (ICCT),<sup>10</sup> less than one percent of all new heavy duty trucks from 2003 to 2007 were registered to sanitation/refuse companies, and not all of those trucks were refuse vehicles (some were service trucks, freight trucks and other trucks used by sanitation companies). The annual North American market for refuse collection trucks, such as those assembled by Autocar, has averaged 6,000 new trucks over the past 10 years. The agencies recognize that an aggregate industry count 5,700 new emergency vehicles per year is too small to justify compliance with the Proposed Regulations (80 Fed. Reg. at 40,294), and should consistently extend this conclusion to the similarly-sized refuse market. Because relatively few of these vehicles exist, and they travel a relatively low number of miles, modified GHG and fuel consumption standards would not detract from the greater objectives of the rulemaking. [EPA-HQ-OAR-2014-0827-1233-A1 p.14]

4.3 The exceptions granted should be limited to 5,000 chassis per year. Autocar proposes to set a 5,000-vehicle limitation on the number of vehicles that a small chassis manufacturer may produce under this exception annually. This figure is consistent with the small-volume vehicle manufacturer exemption for NHTSA's TREAD reporting. See 49 C.F.R. § 579.27 (reporting requirements applicable to manufacturers of fewer than 5,000 vehicles). [EPA-HQ-OAR-2014-0827-1233-A1 p.14]

The exception granted for emergency vehicles should be extended to similar Low-speed/Frequent-stop Vehicles. In the Proposed Regulations, the agencies provide a simplified compliance procedure and less stringent Phase 2 standards for emergency vehicles, and the agencies request comment on extending those flexibilities to other custom chassis manufacturers.<sup>8</sup> 80 Fed. Reg. at 40,292-40,295. If the agencies do not grant an exemption as proposed in Sections 2 and 3 of these Comments above, Autocar proposes that small manufacturers of chassis of Low-speed/Frequent-stop Vehicles be provided a simplified compliance procedure and less stringent Phase 2 standards for their vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.12-13]

The exceptions granted should provide for a simplified compliance model. In light of the different set of feasible technologies discussed above in Section 4.4, it is appropriate to provide a simplified compliance model, as is proposed for emergency vehicles. A Phase 1-style GEM interface with a default compliant engine and transmission<sup>12</sup> and a simpler set of vehicle-level standards and technologies may be appropriate, but that would not sufficiently reduce the small custom chassis manufacturer's administrative burden of running GEM simulations for thousands of custom configurations for its customized chassis. We propose that installing certified engines should be sufficient proof of compliance. [EPA-HQ-OAR-2014-0827-1233-A1 p.16] /12/ Lacking vertical integration, a small custom chassis manufacturer has no means by which to test engines or transmissions to obtain the maps and other data needed to run GEM simulations, and in fact may be prohibited from doing so under its contracts with suppliers

Additional lead time would not provide sufficient relief. Although Autocar appreciates the agencies' willingness to consider providing additional lead time for compliance by small custom chassis manufacturers, the Company believes that additional lead time would not remedy the difficulties faced by such manufacturers in meeting the proposed standards or the negative consequences for the industry. For example, the manufacturers would still have limited ability to benefit from averaging and to spread compliance costs across many vehicles. We would still suffer from the shortage of technical compliance expertise, and customers would still experience disruption to their businesses due to production delays, upfront cost increases and increased continuing maintenance costs.[EPA-HQ-OAR-2014-0827-1233-A1 p.16]

2 Autocar's Low-speed/Frequent-stop Vehicles include the following: residential and commercial refuse collection trucks, street sweepers, asphalt patchers, stripers and blasters, concrete pumpers and conveyers, aircraft deicers, refuelers and stockers and sewage suction trucks.

3 Autocar's class 8 heavy-duty terminal tractors (referred to as "yard hostlers" in the Proposed Regulations) and Class 8 heavy-duty chassis for mobile cranes are "vocational tractors," exempt from Phase 2 compliance under §1037.630, because terminal tractors and mobile cranes are intended for off-road operation. The agencies correctly recognize that these machines do not operate at highway speeds and would not benefit from the efficiency improvements designed for line-haul tractors. 80 Fed. Reg. at 40,654.

4 A typical average refuse vehicle payload is 10,000 pounds, and a typical maximum refuse vehicle payload is 20,000 pounds.

5 Additionally, in the Draft Regulatory Impact Analysis, Autocar observed that the testing for vocational vehicles was conducted using what is described as a "New Flyer refuse truck" with an "AT" Eaton transmission. We are not aware that New Flyer ever produced a refuse truck, and do not believe that the Eaton transmission is an AT, but rather an AMT. Autocar encourages the agencies to confirm that the baselines and standards being asserted for refuse trucks based on this testing were actually derived from a refuse truck, and not a New Flyer transit bus.

8 The agencies correctly recognize that small custom chassis manufacturers such as Autocar offer a narrow range of products, such that averaging is not of practical value as a compliance flexibility. Such companies do not have large sales volumes over which to distribute technology development costs and would bear disproportionate compliance burdens in the event that the agencies require compliance with the primary proposed Phase 2 standards. 80 Fed. Reg. at 40,294.

9 More specifically, according to recent SEC filings, one of Autocar's main competitors in 2014 sold 69,750 Class 8 trucks in the U.S. and Canada, had plants in seven countries, had over 23,000 employees and spent \$215 million on research and development. Autocar's other main competitor, which is part of the world's second largest truck maker, sold 57,714 trucks in North America (92% of which had proprietary engines), had plants in 19 countries, employed over 100,000 people and spent \$1.96 billion on research and development.

10 ICCT, June 2009, "Heavy-Duty Vehicle Market Analysis: Vehicle Characteristics & Fuel Use, Manufacturer Market Shares."

11 As currently designed for use in refuse vehicles, hybrid technology captures normally-wasted energy from braking, converting that energy into available power to accelerate or drive the vehicle, thus reducing fuel consumption and emissions. Testing methodologies for this technology must accommodate the braking, load and terrain factors that are integral to measuring the gains derived from hybrid refuse vehicles. Dynamometer testing will not demonstrate actual improvements in GHG emissions and fuel consumption.

12 Lacking vertical integration, a small custom chassis manufacturer has no means by which to test engines or transmissions to obtain the maps and other data needed to run GEM simulations, and in fact may be prohibited from doing so under its contracts with suppliers.

Supplemental comments from Autocar:

In our October 1, 2015 comments, Autocar explained how the Proposed Regulations would adversely affect this small business that already contributes to substantial GHG emissions reduction, because it installs emissions-certified engines and transmissions<sup>1</sup> and sells a high concentration of trucks with compressed natural gas engines and hybrid-drive powertrains. Yet, the EPA's Vocational Custom Chassis Memorandum (the 'Memorandum') and the underlying research set forth in documents included in the agencies' recent Notice of Data Availability (the 'NODA') propose compliance schemes that do not take into account:

- the impact of this complex compliance path on small, low-volume businesses like Autocar;
- the minimal emissions improvements achievable with the proposed technologies;
- the fact that Autocar only builds the chassis, and the body builder and vehicle owner make considerable modifications to the truck before putting it into service, over which Autocar has no control; nor
- the emissions-reduction effect Autocar already contributes by producing alternative-fuel vocational trucks.

For these reasons, Autocar submits these comments to the NODA and the Memorandum and respectfully renews its request for an exemption. [EPA-HQ-OAR-2014-0827-1885-A1 p.2]

**Organization:** California Air Resources Board (CARB)

CARB staff understands the unique nature and uses of emergency vehicles and supports the proposal's provisions to allow emergency vehicles to certify to less stringent standards with reduced compliance procedures than for other vocational vehicles. California Statute and many of CARB staff's in-use regulations similarly have special provisions for emergency vehicles. CARB staff also understands that current idle reduction technologies applicable to the Phase 2 vocational standards may not be sufficient to power all of the on-board electronics required by emergency vehicles. Therefore, CARB supports proposed emergency vehicle standards that do not require the use of specific idle reduction technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.64]

Additionally, because the proposed compliance method for emergency vehicles is simplified compared to that of other Phase 2 vocational vehicles, emergency vehicle manufacturers would not follow the otherwise applicable Phase 2 approach of entering an engine map into GEM. Instead, CARB staff supports the proposed equation-based compliance approach using a Phase 1-style GEM interface with a default engine simulated in GEM is appropriate for the emergency vehicle category. [EPA-HQ-OAR-2014-0827-1265-A1 p.64]

**Organization:** Daimler Trucks North America LLC

**Fire/Emergency Vehicles and RVs** - On 80 Fed. Reg. 40294-5, the agencies propose a scaled-down certification procedure for emergency vehicles and RVs. For applications like firetrucks and RVs, which drive little, spend little time idling, and have small volume production, a simplified compliance is indeed warranted. We recommend that the agencies use the same certification and compliance mechanisms and procedures as for all other vehicles, however, given that manufacturers cannot implement different computer systems for each type of vehicle. Rather, for vehicle applications like RVs, a GEM-based compliance mechanism that ensures compliance for vehicles built with certified engines may suffice. For emergency vehicles, which may need high torque or power or high traction

tires to react to emergencies, even if such needs result in temporarily high fuel consumption, compliance through GEM may simply mean that the vehicle has a fuel map as good as a 2014 fuel map for such emergency vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.75]

**Possible Standards for Other Custom Chassis Manufacturers** - On providing custom chassis manufacturers with additional lead time to comply. 80 FR 40295. DTNA supports providing custom chassis manufacturers with additional lead time to comply as long as the additional lead time is given to all custom chassis manufacturers regardless of sales volumes or any other criteria which would not be in the best interest of fair market competition. [EPA-HQ-OAR-2014-0827-1164-A1 p.75]

**Lower Rolling Resistance Tires** – The agencies proposed discontinuing the option to qualify for the off-road or low speed exemption solely if the vehicle is fitted with tires that have a maximum speed rating at or below 55 mph. 80 FR 40300. DTNA agrees with EPA that the qualifying criteria related to the design and use of the vehicle should be retained. We agree that the speed rating of the tire is not as reliable a factor as the other factors listed, GAWR of 29k lbs or more, speed attainable of not more than 33 mph in two miles, or speed attainable of not more than 45 mph in two miles with unloaded vehicle weight not less than 95% of the GVWR. [EPA-HQ-OAR-2014-0827-1164-A1 p.79]

#### iv. RV & Custom Chassis

· **Possible Standards for Other Custom Chassis Manufacturers (Compliance Procedure)** - The agencies request comment on extending the above simplified compliance procedure and less stringent Phase 2 standards to other custom chassis manufacturer. 80 FR 40294. DTNA does not believe that it is fair or beneficial to the environment to allow simplified compliance procedures and less stringent Phase 2 standards to certain manufacturers based solely on sales volumes. If the technology exists for one manufacturer to meet the standard, then it exists for all manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.100]

· **Possible Standards for Other Custom Chassis Manufacturers (Stringency)** – The agencies request comment on the merits of offering less stringent standards to small volume chassis manufacturers, and seek comment as well as to other factors the agencies should consider to ensure this approach would have unintended consequences for business competing in the vocational vehicle market. 80 FR 40295. DTNA does not believe that it is fair or beneficial to the environment to allow simplified compliance procedures and less stringent Phase 2 standards to certain manufacturers based solely on sales volumes. If the technology exists for one manufacturer to meet the standard, then it exists for all manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.100-101]

· **Possible Standards for Other Custom Chassis Manufacturers (Sales Volume)** – The agencies request comment on an appropriate sales volume to qualify for these possible standards, and also request comment as to whether the sale volume thresholds should be different for different markets. 80 FR 40295. DTNA does not believe that it is fair or beneficial to the environment to allow simplified compliance procedures and less stringent Phase 2 standards to certain manufacturers based solely on sales volumes. If the technology exists for one manufacturer to meet the standard, then it exists for all manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.101]

· **Possible Standards for Other Custom Chassis Manufacturers (Competitiveness)** – The agencies request comment on whether it could adversely affect business competitiveness if custom chassis manufacturers were held to a different standard than commercial chassis manufacturers, and whether the agencies should consider allowing commercial chassis manufacturers competing in the markets to sell a limited number of chassis certified to a less stringent standard. 80 FR 40295. DTNA

believes that having different and less stringent standards would undermine fair market competition. If the technology exists for one manufacturer to meet the standard, then it exists for all manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.101]

- **Possible Standards for Other Custom Chassis Manufacturers (Recreational Vehicles)** - The agencies request comment on whether we should develop separate standards for different vehicle types such as recreational vehicles and buses. 80 FR 40295. DTNA would be supportive of less stringent GHG standards for recreational vehicle products. Applicable technology package considerations should be focused on 6-8 year payback periods based on typical RV duty cycles. Standard-setting technologies for the RVs should be based on a study of the technology currently used in RVs, including a study of RVs' Crr values. All vehicle labeling standards and requirements should be consistent regardless of any specific application allowances or exemption status. The agencies should establish a pathway to certification of vehicles using engines from small manufacturers, allowing the use of a default engine fuel map without penalizing the vehicle manufacturers, until the time that small engine manufacturers have their fuel maps measured and ready for use. [EPA-HQ-OAR-2014-0827-1164-A1 p.101]

- **Possible Standards for Other Custom Chassis Manufacturers (Vehicle Exemption)** – The agencies request comment on how to design a small business vocational vehicle exemption by means of a custom chassis volume exemption and what sales volume would be an appropriate threshold. 80 FR 40295. DTNA does not believe that it is fair or beneficial to the environment to allow simplified compliance procedures and less stringent Phase 2 standards to certain manufacturers based solely on sales volumes. If the technology exists for one manufacturer to meet the standard, then it exists for all manufacturers. [EPA-HQ-OAR-2014-0827-1164-A1 p.101]

- **Custom chassis manufacturer:** what is the definition of a custom chassis manufacturer? What is the cut off in sales? [EPA-HQ-OAR-2014-0827-1164-A1 p.102]

- **Proposed Standards for Emergency Vehicles** – The agencies request comment on whether we should include any market adoption rate of idle reduction technologies for emergency vehicles, as part of the basis for the phase 2 emergency vocational vehicle standard. 80 FR 40162. In regards to adoption rate of idle technologies for emergency vehicles, we believe that the rate will be 0. We do not plan on providing any type of technology of idle reduction until it is demanded or requested by the industry as we do not want to cause any disruptions when the vehicle needs to be operating at 100% in emergency situations. If idle reduction is still necessary it should follow California's heavy duty diesel vehicle idling regulations. [EPA-HQ-OAR-2014-0827-1164-A1 p.102]

- **Proposed Standards for Emergency Vehicles** - The agencies request comment on the merits of using equation-based compliance approach for emergency vehicle manufacturers, similar to the approach proposed for trailer manufacturers. 80 FR 40293. DTNA believes the agencies should continue using GEM as the source emergency vehicle compliance. This will continue to provide a consistent methodology of compliance for all vehicles and not introduce additional complexities that could arise from using the compliance equation. [EPA-HQ-OAR-2014-0827-1164-A1 p.102]

- **Aligning HDV Emergency Vehicles (Fire Trucks) Definition** – The agencies request comment on the merits and drawbacks of aligning the definition of emergency vehicle for purposes of the Phase 2 program with the definition of emergency of the light duty GHG provisions under 40 CFR 86.1818, such as those used by law enforcement. We support the idea of aligning the definition of emergency vehicle as we have the capability of running separate reports using specific data codes to determine the amount of emergency vehicles that have been sold. The second option that we would like



to propose is that the agencies adopt the same definition as defined in 13 CCR 1956.8(a)(6). [EPA-HQ-OAR-2014-0827-1164-A1 p.102]

**Organization:** ABC Bus Companies, Inc.

Proposed Phase 2 Standards and Vocational Vehicles, states that the agencies have held dozens of meetings with manufacturers, suppliers, non-governmental organizations and other stakeholders. As there are only 4 to 6 motorcoach manufacturers that currently supply motorcoaches to the United States, it does not seem that this small group in the 'Vocational Vehicles' category was invited to provide comments related to these proposed changes. As the commodity of the Motorcoach Industry is moving people safely and comfortably, it seems that the majority of the Phase 2 text is geared to moving freight. Passenger carrying vehicles demand additional constraints that will be described further in this document. It is important to have these stakeholders' input regarding the current and past Phase 1 effects, to help determine the future effects of these Phase 2 proposals on this industry segment during the drafting process. The costs of Phase 2 compliance in the Trucking Industry can be divided up between hundreds of thousands of trucks, while there is less ability to absorb such costs for the estimated 1,000 motorcoaches produced annually. It seems that the motorcoach manufacturers will be left to deal with high compliance costs that could have an adverse effect on the Motorcoach Industry as a whole. [EPA-HQ-OAR-2014-0827-1430-A2 p.1]

There should be preemptive language in any new regulations. [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

Many proposed NHTSA motorcoach 'Safety Standards', for example, coach Roll-Over Roof Structure, Passenger Window Glazing, and Fire Protection requirements, etc. are still being drafted and will not be finalized for some years to come. While motorcoach manufacturers are trying to prepare for the implementation of these 'Safety Standards' many proposed Standards in Phase 2 could conflict with the still unknown mandated 'Safety Standards'. AS NHTSA has had so much involvement in the Phase 2 proposals, we could not find where these future mandates were taken into consideration in any of the current NHTSA/EPA proposed rules, or made any allowances for them? [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

ABC Bus Companies note that the Preamble gives examples of Vocational Vehicles including: urban delivery, refuse hauling, utility service, dump, concrete mixing, transit service, shuttle service, school bus, emergency, motor homes, and tow trucks, but no mention of 'over the road' or motorcoach 'line-run', or 'charter' service has been defined. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

**Organization:** GILLIG LLC

The agencies requested comment on extending the simplified compliance procedure and less stringent Phase 2 standards proposed for emergency vehicles to other custom chassis manufacturers. Many of the reasons the agencies used in support of the separate emergency vehicle standard hold true for transit buses: [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

-as technologies to improve powertrain efficiencies become more complex, the compliance burden is disproportionately high for the low volume of transit buses produced. [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

-with our narrow range of product offering, using averaging as a compliance flexibility is limited. [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

-with approximately 1800 transit buses produced annually, GILLIG's ability to spread compliance costs across a large number of vehicles is limited. [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

-transit buses are designed, built and operated very differently than other vocational vehicles such as dump trucks, tow trucks, cement mixers, refuse trucks, etc. making the proposed one size fits all vocational standard inappropriate. [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

The agencies went on to suggest that a possible approach for custom chassis manufactures would be 'predicated on a simpler set of technologies.....most likely lower rolling resistance tires and idle reduction.' [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

In summary, GILLIG would enthusiastically support Agency efforts for a simplified compliance procedure and less stringent Phase 2 standards for transit buses. We would propose a simplified compliance procedure for transit buses, a separate subcategory from other vocational vehicles, similar to the emergency vehicle procedure, based on lower rolling resistance tire and neutral idle technologies. We feel the neutral idle technology more so than the idle reduction technology is applicable to transit buses for reasons mentioned above. GILLIG also requests the agencies to review again the potential business impacts of the currently proposed Phase 2 rule with respect to the certification process, limited compliance flexibility, the burden of compliance and the stockpiling rule as they relate to transit buses. We believe that any one of these parts of the rule could have crippling business consequences for a transit bus manufacturer, its employees and customers. [EPA-HQ-OAR-2014-0827-1156-A1 p.6]

**Organization:** Tiffin Motorhomes, Inc.

## II. Summary of Comments

It is our belief and contention that the EPA and NHTSA should reconsider how the Proposed Regulations might apply to manufacturers such as Tiffin. If the regulations are adopted in their current form, the chassis division of Tiffin does not see a path to compliance for chassis it manufactures. Using Averaging, Banking and Trading provisions are not a feasible alternative for the chassis Tiffin manufactures due to the low volume, and singular purpose of use. Further, the technologies proposed by these rules do not provide a path to compliance even if all proposed technologies are applied. In order to avoid the closing of our chassis production, we respectfully request that motorhomes (1) be exempted from the proposed rules, or (2) that the EPA should establish separate regulations for motorhomes taking into account their uniqueness in both design and use, similar to what the Agency is doing with emergency vehicles. [NHTSA-2014-0132-0099-A1 p.2]

## III. Impact of the economy and cost on the industry

Tiffin, like the motorhome industry as a whole, was hit hard by the recession of 2008 which saw our production drop from 13 motorhomes per day to 3 motorhomes per day. The chassis division suffered a 50% reduction in employment during this time. It was an extreme example of the volatility in the Recreational Vehicle market. As a leisure item with retail costs from \$120,000.00 to \$650,000.00, demand for Tiffin products drops precipitously when the overall economy significantly constricts or slows down. The chassis division returned to its pre-2008 level in 2010, but the instability in the national economy makes the motorhome market as whole somewhat uncertain. Unnecessary regulations, with a high cost of implementation and a low impact on the environment, would add an additional burden on the recovery that the company has experienced. [NHTSA-2014-0132-0099-A1 p.3]

It should also be noted that unlike commercial vehicles motorhomes do not generate income or increase in value. They are generally used only for personal recreational use and are driven less than 5000 miles per year resulting in significantly lower emissions than those produced by commercial vehicles. These factors make the increased cost imposed by these regulations difficult to absorb, and lead to extended payback periods, often beyond 20 years. [NHTSA-2014-0132-0099-A1 p.3]

#### IV. Compliance with the proposed regulations using ABT is not possible or feasible for Tiffin

After a studied reading of the proposed regulations, it is not possible or feasible for Tiffin to meet the proposed 2021, 2024 and 2027 standards using ABT. [NHTSA-2014-0132-0099-A1 p.3]

The ABT provisions are not a viable alternative for Tiffin for two reasons. First and foremost, Tiffin currently manufactures only two chassis models, one classified as a MHO, the other as an HHD. These chassis are produced only for motorhomes, and exclusively for Tiffin. This narrow range of products along with the low production volume provide a much lower level of compliance flexibility under the ABT provisions. The annual production volumes for these chassis are; MHO 300-500 units per year, and HHD 500-700 units per year. [NHTSA-2014-0132-0099-A1 p.3-4]

#### V. Technologies proposed do not provide a path to compliance for Tiffin

The technologies proposed in this rule, if available, and fully implemented, do not achieve compliance under this rule. The chart below shows the potential outcome using the proposed technologies. [NHTSA-2014-0132-0099-A1 p.4]

[Chart can be found on p.4 of docket number NHTSA-2014-0132-0099-A1]

As can be seen in this chart the proposed technologies when applied still leave a deficit to compliance of almost 6%. This assumes that these technologies are available, and provide the proposed benefit. Our low production volumes also provide less opportunity for Tiffin to spread the cost of developing these new technologies across a large number of vehicles. [NHTSA-2014-0132-0099-A1 p.4]

#### VI. Exemption

Tiffin acknowledges the need for new regulations in an effort to reduce GHG emissions. It is our belief that it is appropriate and acceptable for small chassis manufactures to continue with rules similar to those in Phase 1 of Heavy Duty GHG Standards where chassis are manufacture using LRR tirest and compliant engines. We respectfully request and exemption from the remaining regulations proposed in Phase 2 of these standards. [NHTSA-2014-0132-0099-A1 p.5]

#### VII. If not exemption then less stringent standards

If the Agency is not willing to exempt small specialty chassis manufactures from the proposed Phase 2 regulations it is our belief that a less stringent standard is justifiable for these manufactures. We believe a standard similar to what the Agency has done for the Emergency Vehicle industry would be a viable alternative to provide a path to compliance for these manufactures. [NHTSA-2014-0132-0099-A1 p.5]

**Organization:** Newell Coach Corporation

Looking forward, we are very concerned that compliance with the Phase 2 HI-ID vocational vehicles standards could force us out of business since compliance with the standards do not appear to be feasible for manufacturers like Newell who have no opportunity to utilize the agency's averaging, banking and trading (ABT) provisions. In 2024, even if we were to install all the technology available in the GEM model for regional cycle vocational vehicles (e.g., start stop and weight reduction), our chassis would be far from compliant. Stop-start systems would provide very little benefit given our drive cycle at a tremendous cost.

Given the above, we respectfully request an extension of the current SBA exception for small manufacturers. In our view, a continuation of the current exemption for small businesses, if not for all small businesses then at least for motorhome chassis, would be the simplest solution for small companies like ours, and for EPA. However, if the EPA should conclude that a continuation of the SBA exemption for motorhome chassis manufacturers is not appropriate, we believe that companies who annually manufacture 500 or fewer Class 8 - HHD motorhome chassis should be provided the opportunity to certify their chassis to a less stringent standard (similar to that which has been proposed for emergency vehicles). [EPA-HQ-OAR-2014-0827-1319-A1 p.2]

**Organization:** Recreational Vehicle Industry Association (RVIA)

The motorhome industry is relatively unique within the motor vehicle sector. Motorhome vehicle miles traveled (VMT) and production volumes are relatively low, and the fact that these vehicles are for non-commercial use mean there are no recoupment of costs or asset appreciation considerations available. As we will explain in more detail below, the unique nature of these vehicles merits special consideration under the Proposed Rule. [EPA-HQ-OAR-2014-0827-1261-A1 p.3-4]

RVIA's comments also address EPA's request for information on custom chassis manufacturers and recommend both a standard and a volume-based definition for the group, based on EPA precedent. Our response, however, in no way changes our overall view that motorhomes should be exempt as a group or at minimum subject to separate, more feasible standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.4]

In order to understand the unique nature of the motorhome industry and why the Proposed Regulations inflict such disproportionate costs on the sector, it is important to provide some details on the sector.

General categories of motorhomes, prices and volumes

#### i. Motorhomes Types

Motorhomes are typically categorized by type of chassis as Type A, Type B or Type C. [pictures of motorhomes included][EPA-HQ-OAR-2014-0827-1261-A1 p.5]

##### Type A Motorhome

A Type A motorhome is built on a heavy-duty chassis with the engine located either in the rear or the front. Virtually all are built on chassis designed specifically for motorhomes. Type A's fall into the light heavy duty (LHD), medium heavy duty (MHD) or heavy-duty (HHD) vocational vehicle categories and the average retail price is \$180,000 for gasoline powered units, or \$250,000 for a diesel pusher. [EPA-HQ-OAR-2014-0827-1261-A1 p.5]

##### Type B Motorhome

A Type B motorhome is built using a cargo van as the base. Most are built with a modified roof that is high enough to allow occupants to stand up inside. Type B motorhomes fall into the LHD vocational vehicle or work truck categories and the average retail price is \$90,000. [EPA-HQ-OAR-2014-0827-1261-A1 p.5]

#### Type C Motorhome

Type C motorhomes usually use an extended van or pickup truck chassis with an attached cab. The Type C motorhome is known by many people as a “cab-over” motorhome, as most have an area that hangs over the cabin with a mattress for sleeping. Type C motorhomes fall into the LHD, MHD, or HHD vocational vehicle categories and have an average retail price of \$89,000. [EPA-HQ-OAR-2014-0827-1261-A1 p.6]

### **EPA’s proposed regulations are not feasible for motorhomes and the regulations impose unreasonable costs on manufacturers and consumers with little benefit to consumers or the environment**

For a number of reasons, RVIA believes that it would be inappropriate to apply the proposed vocational vehicle standards to motorhomes.<sup>26</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

Compliance is not feasible for most motorhomes, especially when ABT provisions cannot be utilized. Moreover, the costs of compliance for motorhomes greatly exceed benefits to the environment and consumers. In fact, the Proposed Rules will have significant negative impacts on consumers, motorhome production, and American jobs.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

#### a. Compliance is not feasible for most motorhomes

For motorhome chassis manufacturers, based on *EPA's Own analysis*, compliance with the proposed vocational vehicle standards is not feasible in many instances. RVIA carried out a compliance assessment for all motorhome types against the proposed Alternative 3 regional vocational vehicle compliance standards for 2021, 2024, and 2027.<sup>28</sup> The results of this assessment are contained in Appendix B to this submission. The table below summarizes the results of the assessment, with red shading to indicate where compliance is not feasible based on EPA's own data. It shows the following: [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

- Compliance with the proposed 2027 standards is not feasible for any category of motorhomes
- Compliance with the proposed 2024 standards is not feasible for LHD gas motorhomes, MHD diesel motorhomes, and HHD diesel motorhomes. Only LHD diesel and MHD gas motorhomes could theoretically meet the required improvements commercially or economically available to manufacturers.
- Compliance with the proposed 2021 standards is not feasible for LHD and MHD diesel motorhomes. Only LHD and MHD gas and HHD diesel motorhomes could theoretically meet the required improvements. [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

[Chart, feasible versus needed GHG reductions for motorhomes, can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

ABT provisions will not address the compliance feasibility problem for most motorhome chassis manufacturers. Most manufacturers will not be able to average costs and credits across their own fleets and would be forced to purchase credits corresponding to the relevant vocational vehicle weight groups

elsewhere. However, credits will be limited and expensive and may not even be available. As set forth above, the pool of chassis manufacturers is quite small and the motorhome market is very limited. There are some motorhome chassis manufacturers that serve primarily the motorhome industry and they have no opportunity to utilize the ABT provisions through averaging. There are some motorhome chassis manufacturers that serve only the motorhome industry as well as otherwise exempt segments (e.g., emergency vehicle and military segments). They also have no opportunity to utilize the averaging provisions of ABT. Both categories would have no choice but to compete for a limited pool of credits that might be available from manufacturers of larger fleets, assuming such credits are available. Significantly, EPA has made no analysis of the availability or price of such credits so cannot simply rely on the expectation that such provisions would be available and at a reasonable cost. It is EPA's burden to show its regulations impose reasonable costs. The significant cost numbers we provide below, for example, do not even begin to include the potential costs of buying credits on the market. [EPA-HQ-OAR-2014-0827-1261-A1 p.16-17]

There are also some chassis manufacturers that serve not only the motorhome industry but also multiple truck industry segments and are part of larger entities with larger fleets. These manufacturers are unlikely to utilize ABT to take care of motorhomes as doing so would increase the cost of chassis sold to more important, larger and significantly more profitable business segments. Thus, for many manufacturers of motorhome chassis, compliance with the Proposed Rules would hurt their ability to compete in the more important, larger and more profitable segments that they rely on for the bulk of their revenue. [EPA-HQ-OAR-2014-0827-1261-A1 p.17]

Moreover, it is our understanding that most vocational vehicle manufacturers will face their own difficulties meeting the standards set by EPA, at least without significant changes to EPA's GEM model for vocational vehicles. Given these circumstances, there may very well be no credits available for ABT either within the larger manufacturers' fleets or from other regulated parties. Again, EPA has provided no analysis of the availability of credits for averaging or trading within and among these manufacturers, and simply assumes, without data, that such options will be available at reasonable cost. This kind of assumption is insufficient to support the outcomes that would result with this rulemaking. [EPA-HQ-OAR-2014-0827-1261-A1 p.17]

## **VII. If not exempt entirely, EPA should establish separate standards for motorhomes**

In the event EPA concludes that it will not exempt motorhomes entirely to maintain harmonization with the NHTSA exemption, *see* earlier discussion above in section IV, it is fair and reasonable that separate and more feasible standards for motorhomes be established. Proposed standards are not feasible for motorhome chassis manufacturers, as these entities are generally not in a position to utilize ABT to meet the standards and the technologies are not cost-effective. For LHD motorhomes, we support adopting only the 2021MY LHD vocational vehicle standards and maintaining those standards through 2027. For MHD and HHD motorhomes, the adoption of standards that would only require MHD and HHD motorhomes to be equipped with more efficient engines and tires could be adopted. As discussed by EPA in the Proposed Rules, standards based on improved transmissions for MHD and HHD vocational vehicles/motorhomes would not be feasible since the engine and transmission are manufactured by non-integrated manufacturers. [EPA-HQ-OAR-2014-0827-1261-A1 p.23]

Complying with standards based on the above recommendations in lieu of those proposed would reduce the incremental per vehicle cost of compliance by approximately 75% and this would reduce if not eliminate the negative economic impacts seen in the four scenario analysis discussed in the previous section. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

## VIII. Custom chassis manufacturer exemption

EPA has requested comment on whether “customs chassis manufacturers,” like emergency vehicles, should be exempt from some of the Proposed Rules and how that term should be defined. While we believe that an exemption is appropriate for all motorhomes, or at minimum, separate standards, we will provide some information in response to this request. However, RVIA strongly urges EPA not to take the position that a custom chassis manufacturer exemption will resolve all the issues RVIA has raised in this submission. While custom chassis manufacturers do deserve some special consideration, especially since they particularly cannot use ABT provisions to meet infeasible standards or the costs of the Proposed Rule, this does not mean other motorhome chassis manufacturers do not merit separate and more achievable standards. This is especially true since these other motorhome chassis manufacturers are also unlikely to be able to use ABT to solve their non-compliance problems due to the fact that most other vocational vehicles that might generate credits for motorhome chassis manufacturers are also unable to comply under the GEMS program. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

With the above qualifications in mind, RVIA would support a standard for custom chassis manufacturers that would be solely based on fitting vehicles with more efficient engines and tires. This is similar to that proposed for emergency vehicles. This would allow feasible and reasonable technologies to be applied to reduce emissions rather than fully exempting customs chassis manufacturers from all standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

To reduce the potential for such a provision providing some smaller manufacturers with a competitive advantage, RVIA proposes that all manufacturers, regardless of size, have the opportunity to certify a motorhome chassis to the custom chassis manufacturer standards up to a specified volume threshold. We suggest the following thresholds: [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

1,000 LHD (class 2b-5) motorhome chassis

1,000 MHD (class 6-7) motorhome chassis

2,500 HHD (class 8) motorhome chassis

We note that such a definition is consistent with prior EPA practice. EPA permits small volume test groups to be certified as if they were small volume manufacturer test groups. *See* 40 C.F.R. § 86.183801 (Small volume manufacturer certification procedures). [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

The same logic should apply to large, multi-vehicle manufacturers who only produce low volumes of chassis designed exclusively for use in the motorhome industry. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

EPA and NHTSA should recognize the unique nature of the motorhome sector, including its exceptional cost-sensitivity, low mileage and low production of its vehicles, and its inability to absorb significant and cumulative regulatory costs. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

Given these costs, which exceed any benefits, EPA should put motorhomes in a category separate from other vocational vehicles. If they are not exempt, they should be subject to a different and more feasible set of regulations which impose more reasonable costs. Such standards could be: [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

-For LDH motorhomes, EPA should adopt only the MY 2021 LHD vocational vehicle standards and continue them through MY 2027. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

-For MHD and HHD motorhomes, EPA should require only more efficient engines and tires. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

Custom chassis manufactures merit special recognition given their low volumes and inability to average vehicles across fleets or otherwise make economic use of the ABT provisions. These vehicles should only be required to use more efficient engines and tires. Customs chassis should be defined by volume of production set forth in section VIII to avoid unintended competitive harms, in accordance with EPA precedent. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

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<sup>26</sup> RVIA does not assert that motorhomes belong in a separate regulatory category other than vocational, but that, if regulated, it should have its own separate standards within the vocational group, just as emergency vehicles are regulated separately.

<sup>27</sup> The analysis below only focuses on Alternative 3 as presented in the Proposed Rules. Alternative 4 would be even more problematic, but for purposes of these comments, was not modeled.

<sup>28</sup> Clearly, if requirements under Alternative 3 are not feasible, imposition of Alternative 4 would be even less feasible.

**Organization:** Recreational Vehicle Industry Association (RVIA)

The motorhome industry is relatively unique within the motor vehicle sector. Motorhome vehicle miles traveled (VMT) and production volumes are relatively low, and the fact that these vehicles are for non-commercial use mean there are no recoupment of costs or asset appreciation considerations available. As we will explain in more detail below, the unique nature of these vehicles merits special consideration under the Proposed Rule. [EPA-HQ-OAR-2014-0827-1261-A1 p.3-4]

RVIA's comments also address EPA's request for information on custom chassis manufacturers and recommend both a standard and a volume-based definition for the group, based on EPA precedent. Our response, however, in no way changes our overall view that motorhomes should be exempt as a group or at minimum subject to separate, more feasible standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.4]

In order to understand the unique nature of the motorhome industry and why the Proposed Regulations inflict such disproportionate costs on the sector, it is important to provide some details on the sector.

General categories of motorhomes, prices and volumes

i. Motorhomes Types

Motorhomes are typically categorized by type of chassis as Type A, Type B or Type C. [pictures of motorhomes included][EPA-HQ-OAR-2014-0827-1261-A1 p.5]

Type A Motorhome



A Type A motorhome is built on a heavy-duty chassis with the engine located either in the rear or the front. Virtually all are built on chassis designed specifically for motorhomes. Type A's fall into the light heavy duty (LHD), medium heavy duty (MHD) or heavy-duty (HHD) vocational vehicle categories and the average retail price is \$180,000 for gasoline powered units, or \$250,000 for a diesel pusher. [EPA-HQ-OAR-2014-0827-1261-A1 p.5]

#### Type B Motorhome

A Type B motorhome is built using a cargo van as the base. Most are built with a modified roof that is high enough to allow occupants to stand up inside. Type B motorhomes fall into the LHD vocational vehicle or work truck categories and the average retail price is \$90,000. [EPA-HQ-OAR-2014-0827-1261-A1 p.5]

#### Type C Motorhome

Type C motorhomes usually use an extended van or pickup truck chassis with an attached cab. The Type C motorhome is known by many people as a "cab-over" motorhome, as most have an area that hangs over the cabin with a mattress for sleeping. Type C motorhomes fall into the LHD, MHD, or HHD vocational vehicle categories and have an average retail price of \$89,000. [EPA-HQ-OAR-2014-0827-1261-A1 p.6]

### **EPA's proposed regulations are not feasible for motorhomes and the regulations impose unreasonable costs on manufacturers and consumers with little benefit to consumers or the environment**

For a number of reasons, RVIA believes that it would be inappropriate to apply the proposed vocational vehicle standards to motorhomes.<sup>26</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

Compliance is not feasible for most motorhomes, especially when ABT provisions cannot be utilized. Moreover, the costs of compliance for motorhomes greatly exceed benefits to the environment and consumers. In fact, the Proposed Rules will have significant negative impacts on consumers, motorhome production, and American jobs.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

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- Compliance with the proposed 2027 standards is not feasible for any category of motorhomes
- Compliance with the proposed 2024 standards is not feasible for LHD gas motorhomes, MHD diesel motorhomes, and HHD diesel motorhomes. Only LHD diesel and MHD gas motorhomes could theoretically meet the required improvements commercially or economically available to manufacturers.

- Compliance with the proposed 2021 standards is not feasible for LHD and MHD diesel motorhomes. Only LHD and MHD gas and HHD diesel motorhomes could theoretically meet the required improvements. [EPA-HQ-OAR-2014-0827-1261-A1 p.15]

[Chart, feasible versus needed GHG reductions for motorhomes, can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

ABT provisions will not address the compliance feasibility problem for most motorhome chassis manufacturers. Most manufacturers will not be able to average costs and credits across their own fleets and would be forced to purchase credits corresponding to the relevant vocational vehicle weight groups elsewhere. However, credits will be limited and expensive and may not even be available. As set forth above, the pool of chassis manufacturers is quite small and the motorhome market is very limited. There are some motorhome chassis manufacturers that serve primarily the motorhome industry and they have no opportunity to utilize the ABT provisions through averaging. There are some motorhome chassis manufacturers that serve only the motorhome industry as well as otherwise exempt segments (e.g., emergency vehicle and military segments). They also have no opportunity to utilize the averaging provisions of ABT. Both categories would have no choice but to compete for a limited pool of credits that might be available from manufacturers of larger fleets, assuming such credits are available. Significantly, EPA has made no analysis of the availability or price of such credits so cannot simply rely on the expectation that such provisions would be available and at a reasonable cost. It is EPA's burden to show its regulations impose reasonable costs. The significant cost numbers we provide below, for example, do not even begin to include the potential costs of buying credits on the market. [EPA-HQ-OAR-2014-0827-1261-A1 p.16-17]

There are also some chassis manufacturers that serve not only the motorhome industry but also multiple truck industry segments and are part of larger entities with larger fleets. These manufacturers are unlikely to utilize ABT to take care of motorhomes as doing so would increase the cost of chassis sold to more important, larger and significantly more profitable business segments. Thus, for many manufacturers of motorhome chassis, compliance with the Proposed Rules would hurt their ability to compete in the more important, larger and more profitable segments that they rely on for the bulk of their revenue. [EPA-HQ-OAR-2014-0827-1261-A1 p.17]

Moreover, it is our understanding that most vocational vehicle manufacturers will face their own difficulties meeting the standards set by EPA, at least without significant changes to EPA's GEM model for vocational vehicles. Given these circumstances, there may very well be no credits available for ABT either within the larger manufacturers' fleets or from other regulated parties. Again, EPA has provided no analysis of the availability of credits for averaging or trading within and among these manufacturers, and simply assumes, without data, that such options will be available at reasonable cost. This kind of assumption is insufficient to support the outcomes that would result with this rulemaking. [EPA-HQ-OAR-2014-0827-1261-A1 p.17]

## **VII. If not exempt entirely, EPA should establish separate standards for motorhomes**

In the event EPA concludes that it will not exempt motorhomes entirely to maintain harmonization with the NHTSA exemption, *see* earlier discussion above in section IV, it is fair and reasonable that separate and more feasible standards for motorhomes be established. Proposed standards are not feasible for motorhome chassis manufacturers, as these entities are generally not in a position to utilize ABT to meet the standards and the technologies are not cost-effective. For LHD motorhomes, we support adopting only the 2021MY LHD vocational vehicle standards and maintaining those standards through 2027. For MHD and HHD motorhomes, the adoption of standards that would only require MHD and HHD

motorhomes to be equipped with more efficient engines and tires could be adopted. As discussed by EPA in the Proposed Rules, standards based on improved transmissions for MHD and HHD vocational vehicles/motorhomes would not be feasible since the engine and transmission are manufactured by non-integrated manufacturers. [EPA-HQ-OAR-2014-0827-1261-A1 p.23]

Complying with standards based on the above recommendations in lieu of those proposed would reduce the incremental per vehicle cost of compliance by approximately 75% and this would reduce if not eliminate the negative economic impacts seen in the four scenario analysis discussed in the previous section. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

### **VIII. Custom chassis manufacturer exemption**

EPA has requested comment on whether “customs chassis manufacturers,” like emergency vehicles, should be exempt from some of the Proposed Rules and how that term should be defined. While we believe that an exemption is appropriate for all motorhomes, or at minimum, separate standards, we will provide some information in response to this request. However, RVIA strongly urges EPA not to take the position that a custom chassis manufacturer exemption will resolve all the issues RVIA has raised in this submission. While custom chassis manufacturers do deserve some special consideration, especially since they particularly cannot use ABT provisions to meet infeasible standards or the costs of the Proposed Rule, this does not mean other motorhome chassis manufacturers do not merit separate and more achievable standards. This is especially true since these other motorhome chassis manufacturers are also unlikely to be able to use ABT to solve their non-compliance problems due to the fact that most other vocational vehicles that might generate credits for motorhome chassis manufacturers are also unable to comply under the GEMS program. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

With the above qualifications in mind, RVIA would support a standard for custom chassis manufacturers that would be solely based on fitting vehicles with more efficient engines and tires. This is similar to that proposed for emergency vehicles. This would allow feasible and reasonable technologies to be applied to reduce emissions rather than fully exempting customs chassis manufacturers from all standards. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

To reduce the potential for such a provision providing some smaller manufacturers with a competitive advantage, RVIA proposes that all manufacturers, regardless of size, have the opportunity to certify a motorhome chassis to the custom chassis manufacturer standards up to a specified volume threshold. We suggest the following thresholds: [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

1,000 LHD (class 2b-5) motorhome chassis

1,000 MHD (class 6-7) motorhome chassis

2,500 HHD (class 8) motorhome chassis

We note that such a definition is consistent with prior EPA practice. EPA permits small volume test groups to be certified as if they were small volume manufacturer test groups. *See* 40 C.F.R. § 86.183801 (Small volume manufacturer certification procedures). [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

The same logic should apply to large, multi-vehicle manufacturers who only produce low volumes of chassis designed exclusively for use in the motorhome industry. [EPA-HQ-OAR-2014-0827-1261-A1 p.24]

EPA and NHTSA should recognize the unique nature of the motorhome sector, including its exceptional cost-sensitivity, low mileage and low production of its vehicles, and its inability to absorb significant and cumulative regulatory costs. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

Given these costs, which exceed any benefits, EPA should put motorhomes in a category separate from other vocational vehicles. If they are not exempt, they should be subject to a different and more feasible set of regulations which impose more reasonable costs. Such standards could be: [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

-For LDH motorhomes, EPA should adopt only the MY 2021 LHD vocational vehicle standards and continue them through MY 2027. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

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Custom chassis manufactures merit special recognition given their low volumes and inability to average vehicles across fleets or otherwise make economic use of the ABT provisions. These vehicles should only be required to use more efficient engines and tires. Customs chassis should be defined by volume of production set forth in section VIII to avoid unintended competitive harms, in accordance with EPA precedent. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

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<sup>26</sup> RVIA does not assert that motorhomes belong in a separate regulatory category other than vocational, but that, if regulated, it should have its own separate standards within the vocational group, just as emergency vehicles are regulated separately.

<sup>27</sup> The analysis below only focuses on Alternative 3 as presented in the Proposed Rules. Alternative 4 would be even more problematic, but for purposes of these comments, was not modeled.

<sup>28</sup> Clearly, if requirements under Alternative 3 are not feasible, imposition of Alternative 4 would be even less feasible.

**Response:**

The agencies' responses to comments related specifically to companies meeting the definition of small business under SBA regulations are addressed in Section 15.4 of this response to comments document.

As was mentioned above in Section 6.2.3, use of simplified GEM as an optional certification tool can be justified in cases where either the typical duty cycle of the vocational application is poorly represented by any of the three final test cycles; where we find that the default GEM vehicle characteristics are so different from real world characteristics (for example engine power to vehicle weight ratio) that use of full GEM with active simulation of actual driveline parameters would not reasonably test the effectiveness of applied technologies; and where the certifying manufacturer produces small volumes of vocational chassis using a non-integrated business model where driveline optimization is not feasible and other transmission improvements would either be ineffective or not cost-effective.

Upon careful consideration of all the comments related to vocational vehicle chassis manufacturers who produce small volumes of specialized or non-diversified products, we are adopting optional standards

for seven applications of vocational vehicles that we are calling custom chassis. Although this issue has some implications for our consideration of small business concerns, the custom chassis provisions discussed in the proposal were not intended to be limited to small businesses, and are not so limited in the final rules.

Discussions with representatives on our Small Business Advocacy Review Panel included exploration of a low volume production threshold below which some manufacturers may avoid some obligations of this regulation. Consistent with the recommendations of the Panel, the agencies requested comment on how to design a small business vocational vehicle program, including comments on a possible small volume threshold below which some small business exemption may be available.<sup>195</sup> Some commenters addressing this issue supported a small volume threshold for small businesses of either 200 vehicles per year, or a different threshold set based on the market share of the entity, or other low-volume thresholds ranging as high as 26,000 vehicles per year. We received adverse comment from Daimler stating it would be unfair to make less stringent standards available solely on the basis of sales volume, because if a technology exists for one manufacturer, it is available to all manufacturers. We received adverse comment from OshKosh that less stringent regulations on a limited production volume stifles a custom chassis manufacturers' opportunity to grow their business.

Upon consideration of these comments, the agencies are not finalizing a broad sales volume threshold below which a vocational chassis manufacturer may certify under the optional standards. Instead we are adopting an optional custom chassis program that is available to businesses of all sizes and production volumes. In addition to the flexibilities described in Section 15.4, the custom chassis program includes some flexibilities for small businesses that will not be available to large manufacturers. Specifically, we are permitting small businesses to use credits generated in the primary program as part of a custom chassis compliance plan, and we are permitting small businesses that manufacture drayage tractors to certify a small number of these vehicles each year to the custom chassis standards otherwise applicable to transit buses. See Section V.C.3 of the Preamble.

In response to the comment requesting clarification on our reasons for adopting a non-GEM design standard option for motor homes, cement mixers, and emergency vehicle chassis, this is because we have determined these vehicles to have the least number of feasible technologies that can be applied in Phase 2. Emergency vehicles and concrete mixers have been determined by the agencies to essentially need only to apply low rolling resistance tires in addition to certified engines and low leakage air conditioning. Motor homes have been determined to apply these technologies as well as tire pressure systems. We generally agree with the commenters from the motor home sector that there are very few technologies likely to prove cost-effective for these vehicles, given the typically low miles traveled by these vehicles. See Section 6.3.7 above for more details on why we conclude that tire pressure systems are feasible. Where a manufacturer of these vehicles is able to apply the same technology on all of its production without averaging, we offer the non-GEM option as a compliance flexibility to avoid some of the certification burden associated with running GEM. We were unable to identify other custom chassis technology packages that we believed could be applied at 100 percent adoption rate; thus, averaging (and use of GEM) was deemed necessary for other vehicles.

In response to the comment with concerns about the custom chassis program assuming a single weight class for each vehicle type, we have concluded this simplification is valid for preventing stranded averaging sets and easing the compliance burden for low-volume manufacturers.<sup>196</sup> We fully expect manufacturers to continue producing vehicles in varying weight classes as demanded by the market. The regulatory simplification does not mean that custom chassis vehicles actually must be produced at

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<sup>195</sup> See proposed rules at 80 FR 40295, July 13, 2015.

<sup>196</sup> Averaging sets for custom chassis include all weight classes of a single custom chassis subcategory.

the weight corresponding to the assumed regulatory category. For example, a manufacturer may produce 100 motor homes where 90 are MHD and 10 are HHD. All of these may be simulated as MHD in GEM and comprise one averaging set, and credits for purposes of averaging will be calculated according to the actual vehicle-level regulatory useful life. The actual engines used in these vehicles will separately be certified to the applicable engine standard. See Section 6.5 for responses to comments on certification of custom chassis, and see Section V.D of the Preamble for more discussion of this process.

#### **6.4.2 Off-Road/Low Speed Vehicles**

**Organization:** Clarke Power Services

*1031.631 Exemption of vocational vehicles intended for off-road use:* The chassis of vehicles in the vocational industries in general and the off-road vehicles take a tremendous amount of load and torque (twisting). This kind of use guarantees that the chassis will be worn out prior to the modifications that were used to prepare the vehicle to be a vocational truck. The work box, crane, hydraulic lifts, etc. that are required in the vocational application are expensive and are transferred to the next chassis. When the replacement chassis is a Glider, then this commenter believes that the flexibility should be granted with regard to the engine choice. This commenter recommends that one sentence should be struck from 1031.631; that sentence being “This section does not exempt engines used in vehicles from the standards of 40 CFR part 86 or part 1036” atop of page 40655. Striking this sentence will give maximum flexibility once the agencies realize the vocational equipment being described may be older than MY 2014. [EPA-HQ-OAR-2014-0827-1005-A1 p.5]

**Organization:** Rubber Manufacturers Association (RMA)

#### **The Agencies Should Continue to Exempt Vehicles Equipped with Tires with a Maximum Speed Rating at or Below 55 mph**

In the Phase 1 rulemaking, EPA exempted a vehicle based solely on the use of tires with a maximum speed rating at or below 55 mph (“speed restricted tires”). In the Phase 2 NPRM, the agencies are proposing to eliminate this exemption because “the agencies are concerned that tires are so easily replaced that this would be an unreliable way to identify vehicles that truly need special consideration.” 80 Fed. Reg. at 40295. While RMA recognizes the concern that the agencies express in eliminating this exemption, RMA believes that the speed restricted tires merit special consideration. [EPA-HQ-OAR-2014-0827-1304-A1 p.15] [EPA-HQ-OAR-2014-0827-1933-A1 p.2]

These tires typically are designed to achieve tire performances such as high load carrying capacity and durability that are specific to the vehicles on which they are installed, which often are used in off-road applications. A tire that is appropriate for use on a vehicle used for off-road applications would not see a meaningful fuel consumption benefit due to the use of low rolling resistance tires due to its typical drive cycle at low speeds on aggressive terrain. A speed restricted tire would not be suitable for use on a vehicle that does not specify these tires. The concern that this type of tire could be installed on a vehicle that otherwise does not require these tires is not founded, since speed restricted tires would not perform appropriately on other types of vehicles. For example, if a speed restricted tire were installed on a vehicle that is used in highway applications, the integrity of the tire would be impaired at highway speeds, and the operator of the vehicle would not be satisfied with its performance. [EPA-HQ-OAR-2014-0827-1304-A1 p.15] [EPA-HQ-OAR-2014-0827-1933-A1 p.2]

OEMs specify the vehicle's service and application and comply with the tire and wheel selection requirements of FMVSS 120, and, per FMVSS 119, such tires are marked with "Max. speed\_\_ km/h (\_\_ mph)," e.g. 55 mph (90 km/h), 50 mph (80 km/h), 35 mph (56 km/h). An exemption for tires speed-restricted at or below 55 mph is still appropriate, as such tires are designed for off-road applications or on-road 20%/off-road 80% applications. Such vehicles are generally governed or speed restricted by the vehicle manufacturers, e.g. OEMs. Subsequent changes to tires for higher operating vehicle speed ratings will result in generally larger tires for load capacities, and/or tire designs not appropriate for the off-road application and incidental highway transport. [EPA-HQ-OAR-2014-0827-1304-A1 p.15] [EPA-HQ-OAR-2014-0827-1933-A1 p.2]

Rather than discontinuing the exemption adopted in Phase 1 of this regulation for vocational vehicles with tires restricted to 55 mph (90 km/h), EPA/DOT should continue this exemption, as well as consider adding a GEM input option to exempt on/off road vehicles and their tires. Again, such tires are marked in accordance with the FMVSS 119 tire safety requirements. [EPA-HQ-OAR-2014-0827-1304-A1 p.16] [EPA-HQ-OAR-2014-0827-1933-A1 p.3]

Examples of such on/off road vehicles include:

Mobile Crane "DOT" vehicles with DOT tires and loads adjusted for maximum speed 55 mph that are greater than highway/vocational truck tires rated @  $\geq$  62 mph (100 km/h). Low bed or high cube trailers requiring high load capacities at lower speed ratings, e.g.  $\leq$  55 mph. Mining and Logging "ML" tires (e.g. TRA 10.00-20 ML) @ maximum speed 50 mph (80 km/h) @ intermittent highway service (maximum 50 miles (80 km) in any 1-1/2 hour period) [EPA-HQ-OAR-2014-0827-1304-A1 p.16]

RMA appreciates the opportunity to review the GEM P2v2.1 summary. RMA continues to support the exemption of certain vocational vehicles from the subject regulations. [EPA-HQ-OAR-2014-0827-1933-A1 p.2]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The agencies should restore an exemption from the Phase 1 Standards for vehicles equipped with speed-rated tires. Vehicles equipped with speed-rated tires operate more like nonroad vehicles than heavy-duty on-highway vehicles. In that regard, speed-rated tires are typically large and do not have assigned rolling resistance values. Consequently, inasmuch as those vehicles are not equipped or designed for efficient on-highway operation, they should not be regulated as if there were. [EPA-HQ-OAR-2014-0827-1269-A1 p.47]

**Organization:** Daimler Trucks North America LLC

**Off-Road and Low Speed Vocational Exemptions** – The agencies request comment on the proposed revisions to the off-road and low-speed vocational vehicle categories, including whether the rated speed of the tires should be retained, and whether vehicles intended to be covered by the provision have characteristics that are captured by the proposed criteria. 80 FR 40545. DTNA agrees with EPA that the qualifying criteria related to the design and use of the vehicle should be retained. We agree that the speed rating of the tire is not as reliable a factor as the other factors listed, GAWR of 29k lbs or more, speed attainable of not more than 33 mph in two miles, or speed attainable of not more than 45 mph in two miles with unloaded vehicle weight not less than 95% of the GVWR. [EPA-HQ-OAR-2014-0827-1164-A1 p.32-33]

**Organization:** Terex Corporation

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 105.]

My final comment number four is regarding page 40186. It says that six by six and eight by eight vehicle configurations are only manufactured for specialized vehicles that require extra traction for off road applications. They are very low volume sales, and their increased fuel consumption and CO2 emissions are not significant in comparison to the overall reductions of the Phase 2 program.

Therefore, Terex suggests that vehicles with six by six and eight by eight configurations must be added to the last of exemptions under the proposed 1037.635(b) concerning glider kits. Because these vehicles operate off road, they are far more susceptible to wear and tear type frame damage that is premature compared to the engines that were designed to operate for a million miles. For this reason, glidering six by six and eight by eight vehicles is and has always been common industry practice, even before the arrival of after treatment systems on diesel engines.

**Organization:** Innovus Enterprise LLC

***§ 1037.631 Exemption for vocational vehicles intended for off-road use.***

Page 40521, Paragraph (2) *Off-Road Exclusion Petition Process*...outlines the spirit and intent of the Off-Road Exclusion by stating: “An exemption was warranted because these vehicles operate in a manner essentially making them incompatible with fuel saving and emission reduction technologies, such as performing work in an off-road environment, being speed restricted, or having off-road components or other features making them incompatible for roadways.” While we totally agree with this line of thinking and rational, we do not think the spirit and intent of this exemption is sufficiently captured in the proposed paragraph §1037.631(a) Qualifying criteria. [EPA-HQ-OAR-2014-0827-1116-A1 p.6]

The original wording in this section had two qualifying criteria, (a)(1) and (a)(2) either of which were qualifying factors alone. However the original (a)(1) for 55mph speed rated tires is being deleted evidently because tires can be changed out afterwards. This makes sense to us as well. However, that leaves a much narrower criteria which would now require both the new (a)(1) and new (a)(2) in order to qualify. This dismisses many other potential heavy-duty vocational vehicles designed for off-road use which meet the spirit and intent and rational for this exemption. [EPA-HQ-OAR-2014-0827-1116-A1 p.6]

Looking closer at the proposed/new (a)(1). This is good criteria and almost verbatim with the spirit and intent for this exemption. It covers the mandate for off-road environment, installed components and features making them unsuitable for normal highway operations. [EPA-HQ-OAR-2014-0827-1116-A1 p.6]

The criteria in the new proposed (a)(2) would drive this entire exemption to a vehicle with a GAWR at or above 29000; or vehicle’s speed limited to 33 mph or 45 mph. The axle rating is by no means by itself a rational criteria for this exemption other than the fact it is just an extraction from the definition of *heavy duty off-road vehicle* in 49 CFR 523.2 (2)(ii)(A). It appears as if the wording for this exemption was based on this same definition as the speed limitation criteria is also the same. We must also note: the definition for heavy duty off-road vehicle in 49 CFR 523.2 also contains the single criteria factor of 55 mph speed limited tires. With this, it is rational to believe the 33 mph or 45 mph specific speed limitation was never intended to be a determining factor alone for criteria in the heavy-duty off-road vehicle definition. It is also rational to believe a vehicle’s capability to employ fuel saving



measures or emission reduction technologies was not part of the determining factor when this heavy-duty off-road vehicle definition was scripted. [EPA-HQ-OAR-2014-0827-1116-A1 p.6-7]

*Innovus Enterprise LLC Suggestion: § 1037.631(a) Qualifying criteria.* Change the sentence referring to the criteria of paragraph (a)(1) and criteria of paragraph (a)(2) to read “or” instead of “and” as defining criteria. [EPA-HQ-OAR-2014-0827-1116-A1 p.7]

*Rational:* This off-road vocational vehicle exemption makes total sense if in application the basis for having it is adequately portrayed and executable in the regulations. Continuing with the proposed criteria which includes elements of no logical affect with respect to the spirit and intent of the rule (GAWR) or limiting it to criteria originally designed for a definition of little relevance to the main arguments for this exemption (capability for fuel savings/emissions reduction) detracts from the hard work many public and private individuals have put into developing this ruling as well as those small business’ who could potentially be slighted. [EPA-HQ-OAR-2014-0827-1116-A1 p.7]

**Organization:** Autocar, LLC

Autocar’s products are of a particular vehicle type (low-speed, frequent-stop, stationary-application trucks) that will not produce the environmental benefits intended by the proposed technologies, beyond the use of an emissions-compliant engine.[EPA-HQ-OAR-2014-0827-1233-A1 p.2]

The exceptions granted should impose less stringent standards. Some of the proposed GHG and fuel saving technologies are feasible for Low-speed/Frequent-stop Vehicles, and some are not. All manufacturers should install compliant engines, so long as they are made available by engine manufacturers. Synthetic axle lubricant is also within reach currently. Also, advances can be made in reducing the leak rate of refrigerant from A/C systems. All of these technologies should be required at reasonable levels with appropriate lead times for development in connection with Low-speed/Frequent-stop Vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.14-15]

### **The Types of Vehicles Autocar Assembles Should be Exempt on the Same Basis as Special Purpose Tractors and Off-Road/Low-Speed Vocational Vehicles.**

Autocar’s products are similar to other exempt vehicles. Autocar proposes an exemption from Phase 1 and Phase 2 compliance for vocational vehicles designed to travel at low speeds, stop frequently and conduct core functions from a power take-off (“PTO”) (referred to herein as “Low-speed/Frequent-stop Vehicles”),<sup>2</sup> for the same reasons the agencies exempted special purpose tractors and off-road/low-speed vocational vehicles in proposed §1037.630 and §1037.631.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1233-A1 p.7]

2.2 Low-speed/Frequent-stop Vehicles have a unique design and purpose. Like the exempted special purpose tractors and off-road/low-speed vocational vehicles, Low-speed/Frequent-stop Vehicles are designed to operate at low speeds, and infrequently achieve highway speeds. They operate in one or more of the following states: (A) low-speed, as in the case of street sweepers; (B) stationary, as in the case of concrete pumpers and conveyers; or (C) continuous stop-and-start, as in the case of refuse collection trucks. The chassis of these vehicles are designed to support these severe operational cycles demanding low speed, stationary power or frequent stops. [EPA-HQ-OAR-2014-0827-1233-A1 p.7-8]

2.3 Low-speed/Frequent-stop Vehicles have unique duty cycles. A refuse truck spends most of its time in collection mode, moving at low speeds from house to house or dumpster to dumpster and emptying trash receptacles into the refuse bin of the truck. It is common for a residential refuse truck to make 800-1,000 (and as many as 1,500) pick-ups in a day. A refuse truck typically only operates at highway

speeds on its way to and from its pickup route, and to and from a transfer station or landfill. The truck often has to run its PTO to activate hydraulic lifting arms to dump refuse containers into the bin, or a packer blade to compact the trash in the bin. The truck stops while waste is being loaded. Compaction can occur while the truck is stationary or moving. [EPA-HQ-OAR-2014-0827-1233-A1 p.8]

Similarly, a street sweeper spends most of its time in sweeper mode, moves at low speeds while removing debris from the street, and makes numerous turns and stops due to debris patterns, traffic and other obstructions. Again, a sweeper typically only operates at highway speeds on its way to and from its sweeping route. The operating conditions for Low-speed/Frequent-stop Vehicles necessitate the use of the lower gears of automatic transmissions and often axle ratios of 5.29 or higher. [EPA-HQ-OAR-2014-0827-1233-A1 p.8]

2.4 Some of the Agencies' Proposed Technologies for Low-speed/Frequent-stop Vehicles are feasible, and some are not. Autocar's comments on the feasibility and potential for penetration of the proposed technologies for reduction of GHG emissions and increased fuel efficiency for Low-speed/Frequent-Stop Vehicles are set forth at Appendix A. Some of the proposed technologies are technically possible, but many will be ineffective for Low-speed/Frequent-stop Vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.8]

**Response:**

We interpret Clarke's comment to advocate for allowing new vocational vehicles qualifying for the off-highway provisions of § 1037.631 to also be eligible for relief from engine emission standards under the provisions that apply for glider vehicles. These two sets of provisions apply independently – i.e. they are not mutually exclusive. As such, the proposed statement stating that § 1037.631 does not exempt engines from engine standards is true. If a vehicle qualifying for relief under § 1037.631 should also qualify for relief as a glider vehicle, this would be addressed under § 1037.635. Refer to Section 14.2 for details on how the agencies are responding to comments on use of gliders in vocational applications.

We interpret Terex's comment requesting axle configuration as a criterion in eligibility for relief under our glider provisions as a comment requesting the agencies to consider axle configuration in applicability under the Phase 2 vocational vehicle regulations. We disagree that the presence of a six by six or eight by eight axle configuration is an appropriate basis to qualify vehicles as off-highway for purposes of applying less stringent standards. While this feature may be indicative that the vehicle will not experience purely highway cycles, it is not determinative regarding the feasibility of fuel saving technologies. We believe that to the extent vocational vehicles with unusual axle configurations also have features that qualify them for exemption or less stringent standards under the final Phase 2 program, we don't need to add this as a supplemental criterion. For purposes of Phase 2 certification, vehicles with more than two drive axles will be certified as a 6x4. In Section 2.2 of this response to comments document, we address comments related to simulating unusual axle configurations in GEM.

Commenters failed to address the reasons described in the proposed rule for removing speed-limited tires from the qualifying criteria for off-highway used under § 1037.631. We are adopting these revisions because we are concerned that manufacturers would too easily be able to install tires with a low speed rating to avoid standards, even in cases where the customer or the application does not warrant those tires. Moreover, we believe that the other qualifying criteria are effective apart from considerations of tire ratings for identifying vehicles that warrant relief from greenhouse gas standards. This is especially the case, given that we are adopting less stringent optional CO<sub>2</sub> standards for "custom-chassis" vehicles that qualify for some but not all of the criteria identified in § 1037.631 (see Section 6.2.3).

While we continue to believe that speed-limited tires are not an appropriate basis to qualify vehicles as off-highway for purposes of applying less stringent standards, we are adopting a vehicle-based speed criterion that accomplishes this objective more reliably and more directly. In particular, the regulation allows manufacturers to qualify for off-highway consideration for vehicles with maximum speed below 55 miles per hour (see 40 CFR 1037.631(a)(2)(iv)). Such vehicles would be expected to rarely travel long distances, and are more likely to involve operations separate from transport.

It is not clear why Innovus believes an axle load rating criterion is not germane to consideration of off-highway use. Mobile cranes and mining and logging vehicles, for example, are often designed with high axle load ratings because of their off-highway functions. If a vocational vehicle is designed simply to transport heavy loads but is not speed-limited, it would then not qualify under the provisions of § 1037.631(a)(1).

Innovus and Autocar describe concerns for vehicles that meet one or the other of the criteria from § 1037.631(a)(1) and (a)(2), but not both. Since § 1037.631 exempts vehicles from all greenhouse gas requirements, we do not want vehicles to qualify for the exemption if manufacturers can apply technology to reduce CO<sub>2</sub> emissions. At the same time, we are aware that vehicles meeting one of the two conditions of § 1037.631 may not be able to apply emission control technology to the same degree as other vehicles. We are therefore creating alternate “custom-chassis” standards for such vehicles. We believe this appropriately pairs the stringency of standards with the capabilities and operating characteristics of these vehicles (see RTC 6.2.3). A few of Autocar’s specific vehicle types warrant closer attention:

- Street sweepers with a maximum speed at or above 55 mph are designed for off-highway use, but not in a way that allows us to exempt them from all CO<sub>2</sub> standards. Manufacturers of these vehicles choose to design their vehicles to operate at highway speeds, presumably to allow for substantial driving between sweeping jobs. These vehicles should be expected to apply a certain level of technology for reducing CO<sub>2</sub> emissions.
- Refuse trucks clearly spend a disproportionate amount of time operating at slow speeds; however, this only makes it more important to consider strategies such as hybrid powertrains and idle-reduction technologies. Exempting these vehicles from all CO<sub>2</sub> standards would be a missed opportunity of the first order.

## **6.5 Compliance Provisions and Flexibilities for Vocational Vehicle Standards**

**Organization:** Volvo Group

Need clarification on a manufacturer’s ability to partially certify a product offer as custom chassis, while the same offer in the same application is certified to the primary standard in a separate family.

Need clarification that credits can be averaged across custom chassis types within a weight class.

### **Response**

The final rules allow manufacturers to certify some vehicles to the optional custom chassis standards using simplified GEM while certifying similar vehicles in the same model year to the primary standards using full GEM. Each new application for certification is associated with a standard, and carry-over certificates would be associated with the same standard as the previous year. Any credits generated

against the custom chassis standard must remain within the narrow averaging set of that custom chassis type, and may not be traded.

### **6.5.1 Selection of Subcategory for Certification**

**Organization:** Volvo Group

#### **Vocational Vehicle Segmentation Regression Modeling**

In the previously noted NREL report two regression models were put forth (see sections 3.1.1 and 3.1.2) as a means to segment vocational vehicles into regulatory sub-categories. Both models utilize multiple logistic regressions that categorize vehicles into one of two sub-categories: high-speed or low-speed. In the report NREL states misclassification errors of 25%-30% where vehicles which should fall into the high-speed cluster were classified in the low-speed cluster, while errors for low-speed vehicles being misclassified as high-speed were 6-13%. Since the agencies have stated they will rely on hybrid and engine stop-start technologies in lower speed subcategories (technologies which Volvo has commented are not currently commercially viable and technically infeasible in HHD) any error incorrectly placing more vehicles into lower speed subcategories on aggregate will result in an unintended artificial stringency increase. [EPA-HQ-OAR-2014-0827-1928-A1 p.10-11]

Without understanding proposed stringency changes from the NPRM levels, Volvo cannot sufficiently review these models in order to determine their total impact on our ability to comply with the proposed rule; however, it is inappropriate to consider a segmentation criteria that generates large errors resulting in significant compliance risk to OEMs. [EPA-HQ-OAR-2014-0827-1928-A1 p.11]

**Organization:** Bendix Commercial Vehicle Systems, LLC

Proposed Phase 2 Standards for Vocational Vehicles, (1) Proposed Subcategories and Test Cycles

The agencies request comment on the method for assigning vocational chassis to regulatory subcategories. Bendix supports the proposed approach to align with the objective to allow manufacturers to certify their chassis over appropriate duty cycles, while maintaining the ability of the market to offer a variety of products to meet customer demand. [EPA-HQ-OAR-2014-0827-1241-A1 p.8]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

In addition to providing data on the characteristics of three overarching classes of vehicle, the Oak Ridge analysis provides a path for segmenting vocational vehicles in spite of the limited information that an incomplete chassis can provide.<sup>14</sup> The full prediction model leads to an appropriate categorization of high- or low-speed behavior with 89 percent accuracy, with prediction of low-speed behavior 94 percent accurate. Limiting the model to engine speed at 65 mph provides less accuracy (81 percent) but may allow for more flexibility to changes to the fleet over time (such as a decreasing use of manual transmissions in all classes, or a change in fuel use for applications that were previously predominantly gasoline or diesel). [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

The ability for a manufacturer to more accurately project a new vehicle's likely duty cycle allows better assessment of both the regulatory category of the vehicle and technologies that are most applicable. Correctly identifying high-speed vehicles, particularly ones which now show even greater operation at highway cruise speeds than first proposed, would allow for greater application of aerodynamic

improvements, since there would be a clear need and payback. Similarly, the ability to more clearly define low-speed operation, which now should also include greater idle operation time, would incentivize greater application of idle reduction technologies. [EPA-HQ-OAR-2014-0827-1896-A1 p.5]

**Organization:** Eaton Vehicle Group

Also, the EPA requested comments if “all Hybrids should be tested over the urban cycle only.” We understand the EPA motivation and the underlying assumption that the market will accept Hybrids in urban applications only. However, Phase 2 spans a long interval in which HD line haul Hybrids are feasible and would not be designed for stop-and-go traffic, as shown above. The EPA should allow OEMs to certify Hybrids on the Urban cycle, but should give the option to certify over another cycle if that is more appropriate. [EPA-HQ-OAR-2014-0827-1194-A1 p.19]

**Organization:** American Automotive Policy Council

For class 2b-5 vocational vehicles, the rpm and vehicle speed based cutpoints proposed by the agencies to define the “Urban” duty cycle do not properly identify the classes of vehicles intended. This is likely due to assumptions about engine test speeds that were made based on vehicles prior to the implementation of Phase I Heavy-Duty GHG engine standards. AAPC proposes slight modifications to the cut points used to classify vehicles for these duty cycles. Additionally, AAPC believes that only the highest numerical axle ratio in a 2-spd or greater axle application should be used for classification purposes. AAPC recommends the following changes to the “Urban” duty cycle cut points: [EPA-HQ-OAR-2014-0827-1238-A1 p.32]

- For 2b-5 spark ignited gasoline vehicles, the 55mph cut point should be increased from 50% to 65% of max engine test speed [EPA-HQ-OAR-2014-0827-1238-A1 p.32]

- For 2b-5 compression ignition vehicles the 55mph cut point should be lowered from 90% to 65% of max engine test speed. [EPA-HQ-OAR-2014-0827-1238-A1 p.32]

**Organization:** Allison Transmission, Inc.

### **Manufacturers Should Be Allowed To Select Appropriate Test Cycle**

EPA and NHTSA have proposed an equation for deciding how different chassis configurations will be assigned to vocational vehicle subcategories. The agencies have also requested comment on this approach and whether manufacturers should “have the freedom to select a test cycle without any need for EPA or NHTSA approval.” [EPA-HQ-OAR-2014-0827-1284-A1 p.43]

Allison is generally supportive of the vocational vehicle segmentation as proposed; however, Allison also believes that vehicle manufacturers should have the option to select the test cycle without EPA or NHTSA approval in order to better match test cycles with a vehicle’s end use. If the vehicle manufacturer could select the cycle, then there would be less opportunity for unintended consequences such as changing the number of transmission gears in order to move a vehicle from one test cycle to the next. [EPA-HQ-OAR-2014-0827-1284-A1 p.43]

As it turns out, a vocational vehicle with this 8-speed transmission would always fall into the Regional subcategory – by a large margin. This is not in-line with the expectation that most vehicles would be classified as Multi-Purpose. Allison requests that EPA and NHTSA revise the classification approach to account for ATs with 8 or more speeds. [EPA-HQ-OAR-2014-0827-1284-A1 p.41]

In order to avoid classifications that do not reflect the actual work done by such vehicles, the available calibrations for 8-speed transmissions might be restricted. Although restricting the number of gears would avoid the adverse classification, it would also result in a less fuel efficient vehicle, with greater GHG emissions, when the vehicle traveled at highway speeds. Again, such a result should be avoided in the final rule and such vehicles should be able to be classified as Multi-Purpose or Urban. [EPA-HQ-OAR-2014-0827-1284-A1 p.41]

### **Maximum Engine Test Speed Is Flawed**

EPA and NHTSA are considering new vocational vehicle weightings for Urban vehicles. Under these weightings, transient operation would be at 92%, operation at 55 MPH at 7%, and 65 MPH operation at 1%. [EPA-HQ-OAR-2014-0827-1892-A1 p.9]

The applicable definition to qualify for treatment as an Urban vehicle is that the vehicle must be > 90% of max test speed at 55 MPH. But when the math is examined closely, the following result is obtained:  $65/55 \times 90\%$  of maximum test speed results in the engine running at 106.4% of maximum test speed. For example, with a maximum engine test speed 2000 rpm, 90% of test speed at 55 MPH = 1800 rpm; engine speed at 65 MPH = 2124 rpm engine speed. [EPA-HQ-OAR-2014-0827-1892-A1 p.9]

Maximum engine test speed (for constant-speed engines), however, is defined as no-load governed speed (speed which yields zero torque). By definition, the engine cannot operate under power above maximum test speed. In order to correct this error, Allison recommends zero 65 MPH cycle weight be used in the Urban cycle. [EPA-HQ-OAR-2014-0827-1892-A1 p.9]

### **Regional/Multipurpose Vehicle Breakpoint**

Upon closer review of the Proposed Rule, however, it appears that there are a number of configurations that are 2 points from the Regional/Multi-Purpose breakpoint. Specifically, there are construction vehicles with 7-speed transmissions classified as Regional when the majority of their use is expected to be low speed on/off road duty – a use pattern which is more in line with the Multi-Purpose duty cycle. In addition, we are currently encouraging the vehicle OEMs to configure the transmissions as 6 speeds so they will get the best possible fuel efficiency under all operating conditions. But the Proposed Rule could incentivize the configuring of transmissions at less than 6 speeds in order to change classification (which would also result in a lower stringency level). [EPA-HQ-OAR-2014-0827-1284-A1 p.40]

Therefore, Allison would recommend reducing the breakpoint between Regional and Multi-Purpose classifications from 75 to 70 to address this issue. Allison has examined data from over 8,000 vehicles using an Allison transmission. Based on this data, adjusting the breakpoint would change the classification split to be: [EPA-HQ-OAR-2014-0827-1284-A1 p.40]

Regional 3%; Multi-purpose 95%; Urban 2%

This is more in line with what we would expect to occur in the real world commercial use of vocational vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.40]

In the vocational vehicle section of the Proposed Rule and RIA, all of the assumptions regarding vocational vehicles boil down to the population splits shown below. It is very strongly influenced by assumptions about the distribution of the group that MOVES calls “short haul straight trucks.” [EPA-HQ-OAR-2014-0827-1284-A1 p.40]

[Chart, 'Cycle weightings by percent of population', can be found on p.40 of docket number EPA-HQ-OAR-2014-0827-1284-A1]

EPA indicates in the memorandum that “[a]nother simplification being considered is to assign each type of custom chassis certified with simplified GEM to a single weight class that represents the majority of vehicles of that type.”<sup>2</sup> Allison believes, however, that this would result in an oversimplification of the complexities of medium heavy-duty (“MHD”) and HHD vocational vehicles. For example, emergency vehicles are found in HHD in addition to MHD. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

An unintended consequence of oversimplification would also be to deter innovation and responses to market changes over the long time period covered by the Phase 2 Rule. Specifically, vehicles that are numerous in one classification today would likely remain in this classification due to a regulatory disincentive to downsize or “right size” based on the needs of a specific intended use. [EPA-HQ-OAR-2014-0827-1892-A1 p.5]

**Organization:** California Air Resources Board (CARB)

#### **Comment - Assignment of vocational subcategories**

The NPRM requests comment on the assignment of vocational chassis to regulatory categories. CARB staff supports U.S. EPA and NHTSA’s assignment of regulatory subcategories for vocational vehicles. We recognize the broad range of uses in the vocational sector which dictates the use of many different test cycles to fully encompass all of the vocational duty cycles. However, there is also a need for simplicity in regulating vocational manufacturers to reduce unnecessary burden on both manufacturers and regulators. The proposal of nine subcategories for the vocational sector addresses and balances these two competing factors. The proposal to allow manufacturers to request a different duty cycle would provide necessary flexibility for those vocational vehicles that are not properly accounted for by these simplified subcategories. [EPA-HQ-OAR-2014-0827-1265-A1 p.63]

The NPRM requests comment on allowing vocational vehicle manufacturers to request a different duty cycle versus allowing them to select a test cycle without any need for U.S. EPA or NHTSA approval. CARB staff supports U.S. EPA and NHTSA’s proposal for assigning vocational vehicle test cycles through the designated formulas, while still allowing manufacturers to petition to use an alternative. CARB staff does not support allowing manufacturers complete freedom in choosing a test cycle. CARB staff believes that this freedom could lead manufacturers to test on cycles that are not applicable to the duty cycle of the vehicle in an effort to meet less stringent emission standards. The proposed mechanism of allowing manufacturers to petition for use of an alternative test method means that manufacturers must show proof that the vehicle they are certifying meets the criteria for the specific test cycle. Although slightly more burdensome for regulators, CARB staff believes the requirement of a petition to test on an alternative cycle will keep manufacturers from trying to circumvent the emission standards and is the best approach to take. [EPA-HQ-OAR-2014-0827-1265-A1 p.124]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The proposed standards lack clear criteria for determining which vocational category should apply to a given vehicle configuration. The proposed criteria of maximum test speed and gear ratios do not provide the requisite definitional certainty upon which to base such fundamental aspects of the proposed standards.

**Organization:** Daimler Trucks North America LLC

**Categorization into urban, multipurpose, and regional** – The agencies propose to split vocational categories into three, based on speed. We see upsides and downsides to this approach. In particular, we

are concerned that the agencies' definition for each of the categories does not align with the agencies' expectations. For example, the agencies estimated that their definition of "urban" vehicles would capture 25% of the vocational market (based on calculations shared with the industry through the docket). By contrast, when we use F<sub>n</sub> test figures to calculate, we find that less than 3% do. In turn, this leads to an extremely troublesome error in the agencies' use of "normalization," which is strongly dependent on the percentage of vehicles in each subcategory— and this leads to our recommendation to drop normalization altogether. [EPA-HQ-OAR-2014-0827-1164-A1 p.31]

Almost all vehicles come out in multi-purpose, contrary to the agencies' assumptions. One possible explanation for this disparity is the sensitivity of the categorization to minor changes in F<sub>n</sub> test: a slight change (100 or 200 RPM) in F<sub>n</sub> test can result in a large change in the percentages of vehicles in each bin. This demonstrates a problem, however: the possibility that manufacturers might adjust engine parameters to game the system, making tiny engine changes to move vehicles into other speed categories. In summary, without accurate categorization and without accurate numbers for the percentage of vehicles in each category, the normalization and equalization processes will fail; so we recommend dropping them. Moreover, because few vehicles come up in some of the categories, and because they are widely varied, we propose a weight-based vocational split (described below). [EPA-HQ-OAR-2014-0827-1164-A1 p.31]

#### **Alternative for Categorization Proposal that Eliminates the Need for Normalization and Equalization**

– During discussions with the agencies this summer, the agencies floated the proposal to amend the NPRM's categorization technique to allow manufacturers to simulate vocational vehicles in two speed categories (urban, MP, or regional) and ultimately categorize the vehicle into the category where it appears best. The idea behind this new proposal is that the agencies would assume that vehicle manufacturers design each vocational vehicle to be appropriate for its duty cycle, such that we may look after the design at the appropriate categories and match them to how we designed the vehicle. This being the case, there would no longer be a need to try to stop manufacturers from shifting vehicles from one speed category to another, which is the purpose of the normalization and equalization processes. In turn, this proposal allows us to get rid of those processes. [EPA-HQ-OAR-2014-0827-1164-A1 p.32]

In this categorization, we would subdivide MHD vehicles into Class 6 and Class 7 but keep vehicles of all speeds in one category. The top table shows that almost all of the Class 6 vehicles are of one engine type and (not shown in this table but available in a confidential setting) of one transmission type, and that most of the Class 7 vehicles are similarly homogeneous. This homogeneity of engine type and vehicle weight allows a very uniform choice of target technologies. Similarly in Class 8, splitting into narrower weight bands than simply everything over 33,000 lb. allows us to create homogenous categories. For the sake of giving an example, we have chosen some weight ranges of 33k to 50k, in which most of the vehicles have one type of engine, 50k to 70k, in which most have two types, and 70k and above in which most have one type. Again, this simplifies the process of categorizing vehicles and choosing target technologies. Of course, this does not facilitate the agencies' goal of assigning a penetration rate of hybrids, but as we describe elsewhere in these comments, hybrids are not an appropriate technology for the agencies' standard setting. We understand that we sprung this idea on the agencies at the end of the comment period, and that it is a complicated idea marking a radical departure from the agencies' proposal, so we recommend that we talk through the idea with the agencies. [EPA-HQ-OAR-2014-0827-1164-A1 p.32]

**Organization:** NAFA Fleet Management Association



Fleet needs are diverse. Payback periods and fuel savings vary by use. A case in point – the duty cycle requirements for a tree trimming company may differ from the requirements of an electric utility, although both may use comparable vehicles. Some technologies will not fit in some uses. With respect to vocational vehicles, the proposal attempts to create silos. The agencies propose that a vocational chassis would be presumed to certify using the Multi--Purpose duty cycle unless some criteria is met indicating that another duty cycle would be more appropriate. The agencies acknowledge that even within certain vocational vehicle types, vehicle use varies significantly. [NHTSA-2014-0132-0111-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.180-181.]]

We are concerned with the statement in the proposal – “while intended service class may help a manufacturer decide how to classify some vehicles, we do not believe that intended service class would be a sufficient indicator by itself.” [NHTSA-2014-0132-0111-A1 p.3]

**Response:**

At proposal, we described a process of assigning vocational chassis to regulatory subcategories based on a calculation of the engine speed in relation to the vehicle speed. As proposed, the multipurpose subcategory was the default subcategory; however, if the vehicle’s engine speed at 55 mph was above the cut-point specified for that engine type (CI or SI) then the vehicle would be assigned to the Urban subcategory. Similarly, if the vehicle’s engine speed at 65 mph was below the cut-point specified for that engine type (CI or SI) then the vehicle would be assigned to the Regional subcategory. We also proposed some exceptions, such as specifying that hybrids would be in the Urban subcategory. Since proposal, the agencies have completed our work under the interagency agreement with DOE-NREL, and we have carefully considered all the comments related to this issue.

We note that several comments persuasively identify weaknesses in the proposed approach. Specifically, Allison explained that vehicles with two shift schedules would need clarification as to which top gear to use when calculating the applicable cut-point. Also, Daimler noted that, to the extent that downspeeding occurs in this sector over the next decade or more, cutpoints based on today’s fleet may not be valid for a future fleet. Allison noted that the presence of additional top gears could strongly influence the subcategory placement of vocational vehicles. These comments highlight the possibility of misclassification, and the potential pitfalls in a mandated classification scheme. Another weakness in the proposed approach is that even though we have obtained a great deal of data thanks to manufacturer cooperation and NREL duty cycle analysis, the only regulatory cut-point in which we have a high degree of confidence is the (proposed) cut-point between Regional and Multipurpose class 8 diesels. Any cut-points we could establish based on available data for lower weight class diesels or for gasoline powered vocational vehicles would be less robust.

These weaknesses have led the agencies to take a different approach to assigning vehicles to subcategories. The agencies are adopting final regulations that generally allow manufacturers to choose a subcategory, with a revised set of constraints relating largely to transmission type. In a regulatory structure where baselines are equal but future standards for vehicles in different subcategories have different stringencies, the agencies would typically assign subcategorization based on regulatory criteria rather than allowing the manufacturers unconstrained choice of subcategory because manufacturers could have a strong incentive to simply choose the least stringent standards. However, because the baseline performance levels of the different vocational vehicle regulatory subcategories differ widely, the agencies have determined that it is acceptable to adopt standards with unequal stringencies using the same methodology used to set all of the other standards in the Phase 2 rule: determining stringency based on the performance of the technologies in the projected compliance path, weighted by the penetration rates for those technologies. Considering the final test cycles and technology effectiveness

values, we no longer believe manufacturers will be able to easily make simple design changes and qualify for less stringent standards.

In the final weeks before promulgation of the Phase 2 rules, the agencies received significant new comments from vehicle manufacturers, which suggest there is some uncertainty with respect to the three drive cycle structure being adopted. Please see Section 6.1.4 above to read the agencies' response to these new comments and the potential implications for the framework of the vocational vehicle program.

In the final regulatory structure, although the standards for vocational vehicles in different subcategories have different stringencies, the agencies can allow the manufacturers a large degree of freedom to choose a vehicle's subcategory. We are not particularly concerned that adopting final standards with unequal percent improvements poses a danger of losing environmental benefits from this program, as long as vehicle configurations are properly classified at the time of certification. As just noted, the final standards described in Section V.C.2.d of the Preamble are derived directly from the technology packages without applying any assumptions about fleet averages. Thus, unlike at proposal, the final regulations will generally allow manufacturers to certify in the particular duty-cycle subcategory they believe to be most appropriate. Note that manufacturers may make this choice as part of the certification process and will not be allowed to change it after the vehicle has been introduced into commerce. Under this structure, the agencies expect manufacturers to normally choose a subcategory for each vehicle configuration that best represents the type of operation that vehicle will actually experience in use (presuming the manufacturer and customer would specify the technologies to reflect such operation).

The constraints discussed below and in the Preamble Section V.D.1.e are being adopted as interim provisions in response to manufacturers' concerns that some of them could present competitive disadvantages, where different manufacturers produce very different sales mixes of vehicles equipped with different transmission types, as discussed in Section **Error! Reference source not found.**

The agencies are adopting final regulations that generally allow manufacturers to choose a subcategory, using good engineering judgment as set forth in 40 CFR 1068.5. We also are adopting a set of constraints on duty-cycle selection that have been revised substantially from those proposed. Because the baseline configurations against which vehicles in the Urban subcategories will measure their future performance do not include any manual transmissions, we have determined that vocational vehicles with manual transmissions may not be certified as Urban. In the real world, we do not expect any vehicles intended to be used in urban driving patterns will be specified with manual transmissions. Driver fatigue and other performance problems, especially the need for frequent shifting, make this an illogical choice of transmission. Because the drive idle cycle has a higher weight in Urban than in Regional or Multipurpose, and because manual transmissions have relatively low drive idle emissions, allowing manual transmission-equipped vehicles to be certified as Urban would inappropriately reward a technology that would not see in-use benefit, since the vehicle would not be used in urban settings for the reasons just explained. It is thus appropriate for us to adopt this constraint. In addition, as described in Chapter 2.9.2 of the RIA, both the HHD Regional and HHD Multipurpose baselines have a blend of manual transmissions, although the majority of manuals are in the HHD Regional baseline. Further, by MY 2024, our adoption rate of transmission technology reflects zero manuals in HHD Multipurpose. Thus, beginning in MY 2024, any vocational vehicle certified with a manual transmission must be classified in a Regional subcategory.

We are not adopting constraints on vehicles with automated manual transmissions certifying in either Regional or Multipurpose subcategories, because we believe this is a technology that can provide real world benefits for vehicles with those driving patterns. However, we are adopting a constraint to prevent vehicles with AMT from being certified as Urban for a reason similar to one described above

for manuals, namely that in the real world, we do not expect any vehicles intended to be used in urban driving patterns will be specified with transmissions that do not have powershifts. Lack of smooth shifting characteristics during low speed accelerations and decelerations make AMT an illogical choice of transmission for urban vehicles, suggesting that any such classification would be inappropriate. Also, for reasons similar to those just given for manual transmissions, AMT have relatively low drive idle emissions. Thus, allowing AMT-equipped vehicles to be certified as Urban would inappropriately reward a technology that would not see in-use benefit, since the vehicle would not be used in urban settings for the reasons just explained.

Due to performance expectations we believe it is unlikely that an owner of a vehicle with a true urban driving pattern would choose an AMT or manual rather than an automatic transmission. Because both our baseline and future technology adoption rates exclude manual and AMT from consideration in the urban subcategories, we believe it is reasonable to exclude them from certification over this cycle.

Dual clutch transmissions have very recently become available for medium heavy-duty vocational vehicles and very little data are available on their design or performance. We anticipate that in the future, some designs may have features that make them perform similarly to AMT's while others may have features that make them more similar to automatics with torque converters. Because we are not confident that we know in which duty cycle(s) they are best suited, we are adopting a partial constraint on these, namely that dual clutch transmissions without powershifting must also be constrained out of Urban. We are finalizing as proposed that any vehicle whose engine is exclusively certified over the SET must be certified in the Regional subcategory. Further, to the extent manufacturers of intercity coach buses and recreational vehicles opt these into the full program, these also must be certified as Regional vehicles. We are not finalizing the proposed constraint on hybrid configurations in the Urban test cycle.

Based on NREL drive cycle analysis of the existing fleet, we imagine that HHD vehicles with a diesel engine rpm of 1,400 and below when the vehicle is at 65 mph would be appropriately certified as Regional vehicles. However, this is illustrative only, and (unlike the proposed rules) the final rules do not include an engine speed cut-point as a criterion in subcategory selection.

## **6.5.2 Test Procedures**

**Organization:** Edison Electric Institute

- We support the addition of test cycle procedures that include the ability to capture workday idle reduction;<sup>38</sup> however, e-PTO systems are sufficiently distinct from neutral idle or stop-start technologies that they should qualify for separate off-cycle credits [EPA-HQ-OAR-2014-0827-1327-A2 p.16]
- Add a charge-depleting test cycle option to the hybrid-PTO test cycle that would better capture the fuel savings capabilities of these systems [EPA-HQ-OAR-2014-0827-1327-A2 p.16]
- Ensure that manufactures wishing to certify e-PTO systems for off-cycle credits are given proper credit for the fuel savings and greenhouse gas reduction capabilities of these systems [EPA-HQ-OAR-2014-0827-1327-A2 p.16]

**Response:**

We agree with the commenter that a charge-depleting e-PTO test cycle will better capture the fuel savings from a plug-in hybrid system. The agencies have partnered with NREL to conduct an analysis

of operational data on utility work trucks, and as a result, the final regulations include a utility factor table for use in the hybrid PTO test procedure described at 40 CFR 1037.540. Further discussion of e-PTO technologies is found above in Section 6.3.6.3.

## **6.6 HFC Leakage Standards for Vocational Vehicles**

### **6.6.1 Feasibility of Applying HFC Leakage Technologies for Vocational Vehicles**

**1310Organization:** ABC Bus Companies, Inc.

HVAC systems on motorcoaches are required to maintain a comfortable and healthy environment to as many as 81 passengers on a single motorcoach. Given that some of these systems are more than 10 tons, unreasonable changes to these systems could be very costly and hard to forecast many years out. [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

**Organization:** New Flyer of America Inc.

In our discussions with other transit bus manufacturers (including Gillig LLC) and the American Public Transit Association (APTA), we share aligned concerns on other aspects of the program which are related to vocational classification, including air conditioning leakage (transit buses have significantly larger and more complex air conditioning systems than trucks), and payload. New Flyer believes the differences in vehicle systems and the operating characteristics warrant distinctive classification. [EPA-HQ-OAR-2014-0827-1306-A1 p.2]

**Organization:** GILLIG LLC

“EPA believes the capacity of vocational vehicle air conditioning systems are sufficiently similar to those of other HD vehicles to apply a similar leakage standard as was applied in the HD Phase 1 program for tractors and HD pickup trucks and vans.” We strongly encourage the EPA to revisit this underlying assumption and the part of the rule specifying allowable maximum refrigerant leak rates. Transit buses have appropriately sized air conditioning systems many times larger than other vocational vehicles to keep large passenger compartments supplied with conditioned air in hot and high humidity conditions. Again, this is essential for passenger comfort and safety. Additionally, system design details to allow for manufacturability in low volumes, vehicle integration/assembly, and ease of maintenance to meet the needs of this heavy duty vehicle segment are not similar to other vocational vehicles. Transit buses should be placed into their own subcategory separate from other vocational vehicles with standards more aligned with the types/sizes of air conditioning systems used. [EPA-HQ-OAR-2014-0827-1156-A1 p.3]

**Organization:** Environmental Defense Fund (EDF)

#### **Finalize HFC leakage provisions for vocational vehicles**

EDF fully supports EPA’s proposal to apply A/C refrigerant leakage standards to Class 2b-8 vocational vehicles. Excluded in the Phase 1 rule, vocational vehicles have air conditioning systems similar to tractors and contribute to HFC emissions through leaks. We agree that vocational A/C systems should be subject to the same A/C provisions as tractors and 2b/3 vehicles as proposed. [EPA-HQ-OAR-2014-0827-1312-A1 p.51]

**Organization:** Daimler Trucks North America LLC

**AC leak rate limits:** Carrying the leak rate limits from tractors to vocational vehicles is a good approach. In particular, we agree with the approach of basing compliance on the SAE J2727 calculation-based procedure rather than testing but allowing Helium testing as an option. Further, given the variety of vocational vehicles, and in turn the variety of AC configurations for those vehicles, we agree with the EPA's approach of not tightening the AC leak rate standards at the same time as the standards are extended to vocational vehicles. We agree with the EPA's approach of having the present standards apply only to chassis-cab AC systems, as opposed to AC systems that might be on a refrigerated van truck, as those are installed by manufacturers other than the vehicle manufacturer, and we have no familiarity with those systems. [EPA-HQ-OAR-2014-0827-1164-A1 p.110]

**Organization:** Institute for Policy Integrity at NYU School of Law

The agencies have made several changes to the Phase 2 rule that are consistent with our previous comments. Finally, the agencies have now proposed air conditioning leakage standards for vocational vehicles (though, regrettably, still no air conditioning efficiency standards or credits). For more on Policy Integrity's views on heavy-duty vehicle regulation, see our comments on the Phase 1 rulemaking.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.3] /6/  
[http://policyintegrity.org/files/publications/2211\\_Regulatory\\_Report\\_2011\\_Heavy\\_Trucks\\_Rule.pdf](http://policyintegrity.org/files/publications/2211_Regulatory_Report_2011_Heavy_Trucks_Rule.pdf)

**Organization:** California Air Resources Board (CARB)

#### **Extension of AC leakage standard to vocational vehicles**

U.S. EPA and NHTSA are proposing to retain the AC leakage standard adopted in the Phase 1 program. U.S. EPA and NHTSA are also proposing extending the AC leakage standard to class 2b-8 vocational vehicles, which were excluded from the leakage standard in Phase 1. [EPA-HQ-OAR-2014-0827-1265-A1 p.143]

CARB staff supports the proposal to continue the AC leakage standard adopted in the Phase 1 program. CARB staff believes that the leak rate limits in the Phase 1 program are at appropriate levels that balance technical feasibility and emission reduction goals. CARB staff further supports the proposal to extend the AC leakage standard to class 2b-8 vocational vehicles, because the main obstacles (complexity in building process and potentially different entities other than chassis manufacturers involved in production and installation) identified during Phase 1 regulation development have been resolved with new information received during Phase 2 rulemaking process. CARB staff further believes that it is appropriate to set the leak rate limits for vocational vehicles at the same levels as for other tractors, heavy-duty pick-up trucks and vans, due to the substantial similarity of the AC systems for these vehicle classifications. [EPA-HQ-OAR-2014-0827-1265-A1 p.143]

#### **Response:**

We are adopting as proposed final regulations that apply the Phase 1 level A/C leakage standards to vocational vehicles for the reasons set out at proposal. We note that the comments essentially all supported the proposed approach. The agencies also note that the leakage standards are in terms of percent leakage (not an absolute amount of leakage) to take into account that air conditioning systems come in various sizes. We are not adopting any exemptions or exclusions to this requirement, aside from vehicles qualifying for an engine-only standard under 40 CFR 1037.631. However, in view of concerns expressed from some manufacturers about the complexity of A/C systems on large buses, we have reconsidered the compliance process for certifying leakage rates of A/C systems with refrigerant charge capacities greater than 3,000 grams. See Section 6.6.2 below for details on this process.

With respect to comments about credits for efficient A/C systems, please see Section 6.3.6.2, above, regarding electrified accessories.

## **6.6.2 HFC Compliance Provisions for Vocational Vehicles**

**Organization:** Recreational Vehicle Industry Association (RVIA)

Section 1037.115(e) of the Proposed Rules is the air conditioning leakage requirement which, as drafted, would not apply to refrigeration units installed on trailers or for refrigeration units on vocational vehicles that are limited to cooling cargo. RVIA requests that EPA clarify in the final rule that the air conditioning leakage requirement also does not apply to air conditioning units in motorhomes used to cool the living space rearward of the driver. These self-contained rooftop mounted units, by design, are inherently less prone to leakage. Further, the companies that manufacture these units have no relationship with the chassis suppliers who are covered by this regulation nor are they integrated in any way with the motorhome manufacturers that purchase the chassis. Application of the air conditioning leakage standard to living-space cooling units would thus be inappropriate, impracticable, and potentially extremely difficult and costly for regulated parties. EPA should clarify that air conditioning leakage requirements do not apply to living-space cooling units in motorhomes rearward of the driver. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

**Organization:** Mobile Climate Control (MCC)

To further illustrate the difference between tractor and HD vehicle HVAC vs bus HVAC systems you can look to the SAE J2727 standard which gives a chart for calculating mobile air-conditioning system annual refrigerant emissions. This standard comes from automotive and may give good compliance when calculating the annual refrigerant emissions from a tractor or HD vehicle HVAC system. When you try to apply the same standard for calculating the emissions from a large bus HVAC system you find that the fitting types, compressor seals, and even refrigerant options are not all covered or contained at all within the standard. In the requirement, leakage rates are to be calculated in accordance with 40 CFR 86.1867-12(a). This code of federal regulations specifies refrigerant leakage rates be determined using SAE J2727, where the hose permeation rates be calculated in accordance with SAE J 2064.

As an example both methods were used to estimate refrigerant leakage rate for a typical bus rear mount air conditioning unit, i.e., SAE J2727 in total, and SAEJ2727 supplemented with SAE J2064 for the hose assembly contribution. Each calculation used Aeroquip FC558 hose assemblies as the connection between the rear mount and compressor. The results are as follows: SAE J2727 — 0.56% leakage rate in g/year; SAE J2727 and SAE J2065 - 14.2% leakage rate in g/year. Using SAE J2727 alone resulted in an optimistic value for estimated refrigerant leakage rate. As previously stated above it should be noted that SAE J2727 was primarily developed to characterize automotive systems, where the size, range and type of fittings outlined in this category are not specifically applicable for bus HVAC applications and likely does not adequately represent these applications. Conversely, hose assembly refrigerant leakage rates determined by using the test methods illustrated in SAE J2064 result in conservative estimates. Although these test methods are used by hose manufacturers and subsequently integrated into their specific hose specification, the calculated permeability rate has not been observed in actual practice. Given the wide range between the two calculated values, it would seem premature to target and accept a 1.5% leakage rate without further testing and investigation.

**Response:**

We agree with commenter that the proposed regulations were unclear as to our intended applicability of air conditioning units in motor homes. In the final rule, we are adopting regulations to clarify that the low leakage standard applies for air conditioning or refrigeration units on vocational vehicles only if they draw power from engines used to propel the vehicles. See 40 CFR 1037.115(e). With this clarification, we are excluding independently powered roof units or other auxiliary powered units. We believe systems driven by propulsion engines are most likely to be within the control of the certifying manufacturer.

In response to concerns that the procedure for calculating leak rates may not be representative of leak rates of components used in very large mobile air conditioning systems, we are adopting provisions to allow manufacturers to certify using another method. The final regulations at 40 CFR 1037.115(e) include a statement that, "If air conditioning systems with capacity above 3000 grams of refrigerant are designed such that a compliance demonstration under 40 CFR 86.1867-12(a) is impossible or impractical, you may ask to use alternative means to demonstrate that your air conditioning system achieves an equivalent level of control."

### **6.6.3 Program-Wide HFC Compliance Provisions**

**Organization:** Natural Resources Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD)

We also encourage EPA to strengthen refrigerant leakage requirements in order to reduce leakage of high-GWP refrigerants in advance of the phase-out of those refrigerants. Specifically, we suggest that EPA require that manufacturers take steps to ensure that low leak rates are achieved over the life of the vehicles. The methods used to estimate refrigerant leakage in SAE J2727 do not appear sufficient to ensure or even predict emissions rates over these vehicles' lifetimes of millions of driven miles, sleeper cab use (for long-haul Class 8 trucks), vibrations from independently suspended truck components, larger charge sizes, and many other conditions. [EPA-HQ-OAR-2014-0827-1305-A1 p.2]

In order to better demonstrate the efficacy of low-leak systems, EPA should require that manufacturer conduct stress testing of air conditioning components to provide an indication of their durability under road conditions. Likewise, EPA might also require that OEMs conduct road testing, which could offer a better picture of on-road wear and tear. [EPA-HQ-OAR-2014-0827-1305-A1 p.2]

**Organization:** California Air Resources Board (CARB)

The NPRM states that U.S. EPA and NHTSA are not proposing a specific in-use standard for leakage, because neither test procedures nor facilities exist to measure refrigerant leakage from a vehicle's air conditioning system. [EPA-HQ-OAR-2014-0827-1265-A1 p.142]

While existing test procedures (SAE Standard J2763 and J2762) could be used to assess refrigerant leakage, such procedures are time consuming and costly, and thus impractical. Therefore, CARB is not opposed to U.S. EPA and NHTSA's position of not proposing an in-use standard for leakage at this time. [EPA-HQ-OAR-2014-0827-1265-A1 p.142]

#### **Information required for AC leakage standard certification**

To show compliance with the AC leakage standard, U.S. EPA and NHTSA are only requiring the manufacturer to provide refrigerant leak rates, describe the type of refrigerant, and identify the refrigerant capacity of the air conditioning systems. [EPA-HQ-OAR-2014-0827-1265-A1 p.142]

CARB staff believes more information ought to be required to afford U.S. EPA and NHTSA the opportunity to verify the leakage calculation and to track technological development. CARB staff recommends that U.S. EPA and NHTSA require the following information from the manufacturer: the calculation that leads to the refrigerant leak rate estimates, and specifications of the system components with sufficient detail to allow reproduction of the calculation. This level of detail is consistent with the information that CARB staff requires light-duty manufacturers to report under the AC credit provisions in its “Advanced Clean Cars” programs for light-duty vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.142-143]

### **Emission-related warranty covers components whose failure would increase a vehicle’s emissions of air conditioning refrigerants**

U.S. EPA and NHTSA are proposing that the emission-related warranty cover components whose failure would increase a vehicle’s emissions of AC refrigerants. [EPA-HQ-OAR-2014-0827-1265-A1 p.144]

CARB staff supports this proposal. Although most refrigerant emissions occur as refrigerant gradually leaks through fittings, connection, and seals, and permeates through hoses (“regular leakage”), sudden failure of AC components may lead to the loss of the entirety or a significant portion of the refrigerant charge in a short period of time (“irregular loss”). Requiring that the emission-related warranty cover those components not only provides a venue to restore the system back to working order when component failure occurs, but also promotes the use of technologies more durable and less prone to failure, hence helping to prevent failure and reduce emissions at the design level. [EPA-HQ-OAR-2014-0827-1265-A1 p.144]

#### **Organization:** Honeywell Fluorine Products

SAE J2727 Does Not Properly Consider Real World Circumstances for Leakage Rates from HD, MD and VV [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

In the Proposed Rule, EPA proposes to extend the application of SAE Surface Vehicle Standard J2727 scoring system as an appropriate approach to determine leakage rates from HD, MD and, now by extension, VV. [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

“EPA is proposing a requirement that vocational chassis manufacturers compare the components of a vehicle’s A/C system with a set of leakage-reduction technologies and actions that is based closely on that developed through the Improved Mobile Air Conditioning program and SAE International (as SAE Surface Vehicle Standard J2727, “HFC–134a, Mobile Air Conditioning System Refrigerant Emission Chart,” August 2008 version). See generally 75 FR 25426. The SAE J2727 approach was developed from laboratory testing of a variety of A/C related components, and EPA believes that the J2727 leakage scoring system generally represents a reasonable correlation with average real-world leakage in new vehicles.” [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

We believe that while SAE J2727 may be an accurate predictor of leakage rates in new light duty passenger vehicles, it has not been proven to be accurate in predicting “real-world leakage” in HD vehicles. Studies have shown that leakage rates as expressed as a percentage of the initial charges show a range of 7.3 to 11.5 % (8.9 average) annually for heavy duty vehicles vs. generally 1.5 – 3% range for light duty vehicles.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1191-A1 p.3]



To properly account for leakage from AC units in HD vehicles, the scoring system must consider the significantly higher miles and heavier pounding these vehicles endure each year and over the life of the vehicle, as well as variation.<sup>5</sup> HD vehicles often have much higher annual mileage usage, in many cases over 100,000 miles per year and 1- 2 million miles over the lifetime of the vehicle. In addition, HD vehicles have different loads (engine torque on A/C compressor and engine/road vibration loads on A/C lines, fittings, and components) on its A/C components, which likely results in higher leakage rates than light duty vehicles. Finally since many HD trucks have sleeper cabs, the air conditioning systems are often run even when the vehicle is not moving, adding further to the wear and tear of the A/C system. [EPA-HQ-OAR-2014-0827-1191-A1 p.3-4]

We request EPA to consider more fully these real world realities of harder pounding over many more miles in assigning leakage rates over time for HD A/C systems. While a design based approach in estimating leakage may have applicability to new HD vehicles, we believe that real world performance based testing would reveal short comings in the application of SAE J2727 to HD, MD, and VV over the life of the vehicle. We suggest EPA gather leak rate data on older heavily used vehicles to determine if the leak rates predicted by SAE J2727 are accurate over the life of the vehicles. [EPA-HQ-OAR-2014-0827-1191-A1 p.4]

**Response:**

We are finalizing requirements as proposed to include A/C leakage components in the emissions-related warranty, for the reasons stated at proposal. We note further CARB's support, which endorses the agencies' reasoning. Similarly, in light of supportive comments from CARB, we are not adopting in-use HFC leakage requirements. We disagree that we need to collect more information from manufacturers. We are collecting a sufficient level of detail about compliance with the HFC leakage standard at the time of certification. In addition, the manufacturers are required to maintain the level of detail suggested by CARB as part of the recordkeeping requirements. EPA may audit those records at any time. The agencies also note that the study referred to in the Honeywell comments was conducted in 2007, prior to the implementation of HFC leakage standards for tractors and HD pickups in Phase 1. Thus, this study does not support the commenter's assertion that SAE 2727 may not be an appropriate test procedure for HD vehicles. For responses to comments about our methods for estimating direct leakage emissions of HFC from A/C systems on HD vehicles, please see Section 9.2.

## **7 Pickups and Vans**

### **7.1 General Comments**

**Response:**

There are no comments in this section 7.1.

### **7.2 Proposed Pickup and Van Standards for CO2 and Fuel Consumption**

#### **7.2.1 Stringency of Standards**

**Organization:** American Automotive Policy Council

**Implicit and Explicit Challenges of Alternative 3** - The proposed Phase 2 Alternative 3 stringency is greater than Phase 1. Alternative 3 is aggressive and will drive technology into product. Proposals for

greater stringency than Alternative 3 are not supportable given the required early introduction of unproven technologies with their associated consumer acceptance risk, as well as the many implicit risks that impact stringency. All of these risks are detailed in our comments. [EPA-HQ-OAR-2014-0827-1238-A1 p.2]

**Phase-in of Alternative 3 Stringency** - AAPC recommends a phased-in approach to the full 2027 model year stringency rather than applying a constant 2.5% per year improvement rate to both gas and diesel vehicles standards similar to what was done by the agencies in the Phase 1 rule. [EPA-HQ-OAR-2014-0827-1238-A1 p.2]

### **Need for Customer Acceptance**

AAPC strongly believes that the Phase 2 program must continue to recognize the unique functionality and utility needs of the trucking industry, and that this regulation must preserve the performance integrity and capability of these work trucks. Consumers value the payload and towing capabilities these work vehicles offer and the Phase 2 standards proposed by EPA and NHTSA should continue to align with the industry and business needs of this demographic. [EPA-HQ-OAR-2014-0827-1238-A1 p.6]

There are a couple of very important trends apparent with the customers who purchase vehicles impacted by this regulation. First, the heavy-duty customer is clearly different than the light-duty customer. This is evidenced in that the most important reason for purchase, across the segment, is capability. Research suggests that heavy-duty customers are five times more likely to cite towing requirements than any other single reason for purchase. Second, the heavy-duty customer is most likely to purchase a truck for fleet/commercial needs. Commercial customers view the vehicles as tools to get their jobs done and as pivotal to the underlying success of their business. Customers value proven and durable vehicles with powertrains that meet their capability needs with minimal down-time. The total cost of ownership is an important consideration in this segment. The significant price premium associated with advanced technologies has the potential to upset a demanding customer base. This would be exacerbated if the technologies prove to have little to no benefit on actual, real-world fuel consumption, such as those technologies whose impact is minimized under heavy loads. [EPA-HQ-OAR-2014-0827-1238-A1 p.6-7]

AAPC commends the agencies for repeatedly commenting on the need to preserve consumer choice—that is, the proposed standards should not affect consumers’ opportunity to purchase a vehicle with the performance, utility and safety features that meets their needs. AAPC agrees and supports the use of sales data, showing how customers critically balance capability with value, as highly indicative of the demanding requirements within this segment of vehicle owners and operators. [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

### **Implicit and Explicit Challenges of Alternative 3**

For the 2b/3 heavy-duty truck and van fleet, the Phase 2 rule’s Alternative 3 is aggressive and will challenge industry. It is concerning that there have been calls for even greater stringency beyond the aggressive standards proposed by EPA and NHTSA for Phase 2. The following factors must be addressed when evaluating stringency: [EPA-HQ-OAR-2014-0827-1238-A1 p.8]

- **Limited real data for setting standards** - Manufacturers, the agencies and all other stakeholders have a limited amount of real data under the Phase 1 program. While the light-duty vehicle fleet has been regulated under NHTSA’s CAFE program for roughly forty years, we are

still very early in the Heavy-Duty program. Effectively, we have only one full model year of industry data “under our belt.” [EPA-HQ-OAR-2014-0827-1238-A1 p.8]

- **High levels of technology in baseline fleet** - The baseline fleet has a high percentage of advanced diesel technology making additional improvements considerably more challenging. In the light-duty fleet, diesel technology accounts for 3% of fleet. In the heavy-duty fleet, diesels account for over 50% of fleet. Advanced diesel aftertreatment (i.e., SCR) presented the greatest opportunity for increased efficiency. However, it has already been applied to 100% of the Class 2b/3 diesel fleet today.
- **Customer demand for more technology** - Customer acceptance of vehicles with increasing technology could be challenging for a customer base which has continually expressed a focus on proven capability and utility. This is exacerbated by the forecast of sustained low oil prices (EIA reference) which will limit a customer’s willingness to pay for increased fuel economy. Throughout the NPRM, the agencies repeatedly reference outstanding questions regarding the relative risks in adopting alternative 4. AAPC agrees and is concerned that the required technology penetration rates for alternative 4 places too much emphasis on early introduction of advanced technology vehicles that are not yet part of this market. In addition, this risk places manufacturers in considerable jeopardy for non-compliance should a given technology not develop or make the expected fuel economy gains. [EPA-HQ-OAR-2014-0827-1238-A1 p.8]

[Table VI-21 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

- **Phase 2 technologies being used today** - These work trucks have a wide range of “duty-cycles” so assuming that a specific technology path will be valued by all customers equally is inappropriate. All stakeholders need to learn more about customer acceptance in this very diverse base. For example, FCA’s modern gasoline engine has robust combustion with multiple spark plugs, variable cam phasing, cylinder deactivation, and cooled EGR. These last two technologies (cylinder deactivation and cooled EGR) are suggested Phase 2 gasoline engine technologies (80 Federal Register 40351). Even with this level of gasoline engine technology, FCA is challenged by the early year Phase 1 standards and will need to look at adding even more technology for Phase 2. [EPA-HQ-OAR-2014-0827-1238-A1 p.9]
- **“Downsizing” and “boosting” could be at odds with capability needs** - Smaller displacement boosted gasoline engine technology may be applicable in some variants of commercial vans, as noted by Ford product actions. However, this technology is not suited for the pickup truck variants in this segment because of customer demands for towing capability. The graphic below illustrates fuel usage (brake specific fuel consumption vs kilowatts) effects from boosted engines while doing work. A downsized boosted gasoline engine will use more fuel compared to a larger naturally aspirated heavy-duty engine at higher loads as illustrated by the blue and black lines in the figure below. [EPA-HQ-OAR-2014-0827-1238-A1 p.9]

[Chart of Engine BSFC and Engine Power can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

- **Concurrent reductions in criteria emissions** – The concurrent stringency increases in Tier 3/LEV III criteria emission requirements will negatively impact CO<sub>2</sub> and fuel consumption. For example, there will be increased thermal loads, space velocity and NO<sub>x</sub> flux demands on aftertreatment systems during US06 testing (e.g., enrichment) that will negatively impact CO<sub>2</sub> performance. [EPA-HQ-OAR-2014-0827-1238-A1 p.10]
- **Tier 3 emissions alignment with Phase 2 GHG stringency** - The Phase 2 GHG draft RIA and supporting technical analysis are incomplete and understate the actual stringency on chassis certified Class 2b/3 products for all alternatives. Specifically, the negative aspects of recently

released Tier 3 criteria emissions rules relative to GHG and fuel consumption are omitted from the analysis. AAPC requests that the impact of Tier 3 criteria emissions on the Phase 2 GHG proposal for 2019 – 2027MY be incorporated into cost, benefit, and technology projections and assumptions. [EPA-HQ-OAR-2014-0827-1238-A1 p.10]

AAPC estimates that the full impact of Tier 3 / LEV III requirements in 2025MY will result in an effective stringency increase of >4% for gasoline spark ignited engines and >5% for compression ignition engines. Furthermore the technologies and costs needed to make up the difference do not appear to be incorporated into the existing RIA. [EPA-HQ-OAR-2014-0827-1238-A1 p.10-11]

[Table of Tier 3 and engine response and fuel consumption can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

### **Phase-in of Alternative 3 Stringency**

The class 2b/3 pickup trucks and vans regulated by the NPRM have very long product lifecycles. The primary reason is the large amount of capital investment needed to update the vehicles and powertrains that must be amortized over smaller annual volumes than typical light-duty vehicles. Because very few of the components, including the powertrains, are shared with light-duty vehicles, this requires a longer lifecycle in order to receive payback on the investment. [EPA-HQ-OAR-2014-0827-1238-A1 p.12]

In order to better align with the significant capital investments required to meet the ambitious proposed Phase 2 greenhouse gas and fuel efficiency standards, AAPC recommends a phased-in approach to the full 2027 model year stringency rather than applying a constant 2.5% per year improvement rate to both gas and diesel vehicles standards similar to what was done in the Phase 1 rule. Under this recommendation, manufacturers are still required to achieve the exact same 2027 requirement, but are given flexibility in the stringency to better align with the long lead time required to bring advanced technology vehicles to market. Long lead time is critical given the cumulative impact of the finalized Phase 1 and the proposed Phase 2 standards is 32.5% CO<sub>2</sub> improvement for diesel vehicles and 27.5% CO<sub>2</sub> improvement for gas vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.12]

The 14 model years covered by the finalized Phase 1 and the proposed Phase 2 standards are typically not even two complete product lifecycles for vehicles in the Class 2b/3 market. As a result, AAPC members will be required to rapidly innovate, invest and refine advanced technologies that are both appreciated and embraced by American consumers. The opportunity to phase-in to full 2027 stringency would afford manufacturers the opportunity to make the right choices for their customers while maintaining a sustainable business model. [EPA-HQ-OAR-2014-0827-1238-A1 p.12]

A phase-in approach to full stringency is consistent with how Phase 1 standards were handled (76 Federal Register 57293 Table VI-3): [EPA-HQ-OAR-2014-0827-1238-A1 p.12]

[Tables, of estimated total vehicle CO<sub>2</sub> reductions for HD Pickup Trucks and Vans, and model year percentage reductions, can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

Revising both the gas and diesel coefficients for the 2021-2026 model years to reflect the AAPC proposal above would be consistent with the approach the agencies used in the Phase 1 regulation and would help manufacturers manage the long lead time associated with developing the new vehicles and powertrains that will be required in order to comply with the Phase 2 proposal. [EPA-HQ-OAR-2014-0827-1238-A1 p.13]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

### **Heavy-duty pickups and vans**

Heavy-duty gasoline and diesel pickups and vans will reduce their fuel consumption by 16% each in 2027 relative to the 2018 standards (p. 40338). Figure 2 uses the data in the rule docket for MY 2014<sup>17</sup> heavy-duty pickups and vans to display the distribution of models relative to the Phase 1 standards for 2014 and 2018. Two observations from the data relevant to the discussion below are: 1) work factor is a far better predictor of fuel efficiency for pickups than for vans; and 2) at present, diesel vehicles approach 2018 targets, while gasoline vehicles are approximately at 2014 target levels.

[Figure 2 can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

### Standards for gasoline pickups and vans

The Phase 2 gasoline engine package draws primarily on research done by Southwest Research Institute (SwRI).<sup>19</sup> SwRI evaluated a host of technologies that were deemed suitable for the Phase 2 timeframe. Engine technologies for gasoline pickups include cylinder deactivation, variable valve actuation/lift, and friction reduction. Vehicle and transmission technologies include 8-speed transmission with high efficiency gearbox, aero drag reduction, low rolling resistance tires, mass reduction, accessory improvement, low drag brakes, and hybrids. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]

There is room for substantial improvement in the agencies' gasoline package, both in technology effectiveness and in technology penetration. The agencies sometimes use lower effectiveness values than SwRI finds, without providing justification. For example, agency effectiveness numbers for cylinder deactivation, variable valve lift and turbodownsizing were much lower than the SwRI estimates. The agencies assumed 22% penetration of cylinder deactivation and variable valve lift, which is conservative. Considering the expected adoption of these technologies in light-duty vehicles and considering the Phase 2 timeframe, we assume 50% penetration of these technologies in 2027. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]

A major shortcoming of the agency package is the absence of turbodownsizing for gasoline pickups, although they used this technology for gasoline vans. Downsized, turbocharged engines offer a major opportunity to improve gasoline vehicle fuel efficiency. SwRI compared a 6.2-liter V-8 gasoline engine to a simulated downsized 3.5-liter V-6 and found 16% fuel savings. The National Academy of Sciences (NAS) study found turbocharged downsizing benefits in the range of 10–14%. Downsized, turbocharged engines played a major role in the agencies' compliance scenario for the light-duty fuel efficiency standards for model years 2017–25; the LD rule found 12.3% savings for 33% downsizing with turbocharging.<sup>20</sup> A gasoline engine largely can retain its performance when downsized and turbocharged, but fuel savings benefits may be reduced or eliminated at high load operation, including towing. This technology is therefore especially suitable for vehicles not regularly employed in heavy towing. We assumed that at least 10% of pickups will adopt turbodownsizing in 2027 timeframe. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]

The agencies did not consider cooled exhaust gas recirculation for gasoline pickups. Cooled EGR can reduce the fuel consumption of both direct-injected and port-injected gasoline engines by reducing pumping losses, mitigating knock, cooling the exhaust, and eliminating the need for fuel enrichment.<sup>21</sup> SwRI found 3.7% savings from cooled EGR. We assumed this technology only for pickups and vans with turbocharged, downsized engines. [EPA-HQ-OAR-2014-0827-1280-A1 p.22]

Inclusion of hybrids in the agency package (10% for pickups, 6% for vans) is a positive step. The agency estimate of 6% potential hybrid penetration for vans is likely too low, given that most of these vehicles have urban and vocational-like operation. [EPA-HQ-OAR-2014-0827-1280-A1 p.22]

In light of the above discussion, the standards for gasoline pickups and vans should reflect:

- Increased penetration of cylinder deactivation and variable valve timing. Use these technologies for at least 50% of pickups. [EPA-HQ-OAR-2014-0827-1280-A1 p.22]
- Increased the penetration of GDI and turbodownsizing to at least 10% of pickups and use cooled EGR for all downsized pickups and vans. [EPA-HQ-OAR-2014-0827-1280-A1 p.22]
- The existing hybrid assumption (10% and 6% for pickups and vans by 2027) [EPA-HQ-OAR-2014-0827-1280-A1 p.22]

Tables 4 and 5 compare technology effectiveness and penetration, respectively, for the agency package (Table VI-5, p. 40356) and in our estimate. [EPA-HQ-OAR-2014-0827-1280-A1 p.22]

[Table 4 can be found on p.22 and Table 5 can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

The estimate of overall fuel consumption reductions needs to account for possible overlaps in benefits. For engine and transmission technologies, there is a risk of double-counting benefits when more than one technology in a package addresses the same efficiency losses. A recent ACEEE report discusses the overlapping of benefits for gasoline pickups and vans engine and transmission technologies and develops a correction factor of 23%.<sup>22</sup> Using a multiplicative approach to combining technology benefits, and applying the adjustment for overlapping of benefits, we estimate that the technologies considered above, when applied at the revised penetration rates shown in table 5, provide a 22% average reduction in fuel consumption for gasoline vehicles and vans relative to Phase 1 level, as shown in table 6. [EPA-HQ-OAR-2014-0827-1280-A1 p.23]

[Table 6 can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

This increment in gasoline pickups and vans will promote the integrity of the pickup market in two ways: it will reduce the fuel economy gap between these pickups and full-size light-duty pickups; and it will help reduce the efficiency gap between heavy-duty gasoline and diesel vehicles. Heavy-duty gasoline pickups, according to the Phase 2 proposal, will attain 19.5 miles per gallon (mpg), on average, in 2025 while contemporary LD pickups will average 32.5 mpg in 2025,<sup>23</sup> as shown in table 7. That is, LD pickups will have more than 50% higher fuel economy than HD gasoline pickups and vans will achieve in 2025. Heavy duty pickups and full-size light duty pickups often use similar engine, vehicle, and transmission technologies and are tested on the same test cycles with same cycle weighting for certification,<sup>24</sup> but at different weights. When light-duty fuel economy is corrected for the difference in test weights, the discrepancy is still 43%. Any gap between fuel economy requirements for LD and HD pickups for which there is no engineering rationale could produce distortions in the pickup market, shifting sales toward the heavier vehicles. [EPA-HQ-OAR-2014-0827-1280-A1 p.24]

[Table 7 can be found on p.24 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

Standards for diesel pickups and vans

The agencies' technology package for diesel pickups and vans uses the same vehicle and transmission technologies as the gasoline package. Their engine package is not fully explained. The Phase 2 proposal

says: “Diesel engines in the HD pickup and van segment are expected to have several improvements in their base design in the 2021–2027 timeframe. These improvements include items such as improved combustion management, optimal turbocharger design, and improved thermal management” (p. 40352). The diesel engine technology evaluation, however, estimates savings from friction reduction, turbo efficiency improvement, and engine downsizing. [EPA-HQ-OAR-2014-0827-1280-A1 p.24]

Although the agencies made a more conservative estimate of the potential for friction reduction than the estimate from SwRI, estimates of effectiveness for turbo efficiency improvement and diesel engine downsizing were the same as SwRI estimates. However, the agencies assume zero penetration of engine downsizing for pickups. While the majority of these pickups may carry substantial loads and need high towing capacities, some have low payload and towing capacities, and would be candidates for engine downsizing. In the case of diesel vans, engine downsizing is already occurring. Some manufacturers are providing this option, and its penetration is likely to increase overtime. We estimate 10% penetration of engine downsizing for pickups and 30% penetration for vans in 2027. We also assume 6% penetration of hybrids in vans, similar to gasoline vans. [EPA-HQ-OAR-2014-0827-1280-A1 p.25]

After accounting for the losses from overlapping of benefits for these vehicles, we estimate overall fuel consumption reductions of 18% reduction for diesel pickups and vans beyond Phase 1 in 2027, an additional 1.6% improvement from the agency estimate. Table 8 outlines the proposal and our estimate for Phase 2. [EPA-HQ-OAR-2014-0827-1280-A1 p.25]

[Table 8 can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1280-A1]

*Recommendation: Stringency of standards for heavy-duty pickups and vans* [EPA-HQ-OAR-2014-0827-1280-A1 p.23]

- Increase the 2027 targets for gasoline pickups and vans by 7% to reflect the adoption of advanced technologies. [EPA-HQ-OAR-2014-0827-1280-A1 p.23]
- Consider downsizing for diesel pickups with low work factor and vans, and increase the 2027 targets by 2%. [EPA-HQ-OAR-2014-0827-1280-A1 p.23]

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<sup>17</sup> Market-data\_2014-10-28\_CBI\_2b3\_MY2014\_PB-3606. Rule docket.

<sup>18</sup> <http://www.autonews.com/article/20140804/OEM/308049927/ford-gm-play-with-numbers-for-bragging-rights>.

<sup>19</sup> Commercial Medium- and Heavy-Duty Truck Fuel Efficiency Technology Study – Report #1. NHTSA report no. DOT HS 812 146, June 2015. Submitted to the Phase 2 rule docket.

<sup>20</sup> “Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards.” Final Rule. *Federal Register* 77 (199). October 15, 2012

<sup>21</sup> “Cool and Clean: Cooled EGR Improves Fuel Economy and Emissions in Gasoline Engines.” *Technology Today* (Summer): 1013. <http://www.swri.org/3pubs/today/Summer10/PDFs/Clean-and-Cool.pdf>

<sup>22</sup> Khan and Langer. 2015. “Fuel Efficiency and Greenhouse Gas Emissions Standards for Heavy-Duty Pickups and Vans: Phase 2.” ACEEE research report T1501. <http://aceee.org/research-report/t1501>

<sup>23</sup> Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards.” Final Rule. *Federal Register* 77 (199). October 15.

<sup>24</sup> “Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engine and Vehicles.” EPA-420-R-11-901. <http://www.epa.gov/oms/climate/documents/420r11901.pdf>.

<sup>25</sup> The standards for gallons per 100 miles would continue to differ, due to the difference in energy content of the two fuels.

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

### **Heavy-Duty Pickups and Vans**

The SwRI report<sup>23</sup> updated the benefits of mild and full (parallel) hybrids for heavy-duty pickups and vans. The cycle weighted effectiveness of mild hybrids at ALVW (test weight) was 40% higher than the agency estimate, while full hybrids had a small increase in benefit. The aero and tire benefits for these vehicles were also higher than the agency estimate. [EPA-HQ-OAR-2014-0827-1896-A1 p.7]

#### Impact on proposal

The agencies should strengthen the standards for heavy-duty gasoline pickups and vans to reflect a reasonable penetration of mild and full hybrids in 2027. [EPA-HQ-OAR-2014-0827-1896-A1 p.7]

**Organization:** California Air Resources Board (CARB)

### **Oppose/Requested Change Comment**

#### **Comment - Proposed heavy-duty pickups and vans (class 2b/3) standards should be strengthened**

The NPRM solicits comment on Alternative 4 for heavy-duty pickups and vans, which would result in approximately the same Phase 2 program stringency increase of about 16 percent compared to Phase 1 but would do so two years earlier, in MY 2025 rather than in MY 2027. Alternative 4 would require CO2 reductions of 3.5 percent per year from 2021 to 2025, whereas Alternative 3 would require CO2 reductions of 2.5 percent per year from 2021 to 2027. We encourage U.S. EPA and NHTSA to accept Alternative 4 rather than Alternative 3 for heavy-duty pickups and van. [EPA-HQ-OAR-2014-0827-1265-A1 p.64]

CARB staff believes that Alternative 4 for heavy-duty pickups and vans is technologically feasible, cost-effective, and superior to Alternative 3 for the following reasons: [EPA-HQ-OAR-2014-0827-1265-A1 p.64]

- **The projected payback period for Alternative 4 is still acceptable and only a few months longer than the projected payback period for Alternative 3.** Alternative 4 is projected to pay back in 34 months versus 26 months for Alternative 3 (or 34 months versus 31 months if a dynamic baseline is used), and hence adds only 3 to 8 months to the expected payback period.



Both alternatives pay back in the third year of ownership which is still expected to be well within the period vehicles are owned by the first buyer. [EPA-HQ-OAR-2014-0827-1265-A1 p.65]

- **Alternative 4 is significantly less stringent than the standards light-duty pickup trucks will be meeting in the same timeframe.** Heavy-duty pickups and vans are very similar to light-duty pickup trucks but have higher load and towing capacity requirements. Both groups of vehicles are manufactured by many of the same manufacturers (Ford, General Motors, and Fiat/Chrysler) and utilize comparable engine and vehicle technologies. For this reason, both groups would have similar routes to achieving GHG emission reductions. Furthermore, continuing availability of advanced technology credits (see page 69) would provide additional technology flexibility to manufacturers in achieving reductions beyond alternative 3. For light-duty pickups, U.S. EPA and NHTSA have set GHG emission standards that would reduce emissions by 3.5 percent per year from MYs 2017-2021 and 5 percent per year from MYs 2022-2025. For a typical light-duty pickup, the resulting CO2 standard would be 203 grams per mile (g/mi) by 2025. [EPA-HQ-OAR-2014-0827-1265-A1 p.65]

Alternative 4 would require a 3.5 percent per year improvement in CO2 emission reductions from MYs 2021-2025 and result in an average CO2 standard of 458 g/mi in 2025. Even under Alternative 4, the standard for heavy-duty pickups and vans would be more than double the allowable CO2 emissions for light-duty trucks in the same time period. [EPA-HQ-OAR-2014-0827-1265-A1 p.65]

**Alternative 4 achieves greater emission benefits and greater net societal benefits than Alternative 3.** As summarized in Table 13, Alternative 4 for heavy-duty pickups and vans would achieve an additional 21 MMT of CO2 reductions and \$2.3 billion in societal benefits in the U.S. [EPA-HQ-OAR-2014-0827-1265-A1 p.64]

[Table 13 can be found on p.65 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

**Organization:** Center for Biological Diversity

#### *Heavy-duty Pickups and Vans*

The Proposed Rule fails to apply a number of light-duty pickup/van technologies to heavy-duty pickups and vans, contrary to the technology-forcing nature of the governing statutes. Light duty pickups, along with passenger cars are subject to separate CAFE standards. The CAFE standards for model years 2017 - 2025 are more stringent than the proposed requirements for heavy-duty pickups: large light-duty pickups and vans must reduce emissions by approximately 41 percent between 2012 and 2025, with 32 percent of the reduction due to the most recent CAFE standards for years 2017 to 2025. In contrast, the proposed standards would require medium- and heavy-duty pickups and vans to reduce emissions by only about 24 percent over a similar span of years between 2014 and 2027, with approximately 16 percent of the reduction due to the current rulemaking for years 2017 to 2027. This amounts to only about half the fuel savings in medium- and heavy-duty pickups and vans relative to their lighter duty counterparts. Despite the differences in efficiency standards, analyses by the International Council on Clean Transportation (“ICCT”) and the American Council for an Energy-Efficient Economy have found that manufacturers could apply – and often already are applying – these same technologies to heavy-duty pickups, with the result that much greater efficiency improvements can be achieved in medium- and heavy-duty pickups and vans than currently proposed.<sup>32</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.8]

Just one example: Ford has achieved significant and rapid improvements in fuel efficiency with its F-150 through engine technological advances, weight reduction and start-stop technology to reduce

idling.<sup>33</sup> All of these can be applied equally to medium duty pickups. [EPA-HQ-OAR-2014-0827-1460-A1 p.9]

Closing the gap between large light-duty and heavy-duty pickups and vans is crucial because the overlap in many characteristics allows manufacturers to essentially choose to classify a pickup as “heavy duty” to avoid the more stringent requirements for “light duty” pickups through minor adjustments to the vehicle. Market information is scarce, but there is some evidence that this type of regulatory avoidance is already occurring.<sup>34</sup> This means that large light-duty standards may interact with the proposed standards for heavy-duty pickups. Due to their potential influence on manufacturers’ behavior, the large light-duty pickup standards should be treated as “fuel economy regulations by the government” under EPCA and EISA and be analyzed in the context of what constitutes the maximum feasible improvement for heavy-duty pickups and vans. Creating an incentive through rulemaking for manufacturers to avoid feasible, cost-effective, and already in-use fuel efficiency measures is arbitrary and capricious. [EPA-HQ-OAR-2014-0827-1460-A1 p.9]

The Proposed Rule simultaneously acknowledges the potential for technology migration between large light-duty and heavy-duty pickups/vans and then dismisses the importance of many of these technologies. The available data suggest that the agencies have been too quick to dismiss the potential for technology migration, even if the overall improvements in fuel efficiency are less for heavy duty than light duty pickups and vans. [EPA-HQ-OAR-2014-0827-1460-A1 p.9]

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32 ICCT Pickup Report, *supra* note 27; ACEEE Standards for Pickups, *supra* note 28 at 12.

33 ICCT Pickup Report, *supra* note 27.

<sup>34</sup> *Id.* at 4-8.

**Organization:** Daimler Trucks North America LLC

**Proposed HD Pickup and Van Standard (80 FR 40334)** - The proposed Phase 2 standards can support environmental protection and reduce energy consumption. However, the proposed heavy-duty pickup and van standard, with a total stringency of about 16 percent for Phase 2 and an annual increase of approximately 2.5 percent during model years 2021 to 2027, is a challenge for automotive manufacturers. Under certain conditions, such a standard may necessitate hybridization of the affected vehicle fleet, which would require substantial development and material costs. All technologies taken into account for Class 2b/3 stringencies should reflect cost effectiveness calculations, especially alternative powertrains such as hybrids, battery, and fuel cell driven electric vehicles. Daimler recommends that EPA adopt the proposed standard over Alternative #4, as the additional two years of lead-time will be critical for automotive manufacturers in developing the necessary technologies to achieve compliance. [EPA-HQ-OAR-2014-0827-1164-A1 p.112]

**Organization:** FCA US, LLC

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 60-61.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 132-134.]

We continue to support EPA and NHTSA's attribute-based standards that recognize the utility and functionality of these work trucks. Payload and towing capacity are important to the owners of these work trucks. These work factor-based standards acknowledge the inherently higher greenhouse gas emissions and fuel consumption of higher capability vehicles.

While the light duty fleet has been regulated under NHTSA's Café Program for roughly 40 years, we are still very early in the Heavy Duty Program. We formally have one full model year of industry data under our belt. Given this limited baseline of real data, it is concerning that there have been calls for even greater stringency beyond the aggressive standards proposed by EPA and NHTSA for Phase 2. Comments regarding stringency need to address the many contributing factors, both explicit and implicit. These factors include, but are not limited to, the fact that these are work trucks, and there's a wide range of duty cycle so the values of the different technologies vary from a customer perspective.

We're challenged by year-over-year stringency increases with effectively only two products, a pickup truck and a van, to average in the 2B and 3 segment. The concurrent stringency increases, I think Ford mentioned earlier in the II and LEV III criteria emission requirements and how to manage the increased thermal loads on the after treatment systems while we continue to improve fuel economy.

The impact of changing test fuels and the test procedure adjustments that will be needed are unknowns at this point. Additional technology will be needed going forward given that some of the Phase 2 technologies are already in our fleet today. We have to take that into account, for example, FCAUS cylinder deactivation and cool EGR in today's vehicles, making these technologies unavailable for improvements in Phase 2.

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 101-102.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 120-121.]

Second, the program must continue to recognize the unique functionality and utility needs of the trucking industry, and that we provide vehicles that preserve the performance integrity of these work trucks. Consumers value the payload and towing capabilities that these working vehicles offer, and the work factor-based standards set by EPA and NHTSA should continue to align with the industry and business needs of this demographic.

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 103-104.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p.122-123.]

The agencies' proposed Class 2B-3 standards, which are based on Alternative 3 in the Notice of Proposed Rulemaking, will continue to drive innovation, and will drive General Motors to Invest in and refine new technologies that are both appreciated and optimized by American consumers. We cautiously support this path based on Alternative 3 for future emission reduction standards. This path will challenge our product plan and drive considerable technology into our heavy duty trucks and vans.

Finally, the program must attempt to minimize the potential for unintended consequences, especially for the consumer. The heavy duty fleet does not benefit from the years of data that have been collected and analyzed for the light duty fleet. Indeed, comprehensive data for this private segment is only now being accumulated and analyzed for the 2014 model year, which is the first year of Phase 1 of the medium and heavy duty truck regulations.

Year-end reports for 2014 were due to EPA by the end of March 2015, so this first year of comprehensive industry-wide data is still fairly new. This new data should be carefully evaluated and then compared to the estimates and assumptions that form the basis for both Phase 1 and the proposed Phase 2 of the heavy duty regulations.

Further, the utility provided and the duty cycle of these vehicles is completely different from the light-duty fleet. And any attempt to force more stringent regulations, such as alternative 4, would be extremely detrimental to manufacturers, consumers, the U.S. economy, and the millions of transportation-related jobs. Indeed, comprehensive data for this product segment is only now being accumulated and analyzed for the 2014 model year, which is the first year of phase 1. The data should be carefully evaluated by the technical experts at the agencies and compared to the estimates and assumptions that form the basis for both phase 1 and the proposed phase 2 regulations.

**Organization:** International Council on Clean Transportation (ICCT)

- *Heavy-duty pickups and vans* – The technology availability from full-size body-on-frame light-duty pickup trucks is far greater than the efficiency technology applied in the agencies proposed 2027 pickup and van stringency determination. The agencies have applied technology improvements over 2018-2027 at about two-thirds the rate of the comparable full-size, body-on-frame light-duty pickups (i.e., 1.9% annual improvement for heavy-duty versus 2.7% for light duty). Advancing the proposed standards by three years would still keep the heavy-duty pickup and van standards well within known technologies that have already been proven out in much larger numbers in the light-duty space. More specifically regarding the applicable technologies, the major pickup and van manufacturing companies are already deploying the efficiency technologies in the heavy-duty Class 2b/3 space. For example, Ford, General Motors, Chrysler, and Daimler are applying lightweighting, downsized turbocharged engines, stop-start, cylinder deactivation, and automated manual transmission technologies in their heavy-duty products (Lutsey, 2015c, 2015d). [EPA-HQ-OAR-2014-0827-1180-A4 p.5]

### **Heavy-duty pickups, vans, and vocational vehicles**

*Pickup and van technology.* Based on our extensive analysis in this area, the proposed heavy-duty pickup and van, as well as gasoline efficiency, standards appear to fall significantly short in their promotion of the full technology potential, based on the ICCT's recent research in this area (Lutsey, 2015c,d), as well as Reinhart (2015a, b) and Khan and Langer (2015). We summarize several points from our previous work to help inform the Phase 2 rulemaking, and direct the agencies to the underlying referenced work for the full analysis. [EPA-HQ-OAR-2014-0827-1180-A4 p.11] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.40.]]

The pickup and van manufacturers are deploying the same technologies in light-duty and heavy-duty products. The light- and heavy-duty categories are a bright-line *regulatory* distinction; however, our assessment indicates that these two classes share many commonalities and overlap in physical attributes, engineering and design, engines, vehicle size, functionality and capacity, and efficiency technology applicability. As a result, manufacturers can and do deploy many of the same efficiency technologies in light-duty pickups as in the heavy-duty space. However, the agencies include substantially lower penetration of efficiency technology in their heavy-duty analysis. For example, cylinder deactivation, downsized turbocharged engines, advanced transmissions, low-rolling resistance tires, lightweighting each have significantly lower technology penetration and lower efficiency effectiveness in the Phase 2 rulemaking, as compared to the agencies' light-duty rule. Reports from multiple sources suggest that leading companies are indeed increasingly planning to deploy their light-duty full-size pickup and van technology on their similar heavy-duty pickups and vans. Here are several such public examples -- [EPA-HQ-OAR-2014-0827-1180-A4 p.11]

- Ford: The Ford F250/F350 Super Duty trucks are headed toward application of F150 lightweighting technology for economies of scale gains, possibly as early as 2016 (Wernie, 2015), and this would mean downsized turbocharged engines, lightweighting, and stop-start technology would apply in the larger pickups and vans. Ford has indicated that it is indeed rolling out light-duty technologies on its heavy-duty vans and Super Duty trucks (Ford, 2014a b). [EPA-HQ-OAR-2014-0827-1180-A4 p.11]
- Fiat-Chrysler-Ram: Fiat-Chrysler is deploying its Hemi cylinder deactivation technology on its Ram 2500 and 3500 models (Williams, 2013). In addition, the Ram ProMaster commercial van offers downsized turbocharged gasoline and diesel engines, and is equipped with an automated manual transmission (Ram Commercial, 2014). [EPA-HQ-OAR-2014-0827-1180-A4 p.12]
- Daimler: Mercedes-Benz Sprinter commercial vans already utilize an advanced 7-speed automatic transmission and a downsized two-stage turbocharged diesel engine—for an 18% increase in fuel efficiency (Mercedes-Benz, 2014). Mercedes also has used start-stop technology on its Sprinter vans in Europe since 2009 (Abuelsamid, 2009). [EPA-HQ-OAR-2014-0827-1180-A4 p.12]

We recommend that the agencies establish commercial pickup and van CO<sub>2</sub> emission and efficiency standards that are as technology-forcing as for the full-size trucks as in the light-duty vehicle standards. The proposed Phase 2 standards for heavy-duty pickups and vans will significantly increase their fuel economy and reduce their CO<sub>2</sub> emissions, but not nearly as much as for light-duty pickups. U.S. EPA (2012) identified cost-effective technology paths to reduce the fuel consumptions and CO<sub>2</sub> emissions of full-size body-on-frame pickups and vans by 40% in the light-duty rulemaking, before considering hybridization. However the agencies, in the case for heavy-duty Phase 2, based on our analysis of the primary NHTSA data file, appears to only be calling for a reduction of heavy-duty pickup and van CO<sub>2</sub> emissions of 23% compared to a 2010 baseline. This demonstrates that the agencies are leaving a lot of highly cost-effective technologies, which are being deployed in large numbers in full-size light-duty pickups, out of their Phase 2 regulatory analysis. [EPA-HQ-OAR-2014-0827-1180-A4 p.12]

Another way to view the relative agency proposal versus the technology potential is to assess its annual rate of efficiency improvement. Although the agencies indicate the rules are reducing fuel consumption of pickups and vans by 2.5%/year, this neglects two facts: (1) the 2014 fleet is already beating the adopted regulations, and (2) there is a 2018–2020 period during which there is regulatory stability, with no movement in the standards. As a result the gasoline fleet appears to move at 2.2%/year, and the diesel fleet at 1.6%/year from 2014 through 2025 to meet the standards (Lutsey, 2015d). This compares with the light-duty standards that generally require a 4%/year reduction in fuel use, and almost 3%/year

for full-size pickups in particular, for model years 2014 through 2025. [EPA-HQ-OAR-2014-0827-1180-A4 p.12]

Based on our analysis, we recommend that the agencies develop a more stringent progression of pickup and van standards, and advance the timing several years, to be as technology-forcing as the light-duty regulations for pickups and vans and promote all the new technologies that are available. We believe that as the agencies incorporate their full analysis and inputs from the light-duty rulemaking and recent developments from leading full-size pickup technology developers the result will be closer to a 35% (rather than 23%) 2014-2025 fuel consumption reduction and a 3%/year (rather than about 1.6%-2.2%/year) annual 2014-2025 fuel consumption reduction rate. [EPA-HQ-OAR-2014-0827-1180-A4 p.12]

**Organization:** National Automobile Dealers Association (NADA)

This vehicle group includes Class 2b and Class 3 large pickups and vans not otherwise covered by the light-duty fuel economy/GHG program. They are commonly recognized as “work trucks” principally used for a variety of commercial purposes, including heavy-trailer towing, shuttle vans, and mini-school buses. They are sold by two categories of dealerships: those primarily engaged in selling noncommercial, light-duty vehicles and those primarily engaged in selling medium- and/or heavy-duty commercial vehicles. At present, Class 2b vehicles are offered by Chrysler, Ford, General Motors, and Mercedes dealers, and Class 3 vehicles by Chrysler, Ford, General Motors, Isuzu, Mercedes, and Mitsubishi-Fuso dealers. [EPA-HQ-OAR-2014-0827-1309-A1 p.8]

Like Phase 1, the proposal targets standards using an appropriate “work factor” attribute designed to reflect consideration of vehicle payload, towing capacity, and 2 or 4 wheel drive. Standards are to phased-in between MY 2021 and MY 2027, ratcheting up by 2.5 percent each model year with the goal of achieving a 16 percent improvement over Phase 1. As under the Phase 1 rule, each OEM will have its own target based on the “work factor” of the fleet it produces for sale. [EPA-HQ-OAR-2014-0827-1309-A1 p.8]

Like vocational vehicles, “work trucks” often aren’t built by a single manufacturer, but rather are completed or altered (upfitted) by body and equipment installers or truck dealerships. This reality should be taken into consideration as the standards are finalized. OEMs who build complete vehicles or cab chassis for this vehicle group indicate that while aggressive, the proposed standards are achievable through strategies such as engine downsizing, new engine and transmission technologies, and light-weighting. [EPA-HQ-OAR-2014-0827-1309-A1 p.8]

**Organization:** Nissan North America, Inc.

As set forth below, the feasibility of the proposed Phase 2 standards for Heavy Duty Pickups and Vans (HDPV) will depend on providing significant flexibilities and credit opportunities. [EPA-HQ-OAR-2014-0827-1026-A1 p.1]

The agencies have appropriately recognized that many of the technologies used to reduce greenhouse gas emissions and fuel consumption in the light duty pickup truck and van segment are not applicable at the same adoption rate and do not have similar impacts when applied to the heavy duty segment. [EPA-HQ-OAR-2014-0827-1026-A1 p.2]

Relying on aggressive application of new technology to meet the Phase 2 standards is especially difficult for a manufacturer, such as Nissan, with limited offerings and relatively low volumes in this segment. Adding to this challenge is the fact that product life cycles tend to be longer in the heavy duty segment, making it even more difficult to make fundamental changes to the vehicle architecture that could further enhance fuel efficiency. [EPA-HQ-OAR-2014-0827-1026-A1 p.2]

The agencies' expectations with regard to hybrid technologies are particularly aggressive. Nissan believes the widespread adoption of hybrid technology in the larger vehicle segments to be cost prohibitive and inconsistent with the utilitarian function of vehicles in the segment. Nissan does not expect hybrid technology to play a significant role during Phase 1 or during Phase 2 of the program. [EPA-HQ-OAR-2014-0827-1026-A1 p.2]

Nissan, however, continues to invest heavily and to improve its heavy duty gasoline and diesel powertrain technologies. As discussed with the agencies, Nissan already has planned substantial improvements that will dramatically increase fuel economy performance during Phase 1 of the program. These include improvements to both our V6 and V8 powertrains, and to both our gasoline and diesel engines. A significant amount of these improvements are being implemented in the short term and represent the best technological advances currently available. While Nissan and others will continue to invest in newer and yet more advanced technology, there is no certainty that the type of significant advances that are necessary to meet the stringent standards will be achieved. [EPA-HQ-OAR-2014-0827-1026-A1 p.2-3]

As Nissan has discussed with the agencies, the costs of translating light duty technology to the heavy duty market outweigh the company's ability to recoup those costs in the competitive HDPV market. The proposed stringency level of 2.5% annual improvement is aggressive, and will require a substantial amount of technology adoption. Even with an array of credit programs and flexibilities, it may prove extremely difficult for companies with limited offerings in the segment to meet the standards, particularly in the later years. This would include each of the credit programs discussed below at the levels suggested. [EPA-HQ-OAR-2014-0827-1026-A1 p.3]

A 3.5% per stringency level is simply not feasible. The 3.5% alternative does not provide the necessary lead-time to enable manufacturers to balance competitive market constraints with the cost of applying new technologies to a limited product offering. To the extent, moreover, that the more stringent alternative is predicated on the adoption of hybrid and electric powertrain technology, Nissan -- engineering and market leader in electric vehicles -- does not believe that such technology is feasible for this market segment. [EPA-HQ-OAR-2014-0827-1026-A1 p.3]

The structure of the HDPV program is generally consistent with the Phase 1 program, and as such, provides Nissan and other manufacturers with consistency for compliance planning. In particular, the continuation of separate standards for gasoline and diesel vehicles and the work factor attribute are both critical to maintaining such consistency. Averaging and carry forward credits are essential to provide flexibility in compliance planning. [EPA-HQ-OAR-2014-0827-1026-A1 p.3]

The standards being proposed, at 2.5% annual increase in stringency, are in and of themselves at the limits of technological feasibility during the covered time frame. Alternative 4 is beyond those limits. Both levels should be supported by the array of credit opportunities described above. Should the agencies adopt the more stringent Alternative, however, these credit programs would be essential for compliance. Without them, companies with fewer product offerings, such as Nissan, will need to consider the feasibility of this market segment. With the most advanced technologies available today already being incorporated into Nissan's offerings, the greenhouse gas reducing potential for the

medium- and heavy-duty fleets would best be achieved by accommodating lower-volume manufacturers and allowing the flexibilities to contribute to this market. [EPA-HQ-OAR-2014-0827-1026-A1 p.7]

**Organization:** Sierra Club

### **Strengthen the proposed standards for heavy-duty pickup trucks and vans**

EPA and NHTSA should strengthen the proposed standards for heavy-duty pickups and vans. Strengthening these standards will reduce the discrepancy in standards for light and heavy-duty pickups, thereby reducing the possibility of market distortions. Many technologies are already in use in light-duty pickups, they just need a regulatory push to enter the heavy-duty pickup market. [EPA-HQ-OAR-2014-0827-1277-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.189.]]

**Organization:** Union of Concerned Scientists (UCS)

#### Class 2b-3 Heavy-Duty Pick-ups and Vans

Heavy-duty pick-ups and cargo vans form a continuum between vehicles classified under the light-duty passenger vehicle standards and the vocational vehicles and tractor-trailers that many would consider “heavy-duty” trucks. As such, the regulations of these vehicles is unique within the heavy-duty space because it is based on dynamometer testing like its light-duty counterparts, but the duty cycles can be different for these vehicles because more often they are truly used as work trucks. [EPA-HQ-OAR-2014-0827-1329-A2 p.25]

Because of the close relationship between light- and heavy-duty pick-ups, it is important that the heavy-duty and light-duty vehicle standards be harmonized as much as is reasonable to minimize environmental impacts from upsizing (customers shifting from LD to HD pick-ups)—this would also broaden deployment of technologies and help bring down costs. Below are comments related to increasing the standard of gasoline (up to a 23.6 percent improvement in 2027) and diesel (up to an 18.0 percent improvement in 2027) heavy-duty pick-ups and vans as well as the test procedures used to measure compliance. The pace of these standards would not only better represent what is feasible in this timeframe—they would also more closely align with the 3- to 4-percent annual improvement for full-size light duty pick-ups. [EPA-HQ-OAR-2014-0827-1329-A2 p.25]

#### HEAVY-DUTY PICK-UP AND VAN STRINGENCY

The technology employed in Class 2b-3 pick-ups and vans should reflect the fact that these vehicles share much in common with their light-duty counterparts. Historically, heavy-duty pick-ups were a significant increase in cost above and beyond light-duty pick-ups, where the purchaser was paying for significantly higher payload and towing capacity. However, with the increasing costs of light-duty full-size pick-ups and their increase in power, payload, and towing capacity, this segment of vehicles is more of a continuum than a step increase (Table 8). It is critical that the regulations regarding the fuel economy and greenhouse gas emissions of both light- and heavy-duty vehicles be more closely aligned given the close linkage of use and applicable technologies in these fleets. [EPA-HQ-OAR-2014-0827-1329-A2 p.25]

[Table 8, 'Cost and Performance of the Ford F-Series', can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1329-A2]



In a number of cases, manufacturers are already incorporating technologies from light-duty vehicles: Ford will be moving its 2017 F-Series Super Duty pickups to an aluminum body, just like the recently redesigned F-150; the 2014 Ram 2500 and 3500 incorporated cylinder deactivation, which had previously only been available in the 1500; and Mercedes is now offering a downsized 4-cylinder diesel engine for its Sprinter vans in addition to its 6-cylinder. The standards should reflect and encourage the further adoption of all available fuel consumption reduction technologies. [EPA-HQ-OAR-2014-0827-1329-A2 p.25]

Most of the specific engine technologies that could be applied in this space overlap with the technologies detailed in the vocational vehicles section of these comments, based on research from SwRI (Reinhart 2015a,b). For gasoline-powered vehicles, these technologies include direct injection, exhaust gas recirculation, variable valve lift and timing, cylinder deactivation, friction reduction, and turbodownsizing. For diesel-powered vehicles, more efficient turbochargers, friction reduction, downsizing, and even downsizing can further reduce fuel use from the engine. While we noted only a 10 percent application of downsizing to gasoline-powered vocational vehicles, we would expect significantly higher than that for both gasoline- and diesel-powered pick-ups and vans—Mercedes already acknowledged underestimating demand for the smaller four-cylinder diesel in its popular Sprinter (Brown 2014), and the less-demanding duty cycle for many of these vehicles, including the pick-ups, should allow for a greater opportunity in downsizing of the fleet. [EPA-HQ-OAR-2014-0827-1329-A2 p.25-26]

In terms of vehicle improvements, some of these are already happening and should be taken into consideration—for example, already mentioned was the lightweighting of the Ford F-Series Super-Duty pick-ups, which will shed hundreds of pounds thanks to the use of both an aluminum body and a high-strength steel frame (Priddle 2015). This change will already result in a 5-percent reduction in curb weight of the pick-ups, which is the maximum level of reduction assumed by the agencies by 2027. In other areas of the vehicle, the agencies have largely gotten things right: reductions in aerodynamic drag and rolling resistance, an increase in the number of gears of the transmission, and the electrification of accessories will all offer significant reductions in fuel consumption from this sector. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]

Taking into account the greater adoption of downsizing and greater effectiveness of the engine technologies mentioned above, the data indicates that the agencies should be adopting a significantly higher standard for gasoline-powered pick-ups and vans. Vehicle improvements were identified from 11 to 16 percent on the regulatory cycle at 50-percent payload and 12 to 14 percent at maximum towing capability. Using the same engine packages as the vocational vehicles but with 20-percent downsizing, gasoline engine performance could improve by nearly 12 percent in the timeframe of this rule on the pick-up and van test cycles, while diesel performance could improve by slightly more than 5 percent. This would lead to gasoline pick-up standards of 23.6 percent beyond 2019 levels by 2027 and diesel standards for pick-ups and vans of 18.0 percent. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]

The agencies' proposal must be 'technology-forcing' and achieve the 'maximum feasible' reductions in the timeframe of the rule. To do this, the agencies must strengthen Alternative 4 by: [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

- Ensuring that light- and heavy-duty pick-up and van standards are more closely aligned by acknowledging the full complement of applicable technologies - this would reduce consumption from gasoline-powered pick-ups and vans by 8.8 percent and diesel-powered pick-ups and vans by 2.1 percent in 2024; and [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

**Response:**

The agencies agree that the form of the standards (work factor based) and the standard levels themselves are appropriately designed to maintain the functionality requirements of heavy duty pickups and vans while achieving emission reductions. These vehicles are purchased because of the need to perform certain jobs that cannot be performed by a light duty vehicle. By basing the standards on the working capacity by using work factor of the vehicle instead of the light duty footprint approach, these new emission standards achieve emission reductions at all the different working capacities and capabilities demanded by this segment. This approach also preserves consumer choice because consumers will seek vehicles with the necessary capabilities they require and manufacturers will design and produce vehicles for the consumer that meet new stringent emission standards solely based on the vehicle work capabilities the market demands. Consumers that need higher payload or towing or four wheel drive will purchase vehicles for that specific reason and not because of the footprint or other attribute that is not relevant to the intended use of the vehicle.

After considering the comments, EPA believes that the Phase 2 final standards that the agencies are adopting represent the most stringent standards reasonably achievable within the MY 2021-2027 period. The standards are based largely on the same technologies projected to be used in the light-duty fleet with appropriate adjustments for the heavy-duty fleet because of their specific higher load duty cycles. As described in Preamble Section VI.E.1, several technologies are projected to be used at very high adoption rates at or near 100 percent including mass reduction, 8-speed transmissions, engine friction reduction, low rolling resistance tires, improved accessories, and aerodynamic drag reductions. For gasoline engines, some commenters noted that downsize turbo engines which are projected to be used extensively in light-duty vehicles should also be relied on in the heavy-duty analysis, including for HD pickups. As discussed in Preamble Section VI.C.4.vii, the agencies agree with the comments provided by AAPC that turbo downsizing is likely to be counter-productive in heavy-duty pickups. Under heavy loads, turbo downsized engines may have higher CO<sub>2</sub> and fuel consumption than the engine it replaces. For this reason, EPA continues to believe that the technology can only be projected to be available for heavy-duty vans (and not pickups) and is projecting its use at 77 to 97 percent. NHTSA, in its method A analysis, likewise projects use of this technology only for heavy-duty vans. One commenter argued for a standard predicated on a more aggressive penetration rate for cylinder deactivation, noting that in the NPRM the agencies only projected cylinder deactivation at an adoption rate of 22 percent of the overall fleet. The commenter believes that an adoption rate of 40 percent would be more appropriate. In response, cylinder deactivation is a gasoline engine technology and EPA is projecting an adoption rate of 56 percent for pickups and an adoption rate of essentially 100 percent for the gasoline engines in vans not projected to be downsized turbo engines -- a more aggressive penetration rate than urged by the commenter. With regard to some of the other technologies selected by the agencies as part of the technology basis for the standards, UCS commented that the agencies have largely gotten things right: reductions in aerodynamic drag and rolling resistance, an increase in the number of gears of the transmission, and the electrification of accessories will all offer significant reductions in fuel consumption from this sector.

AAPC commented that some of the technologies projected for Phase 2 are actually already present on some vehicles today. The agencies acknowledge that some of the same technologies are being implemented to meet the Phase 1 standards and that higher penetration levels or additional projected technologies may be required to meet the phase 2 standards. The agencies' analysis looked at technology levels in the baseline model years of 2014 for the EPA analysis and 2015 for the NHTSA analysis, which represents the first couple of years of the Phase 1 standards where manufacturers may have already begun to add some technology. The agencies' analyses determined that some of the projected technologies may be the same as what some manufacturers choose to adapt in order to meet the final Phase 1 standards in MY2018. However, additional technologies are available beyond those

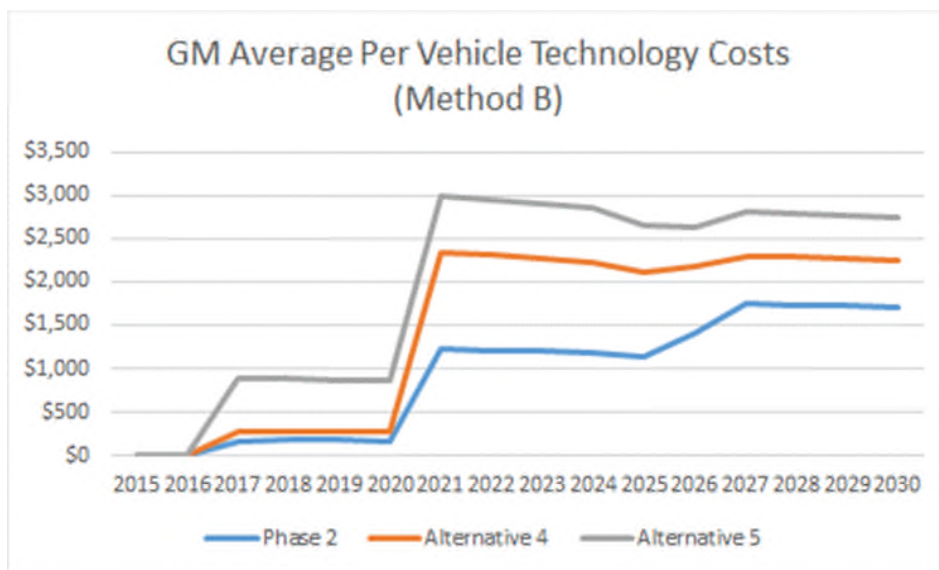
used to meet the Phase 1 standards and significant technology opportunities may only be available at vehicle redesign cycle occurring after Phase 1 and into Phase 2. Thus, addition of these more aggressive technologies before the Phase 2 rule takes effect is not an indication that the standards are insufficiently stringent. A specific example involves lightweighting, as already seen in some of the Ford pickup fleet. ICCT commented that the Ford F250/F350 Super Duty trucks are headed toward application of F150 lightweighting technology for economies of scale gains, possibly as early as 2016. As discussed above, the agencies believe that manufacturers are already beginning to select the key technologies they believe will allow them to meet the requirements for the Phase 1 program but also to prepare for the Phase 2 program in consideration of the limited opportunities to implement some of the technologies generally restricted to redesign cycles. Similar to the completely redesigned aluminum bodied MY2015 F150, Ford appears to be planning a similar lightweighting of the F250/350 in MY2017 due to the opportunity presented at the scheduled redesign cycle. The agencies anticipate that lightweighting technologies will be utilized by almost all manufacturers as a means to reduce emissions and fuel consumption of the next generation of pickups and vans.

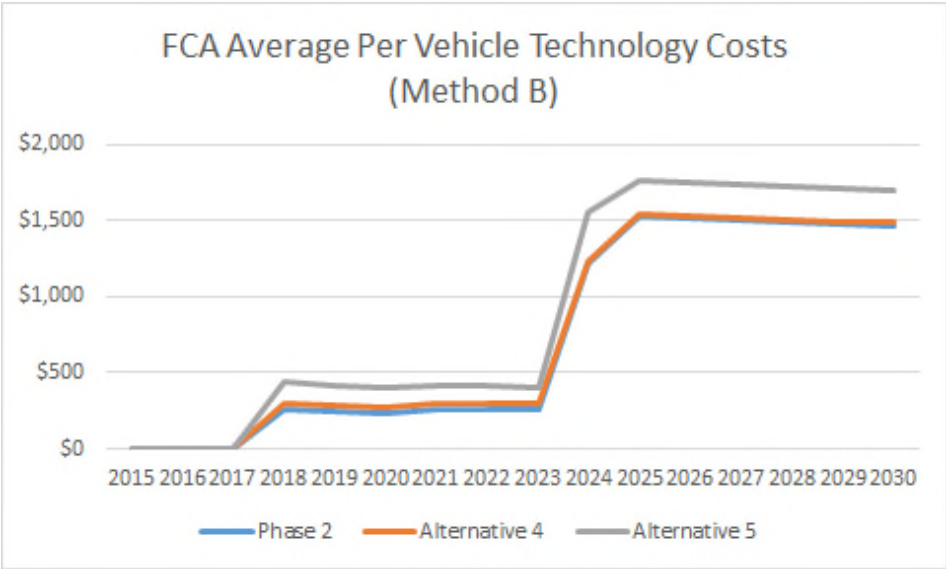
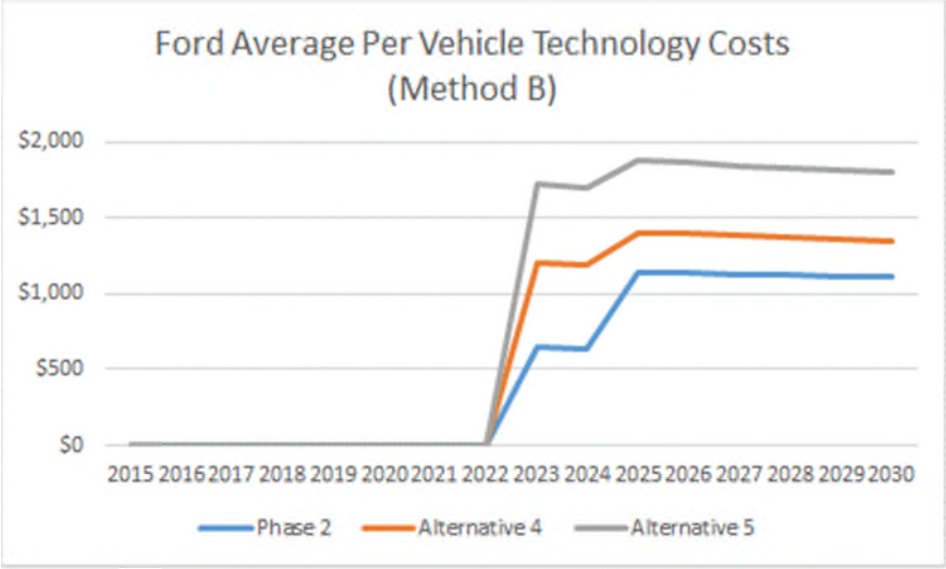
EPA also remains concerned about projecting standards predicated on high levels of hybridization in the heavy-duty pickup and van fleet. Many heavy duty applications need maximum payload and cargo volume which may compete with weight increases and lost cargo volume from hybridization, directly reducing the capability and therefore work factor of the vehicle. Additionally, it is likely not feasible to size a hybridization system to be effective for any high or maximum payload or towing operation in a heavy-duty pickup or van without changing the utility of the vehicle. A manufacturer choosing to hybridize a heavy duty vehicle would likely target vans that are primarily used for cargo volumetric capacity reasons where a reasonably sized hybrid system could be incorporated and be effective under typical operation. EPA believes that the final Phase 2 standards will drive the orderly use of strong hybrid technology (the technology path under the Method B analysis includes modest penetration rates for strong hybrids) while still providing enough lead time that manufacturers could meet the standards using technology paths other than high penetration rates of strong hybrids. Thus, the gap in stringency between light-duty trucks and the Phase 2 standards for HD pickups and vans reflects constraints of the use of some technologies in the heavy-duty market resulting from the intended use of the vehicles to do more work than light-duty trucks. In addition, it is not appropriate to simply compare the change in the light-duty pickup footprint based standards to the change in the heavy-duty work factor based standards. In an apples to apples comparison, the agencies believe that the expected improvements in overall vehicle efficiency with the addition of advanced technologies to comply with the new standards for heavy-duty vehicles expressed in the form of fuel used to transport goods likely exceeds the light duty equivalent efficiency at doing work proportional to capability.

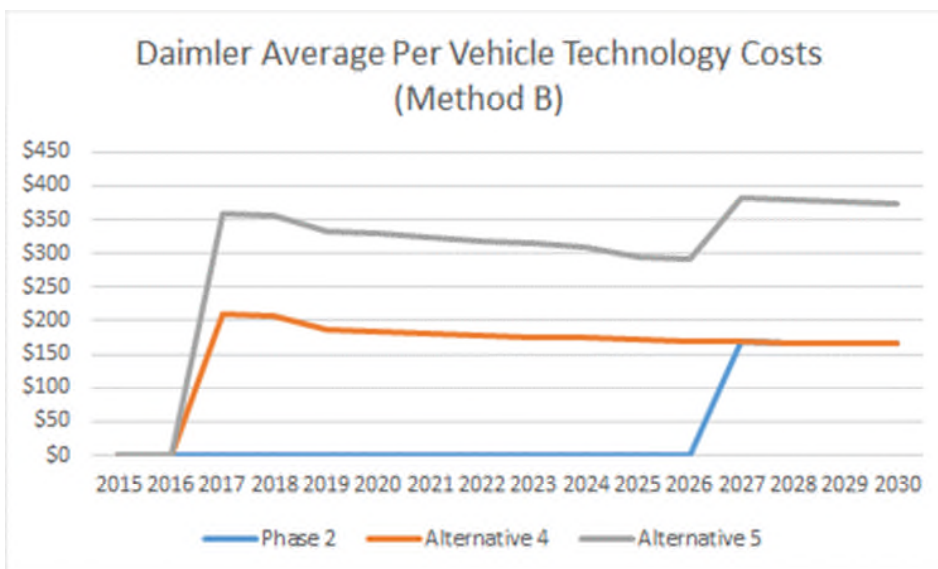
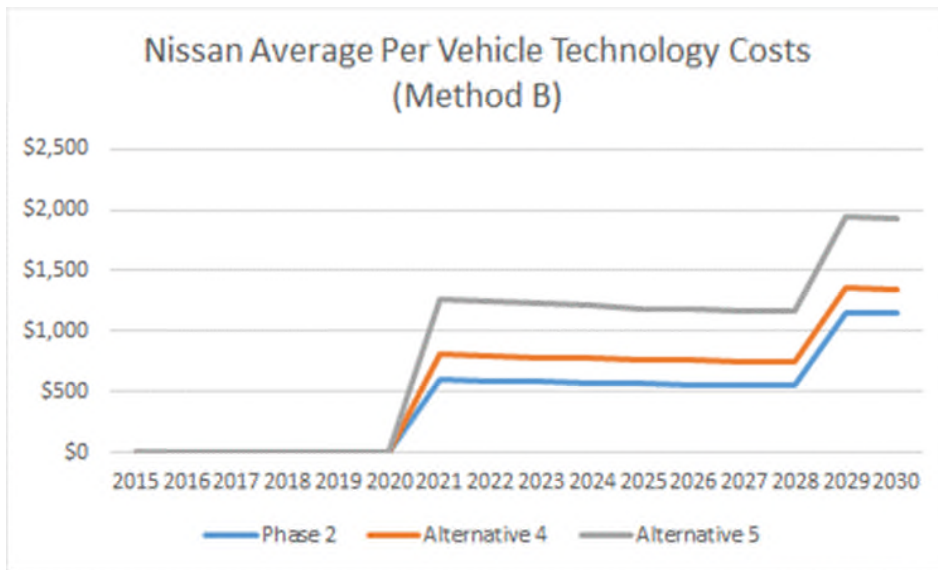
The proposed rule discussed several considerations that EPA believes remain valid. The NPRM projected that the higher rate of increase in stringency associated with Alternative 4 and the shorter lead time would necessitate the use of a different technology mix under Alternative 4 compared to the Phase 2 standards that the agencies are adopting. In EPA's Method B analysis, the Phase 2 standards are projected to achieve the same final stringency increase as Alternative 4 at about 80 percent of the average per-vehicle cost increase, and without the expected deployment of more advanced technology at high penetration levels. In particular, under EPA's primary analysis (Method B analysis), which does not constrain the use of strong hybrids, manufacturers are estimated to deploy strong hybrids in approximately 8 percent of new vehicles (in MY2027) under the Phase 2 standards, compared to 12 percent under Alternative 4 (in MY 2025). Less aggressive electrification technologies also appear on 33 percent of new vehicles simulated to be produced in MY2027 under Alternative 4, but are not projected to be necessary under the Phase 2 standards. Additionally, it is important to note that due to the shorter lead time of Alternative 4, there are fewer vehicle refreshes and redesigns during the phase-in period of MY 2021-2025. The longer, shallower phase-in of advanced technologies in the final standards allows for more compliance flexibility and closer matching with the vehicle redesign cycles,

which can be up to ten years for HD vans. While the Method B CAFE model’s algorithm accounts for manufacturers’ consideration of upcoming stringency changes and credit carry-forward, the steeper ramp-up of the standard in Alternative 4, coupled with the five-year credit life, results in a prediction that manufacturers would need to take less cost-effective means to comply with the standards compared with the final phase-in period of MY 2021-2027. The public comments from industry commenters generally confirmed that this is a realistic prediction.

The graphs below show the projected average per vehicle costs for the Phase 2 standards and Alternatives 4 and 5 for each manufacturer under the Method B analysis. As shown, in this Method B analysis, the Phase 2 standards are not projected to drive significant levels of technology prior to the start of the Phase 2 program in MY 2021. GM and FCA are projected to make some relatively small investments in technology prior to MY 2021 while Ford, Nissan, and Daimler are not projected to implement technologies to meet the standards until after the beginning of the program. These are the same projections presented at proposal, and the agencies did not receive comments disputing these technology projections for Phase 2 standards for years prior to MY 2021. Under Alternative 4, GM’s costs increase substantially, including costs prior to MY 2021. Ford’s costs are projected to almost double under Alternative 4 in MY 2023. Alternative 5 (even assuming, against our view that Alternative 5 is even technically feasible) drives these costs up even further with GM’s costs in MY 2021 projected to be about \$3,000 per vehicle. Alternative 5 also shows significantly higher costs in MYs 2017-2018 for several manufacturers, raising additional issues of feasibility for this alternative given the lack of lead time to make substantial changes in the next few years. These graphs further illustrate that the additional lead time provided by the Phase 2 standards is projected to lower costs due to the use of less advanced technology such as hybridization, including during the early years of the program.





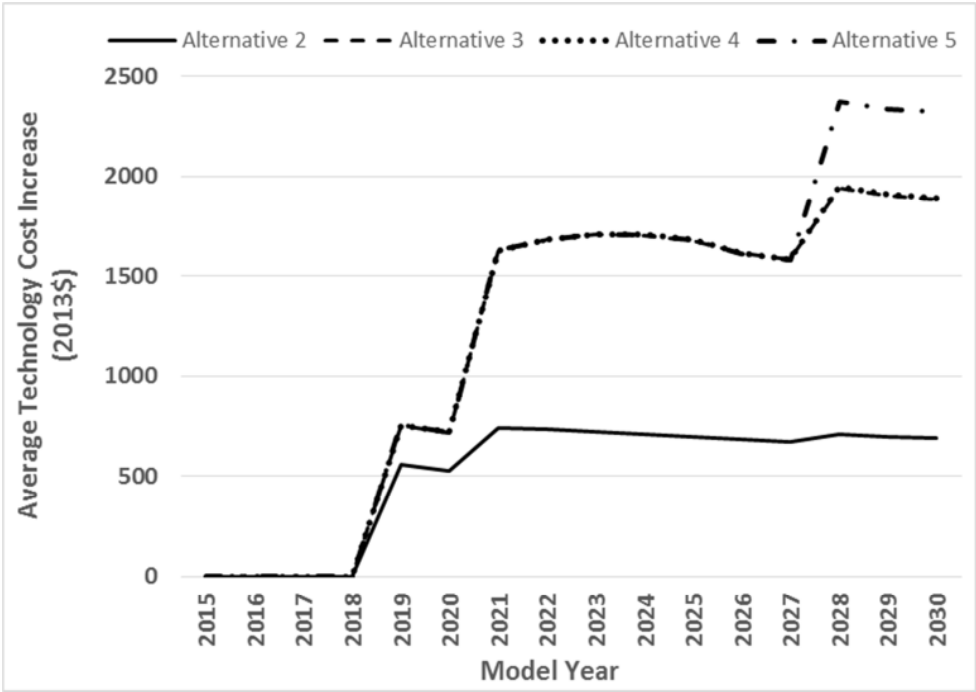


After several changes to the modeling inputs and logic, noted in Section VI.C(8) of the Preamble and Chapter 10.1.7 of the RIA, NHTSA’s Method A analysis shows that manufacturers could potentially meet standards with minimal reliance on strong hybrid technologies (2 percent under both Alternatives 3 and 4, and 7 percent under Alternative 5). The implementation and marketability of these technologies at this level of penetration of the market is no longer concerning in the Method A analysis. However, the same issue with lead-time still presents itself in the Method A analysis. The concern of lead-time leads NHTSA to reach the same conclusions about the maximal feasibility of Alternative 3.

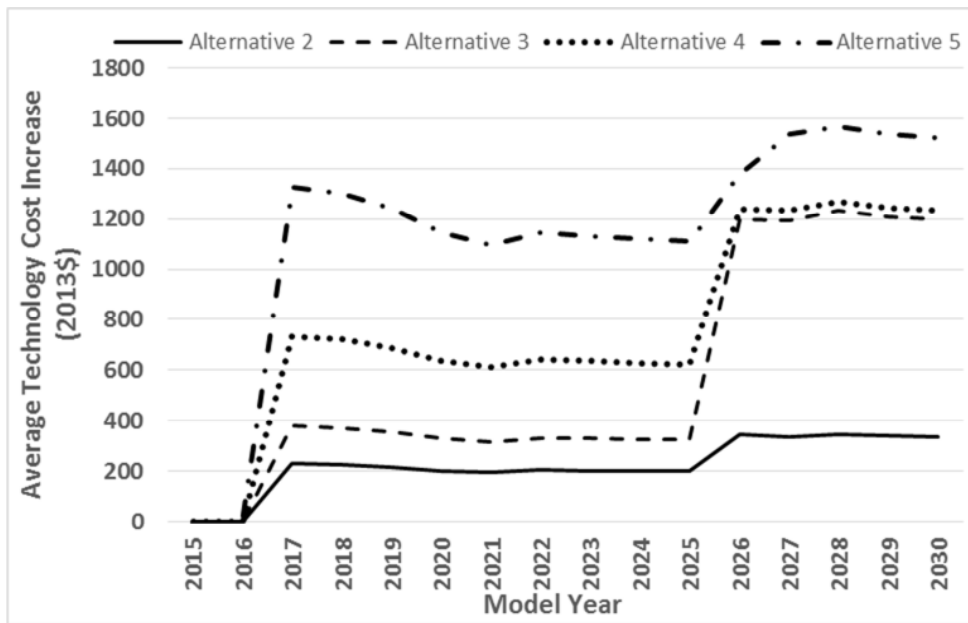
The figures below show the year-by-year average per vehicle technology costs for Method A for GM, Ford, Fiat/Chrysler, and Nissan. The simulated GM progression of technology costs is similar under Alternatives 3 and 4. However: Ford, Fiat/Chrysler, and Nissan show more technology costs in early model years under Alternative 4 rather than Alternative 3. Ford’s simulated compliance strategy shows per-vehicle technology costs of \$400 in MY 2017 under Alternative 3, \$700 under Alternative 4, and almost \$1400 under alternative 5. Alternatives 4 and 5 would put the majority of the cost burden on the

MY 2017 redesign, while Alternative 3 allows most of the cost burden to be on the MY 2025 redesign. The MY 2017 fleet will be in production at the time of publishing this rule. The next major redesign for Ford is not until MY 2025; to add an additional redesign in between the MY 2017 and MY 2025 fleet would involve much capital investment and does not seem feasible.

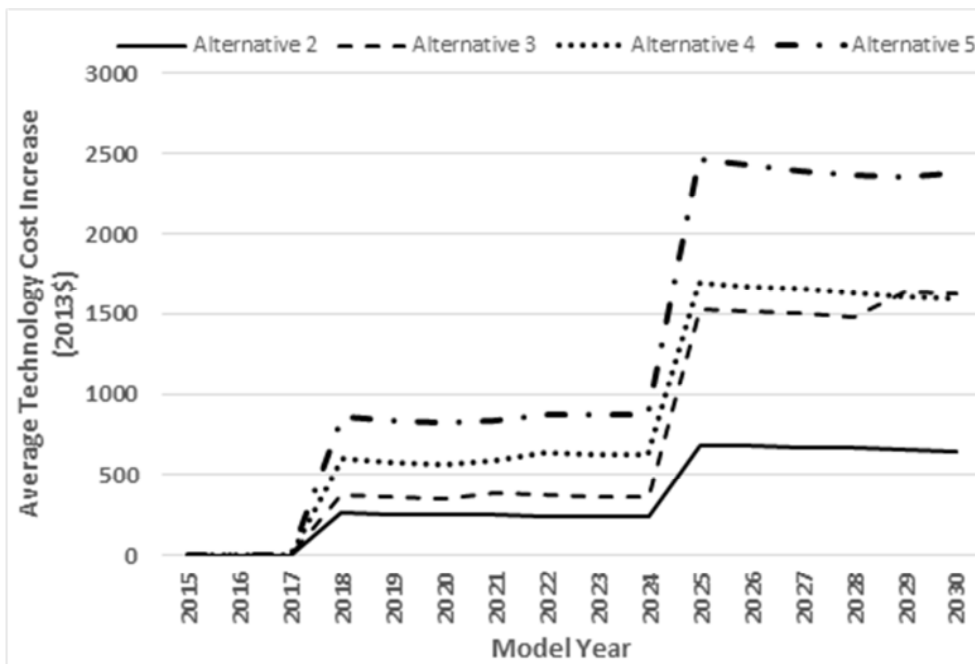
Similarly, FCA shows technology costs of \$300 in MY 2018 under Alternative 3, \$600 under Alternative 4, and \$800 under Alternative 5. Nissan shows costs of \$1000 in MY 2021 under Alternative 3, \$1800 under Alternative 4, and \$2700 under Alternative 5. The only manufacturer not shown here is Daimler; using the 2015 reference fleet Daimler does not apply additional technology in the regulatory alternatives, and incurs no additional costs. The general sequence of simulated technology costs remains the same as in the NPRM and Method B of the FRM; Alternatives 4 and 5 involve more each incurrence of technology costs than Alternative 3, even though the ending stringency curves for Alternatives 3 and 4 are the same, the additional lead time allows that manufacturers could implement technologies on during later redesigns under Alternative 3. While modeling results show that Alternative 3 could involve some early model year technology costs, they also show that Alternative 2 would forgo much of the benefits of Alternative 3. Further, the results shown here represent only one possible way that manufacturers may meet regulatory alternatives; they may avoid adding technologies in early model years, but adding more to reach over-compliance in later model years. For these reasons, NHTSA has determined that Alternative 3 represents the maximum feasible standards. Further description of the rationale behind the finalization of these standards can be found in Chapter VI.D.(9) of the Preamble and Chapter 10.2.8 of the RIA.



**Per-Vehicle Technology Cost Increase for General Motors by Model Year and Alternative (Method A)**

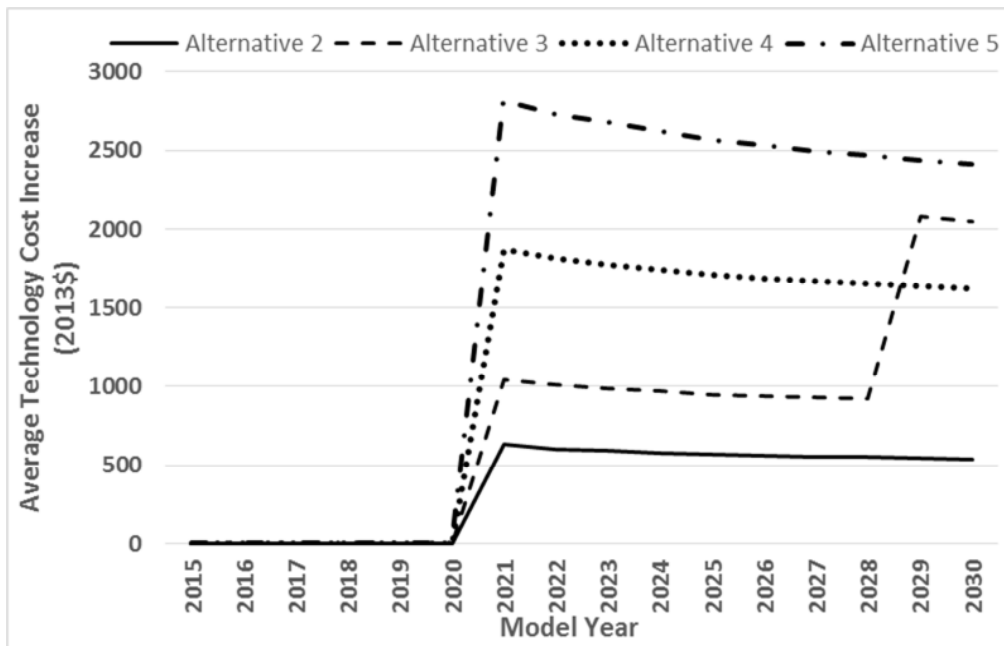


Per-Vehicle Technology Cost Increase for Ford by Model Year and Alternative (Method A)



Per-Vehicle Technology Cost Increase for Fiat/Chrysler by Model Year and Alternative (Method A)





**Per-Vehicle Technology Cost Increase for Nissan by Model Year and Alternative (Method A)**

AAPC commented in support of an alternative year-over-year phase-in that would phase-in stringency more gradually than the proposed (and now adopted) standard. AAPC recommended that rather than a 2.5 percent per year improvement, the increase should be at 1.75 percent per year through MY 2024 and then 3.5 percent per year for MY 2025 through 2027 with the MY 2027 level of stringency equally the proposed level. AAPC commented that this more gradual approach was consistent with the Phase 1 phase-in approach and would help manufacturers manage the long lead time associated with developing the new vehicles and powertrains that will be required in order to comply with the Phase 2 proposal.

The agencies are finalizing the proposed phase-in rather than adopting the approach recommended by AAPC. The more gradual phase-in recommended by AAPC would result in a loss of program benefits in each of the interim years of the program compared to the promulgated standards until the phase-in caught up with that phase-in in MY 2027. Because of the slower phase-in, the overall reduction in each interim year is lower than the phase-in being finalized. The phase-in adopted for Phase 1 with a more gradual ramp-up in standards took into consideration the shorter lead time associated with the Phase 1 standards and the uncertainty associated with implementing a new program. Phase 2 provides more lead-time than Phase 1 and the agencies believe based on their analyses of the standards that the lead-time provided is sufficient, particularly considering the flexibility also provided by credit carry-forward and carry-back provisions.

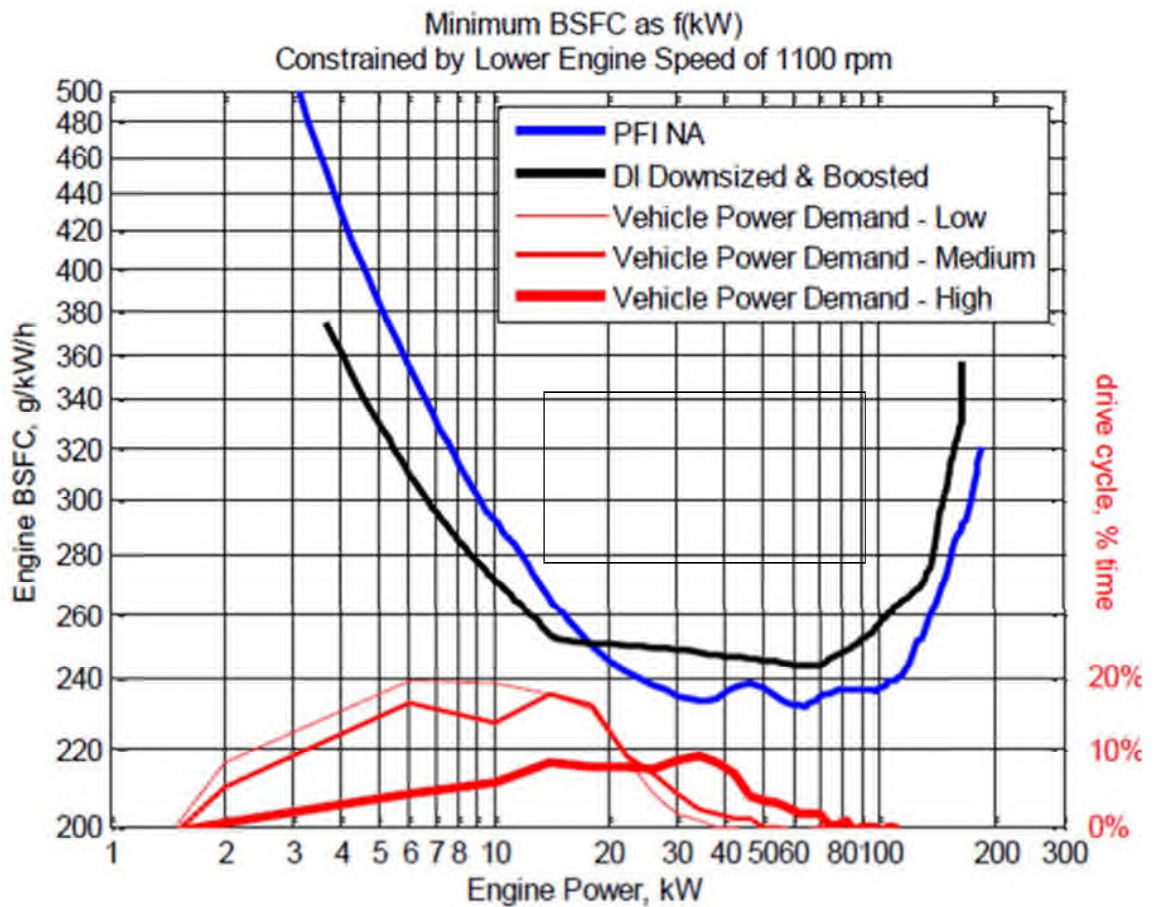
Nissan commented that the proposed stringency level of 2.5% annual improvement is aggressive, and will require a substantial amount of technology adoption. A 3.5% per stringency level – which is what Alternative 4 would necessitate-- is simply not feasible, according to this commenter. The 3.5% alternative does not provide the necessary lead-time to enable manufacturers to balance competitive market constraints with the cost of applying new technologies to a limited product offering. To the extent, moreover, that the more stringent alternative is predicated on the adoption of hybrid and electric powertrain technology, Nissan -- engineering and market leader in electric vehicles -- does not believe that such technology is feasible for this market segment. Nissan believes the widespread adoption of hybrid technology in the larger vehicle segments to be cost prohibitive and inconsistent with the utilitarian function of vehicles in the segment. Nissan does not expect hybrid technology to play a

significant role during Phase 1 or during Phase 2 of the program. As explained above, the Method B analysis indicates that Alternative 4 would lead to more aggressive penetration rates of strong hybrids with less lead time than the standard being adopted, and EPA is rejecting Alternative 4 pull ahead standards in part for that reason. So to this extent, EPA agrees with Nissan's comment. While Method A does not show the amount of hybrid technologies as is shown in Method B, the Method A analysis does show the highest early technology costs for Nissan of \$1000 per-vehicle by MY 2021 under Alternative 3, and almost \$2000 per-vehicle in MY 2021 under Alternative 4. NHTSA agrees that, based on the Method A analysis, Alternative 3 is aggressive (though feasible) and that Alternative 4 is likely not feasible.

Several commenters discussed the technology selection and effectiveness levels used by the agencies to determine the feasibility of the proposed standards had lower effectiveness levels and penetration rates than expected. The agencies worked together to determine appropriate technologies and the effectiveness of those technologies based on previous heavy duty GHG Phase 1 work, light duty GHG studies and the Southwest Research Institute (SwRI) research contract performed for the agencies. The technology effectiveness estimates were specifically adjusted for heavy duty applications subject to the conditions that these heavy duty pickups and vans are expected to experience in operation and during certification test cycles which differ from light duty. Comments from ACEEE, ICCT, Sierra Club, UCS and Center for Biological Diversity focused in on the opportunity to adapt more light duty technologies into the heavy duty segment. The agencies researched and took into consideration all light duty and heavy duty technologies currently available or believed to be available in the time frame of this rule. We determined that many light duty technologies could be used in heavy duty vehicles but at a generally reduced effectiveness and that some technologies were only appropriate for certain segments of the heavy duty fleet. Based on this understanding, we restricted certain technologies from some segments of heavy duty pickups and vans. For example, as explained above, we generally allowed specific light duty technologies, such as turbocharged downsized engines, in the van segment because of the expected loads vans experience are similar to loads experienced by the largest light duty pickups. Heavy duty pickups, on the other hand, are expected to be used much differently than vans or the light duty pickups version inasmuch as they have fewer available technology options operating at reduced effectiveness levels. Nissan, a large volume manufacturer developing vehicles with technologies for both the light duty and heavy duty applications, commented that the agencies have appropriately recognized that many of the technologies used to reduce greenhouse gas emissions and fuel consumption in the light duty pickup truck and van segment are not applicable at the same adoption rate and do not have similar impacts when applied to the heavy duty segment.

ACEEE commented that 10 percent of pick-ups in the heavy duty sector are candidates for turbocharging and downsizing if they do not require higher payloads or towing capacity. Other commenters suggested that downsizing that has occurred in light duty could also occur in heavy duty. As discussed above, the agencies evaluated turbocharging and downsizing in vehicles like vans which are not typically designed for extensive trailer towing. When we looked at pick-ups, we determined that consumers needing a pick-up without higher payload or trailer towing requirements would migrate to the lower cost light-duty versions which are typically identical in cabin size and seating as the heavy-duty versions but have less work capability. Because of this, in the agencies' assessment, the heavy-duty pickups retained the high trailer towing and payload requirements and the corresponding larger normally aspirated gasoline engines instead of downsized turbocharged gasoline engines. Similarly, the agencies retained the larger diesel engines although there may be a segment of consumers that could use a smaller and less capable diesel engine in the heavy duty pickups. AAPC comments supported this approach as the correct combination of engine to intended use and even provided in their comments data indicating that turbocharged and downsized engines are more fuel efficient at lighter loads; however, under working conditions expected of a heavy-duty pick-up they are actually less fuel efficient than the larger engines. See the chart below supplied by AAPC in their comments.





ACEEE also commented that the agencies mistakenly did not consider cooled exhaust gas recirculation for gasoline pickups. Cooled EGR can reduce the fuel consumption of both direct-injected and port-injected gasoline engines by reducing pumping losses, mitigating knock, cooling the exhaust, and eliminating the need for fuel enrichment. ACEEE assumed this technology only for pickups and vans with turbocharged, downsized engines. The agencies determined that the basic form of EGR technology to reduce pumping losses, mitigating knock, cooling the exhaust, and eliminating the need for fuel enrichment is already present in the majority of the baseline vehicles or is added during technology implementation through the use of variable valve timing. Cooled EGR is an extension of basic EGR technology but the incremental benefit beyond basic EGR falls largely outside of areas of operation encountered during the certification test cycles. Cooled EGR is generally an incremental benefit over basic EGR in gasoline engines with elevated knock sensitivity or engines operating in areas where high exhaust temperatures require the engine to go into thermal protection. Heavily downsized and boosted engines or high compression engines are typically the applications that will see a significant benefit of cooled EGR, which is why the agencies expected high penetration of cooled EGR in light duty applications. Due to the higher load usage patterns and durability constraints, heavy duty engines will not see the same degree of downsizing and boosting or compression ratio increases in engines as projected for light duty vehicles. However, the agencies expect some manufacturers will use cooled EGR in heavy duty applications where they deem a customer benefit can be realized in the form of reduced fuel usage under the conditions described above.

UCS, Sierra Club, ICCT, CARB, and ACEEE all expressed concerns about the fact that light-duty pickup standards are much more stringent than the proposed standards for the heavy-duty fleet. UCS and ACEEE all expressed concerns that this discrepancy might create distortions between the heavy-duty and light-duty markets. It is important to note, that the heavy-duty standards are new; if distortions exist in the market they have likely existed before the new regulation. Moreover, while there are similarities between the light-duty and heavy-duty fleets, there are also differences—the redesign cycle is historically longer in the heavy-duty fleet and these vehicles are purchased for work capability, where many light-duty pickups may not be. The factors that give heavy-duty vehicles their added utility will also decrease fuel efficiency. Further, the ABT provisions in the light-duty standards allow averaging within a manufacturer’s combined car and truck fleet so that light-duty pickup stringencies can be offset by credit-generating passenger cars. In contrast, although all HD pickups and vans are a single averaging set under Phase 2 (and Phase 1), the product lines are more limited than in the light-duty fleet. Thus, there are fewer possibilities for averaging. The commenters also do not address that heavy duty pickups’ base price is typically considerably higher than the light duty pickup equivalent. A standard Google search indicates that the Ford 150 light duty pickup has a base price of \$26,540; the 2016 MY F 250 base price is \$32,385. The addition of fuel economy technologies on light and heavy duty pickups is unlikely to alter this basic disparity.

UCS further cited the close relationship between light-duty and heavy-duty models. NHTSA’s Method A analysis of the final rule includes some limited engine and platform sharing across these classes, as discussed in Section VI.C(7)(d) of the Preamble and Chapter 10.1.7.1 of the RIA. Results suggest that sharing between the light-duty and heavy-duty vehicles result in a small amount of technology sharing between classes, but that amount of sharing does not result in significant additional technology applications in either class. For this reason, NHTSA further concludes that the ability to share technologies from the light-duty fleet to the heavy-duty fleet does not affect a significant proportion of the fleet. NHTSA will continue to investigate the issue of engine and platform sharing between classes in future rules.

With regard to comments on the relationship of these Phase 2 standards to the EPA’s recent Tier 3 standards, as discussed throughout the Tier 3 final rule, EPA has designed the final Tier 3 program in full recognition of the parallel implementation of the GHG standards in the same time frame as the final year for the heavy duty Phase 1 standards and the light duty 2017 to 2025 GHG rule. By aligning the implementation schedules for both sets of standards, we are facilitating the ability of manufacturers to meet one of their stated goals, the ability to develop product plans that simultaneously account for the technological challenges of both programs well into the future. We considered the feasibility of the Tier 3 standards in the context of the established GHG requirements.

The agencies recognize that these new standards will require concurrent implementation of the Tier 3/LEV III criteria emission requirements and the new heavy duty GHG and fuel consumption requirements we are finalizing. The technologies expected to be used by manufacturers to meet the Tier 3/LEV III standards do not necessarily result in negative impact to GHG emissions or fuel consumption. The majority of exhaust emission reductions from the Tier 3/LEV III programs are expected to be from reduced cold start emissions in the first couple of minutes of operation. For example, a Tier 3/LEV III strategy (see 79 FR 23461) to reduce emissions in gasoline applications may include reduced cold start enrichment to both lower engine out emissions and accelerate warm-up of the catalytic converter. This strategy should result in reduced emissions for both criteria emissions and GHG emissions. Diesel applications may require improved thermal management of the aftertreatment which should be beneficial for both programs by accelerating the warm-up and keeping the SCR system at high conversion efficiencies throughout the different areas of vehicle operation. However, due to uncertainties with these improvements regarding the extent of current optimization and future criteria emissions obligations, the agencies are not considering aftertreatment improvements in diesel

application as a fuel-saving technology in the rulemaking analysis as discussed in Preamble section VI.C.4. In other words, while we believe that optimization of the SCR system can be considered a fuel saving technology, we did not premise the rulemaking or include technology costs on the need for this technology because of the possible future need to optimize the system for Tier 3/LEVIII emission requirements.

CARB and ACEEE also expressed concern about the dynamic baseline. ACEEE suggested that the assumption that manufacturers will apply technologies that payback within 6 months of discounted fuel savings, even if these technologies are not necessary to reach compliance is arbitrary. This assumption is based on the idea that there is a non-zero market demand for fuel economy and that this can be measured from the payback period. The assumption is that the market demand for fuel economy is small, but greater than zero. While the exact market demand for fuel economy is unknown, it is not arbitrary to assume that it is positive—ACEEE does not provide any data to suggest that the market demand for fuel economy is otherwise.

CARB cites that in their regulations they have assumed that manufacturers would comply, but not over-comply. However, it is important to note that their history is to regulate from the perspective of criteria pollutant emissions—these are typically assumed to be an externality and would not have a market value for consumers. Thus, for criteria pollutants regulation provides the only incentive for reduction, while for fuel consumption the market provides some incentive for reduction even absent regulation (the discounted value of fuel savings). It is also important to note that changing the baseline affects the benefits and costs attributed to the regulatory alternatives, but not the simulated compliance strategies themselves. For these reasons, NHTSA has continued to use the dynamic baseline in Method A for its main analysis of heavy duty pickups and vans. In other words, the same technology packages are required to meet the standards with either agency baseline approach however in the dynamic baseline used by NHTSA, less of the technologies and their costs are attributable to the new standards while in the EPA flat baseline analysis, all technologies and associated costs are included in the technology packages required to comply with the new standards.

Use of a flat baseline is also reasonable. There is a lack of empirical evidence for any specific baseline. See generally Preamble section X.A. Industry comments on payback generally refer to it as a necessary but not sufficient criteria for investment. Insofar as buyers require a positive payback within some denominated period of time, our understanding is that buyers' considerations are informed by at least implicit judgments regarding the full range of potential risks and costs. In addition, the agencies' analyses with different baselines is consistent with OMB guidance in Circular A-4. Finally, we note that the agencies conducted sensitivity cases for Pickups and Vans with 0, 6, 12, 18, 24 month payback periods. See Preamble Chapter 6 for details. These analyses all supported the same conclusion as to the appropriateness of the standards being adopted for heavy duty pickups and vans.

The agencies received limited comments on these different baseline approaches that dictate the costs. Some commenters expressed support for the flat baseline in the context of the need for the regulations, arguing that little improvement would occur without the regulations. Others supported the flat baseline because they believe it more fully captures the costs. Some commenters thought it reasonable that the agencies consider both baselines, given the uncertainty in this area. No commenters opposed the consideration of both baselines.

## **7.2.2 Work Factor**

**Organization:** American Automotive Policy Council

**Work Factor** – AAPC supports the agencies’ attribute-based approach to medium-duty pickup and van standards that recognizes the physical demands placed on these work vehicles. These standards recognize that the various products offered have differing degrees of load carrying, trailer towing, and off-road capabilities. AAPC proposes an additional term be incorporated into the work factor for vans to account for cargo and passenger volume. [EPA-HQ-OAR-2014-0827-1238-A1 p.2]

### **Work Factor Changes for Vans**

AAPC commends the agencies for continuing with a “work factor” based approach that recognizes the functional payload and towing capabilities that define vehicles in this segment. While AAPC believes that the payload, towing, and four wheel drive inputs to the work factor equation properly represent the primary intended uses of heavy-duty pickup trucks, they do not fully represent the intended uses of cargo and passenger vans, for which cargo or passenger volume are of primary importance. [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

AAPC proposes that an additional volumetric term be incorporated into the work factor for vans to account for cargo and passenger volume: [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

$$WF = (0.75)* (GVWR - \text{Curb Weight} + xwd) + 0.25* (GCWR - GVWR) + \text{Max} [AV / Vref, 0]$$

(GVWR – Curb Weight)

Where Vref=208 cubic feet and AV = Cargo Volume - Vref

Note: Cargo volume is as determined by SAE J1100 methodology considering the total volume behind the front row of seats. [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

In this scenario, vans with cargo volumes less than 208 cubic feet would receive no work factor adjustment for volume/passenger capacity. [EPA-HQ-OAR-2014-0827-1238-A1 p.8]

Separately, the agencies were seeking comment on whether inclusion of GCWR in construction of the work factor was resulting in manufacturers designing surplus towing capacity. The agencies work factor-based standards were derived using actual vehicle data (i.e., a combination of payload, towing, and 4x4 capability from actual vehicles when tested on the city highway cycle under ALVW conditions). Existing DOT Federal Motor Vehicle Safety Standards (FMVSS) and SAE J2807 requirements effectively cap the towing and GCWR in this segment. [EPA-HQ-OAR-2014-0827-1238-A1 p.8]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

### **Work factor**

The rule defines work factor from payload and towing capacities which involves three weight parameters including gross vehicle weight rating (GVWR), gross combined weight rating (GCWR) and curb weight. Definitions of these three weight parameters, provided in the rule, involve manufacturer discretion. This leeway could weaken the standards, in effect. For example, two manufacturers recently claimed 150 to 250 lbs. additional payload in model year 2015 pickups by lowering vehicle curb weight<sup>18</sup>. Adding 250 lbs. to the payload would increase a vehicle’s work factor by 188 lbs. This in turn would lessen the fuel consumption/CO2 emissions reduction required in 2018 by 8.3 grams per mile, or

11 to 20%, depending on the work factor of the vehicle. Hence it is important that the agencies better define these weight parameters. [EPA-HQ-OAR-2014-0827-1280-A1 p.20]

When manufacturers can increase work factor at little cost and get benefit in fuel consumption, work-factor-based standards will incentivize such increases. This is an undesirable result that will reduce the benefits of the proposed standards. The agencies proposals to address this problem (*p. 40336*) are welcome. In particular, changing the shape of the standard curve for both gasoline and diesel vehicles to be flatter at higher work factors warrants further consideration. We also support the agencies' consideration of adopting different work factor formulas for pickups and vans, especially in light of the very poor correlation between work factor and CO2 emissions for vans, as shown in figure 2. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]

*Recommendations: Work factor*

- The agencies should better define GVWR, GCWR, and curb weights in order to reduce manufacturers' discretion in determining these weights. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]
- For the final rule, adopt a mechanism to minimize the incentive the proposed standards provide to increase work factor. [EPA-HQ-OAR-2014-0827-1280-A1 p.21]

**Organization:** Cummins, Inc.

*Cummins opposes revised payload/towing split* [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

Cummins supports the continued framework and metrics of Phase 1 for HD pickups and vans, which uses the work factor attribute for GHG evaluation over the same certification test cycles used for criteria emissions. The work factor term recognizes the work capacity of these vehicles to haul goods and provide services and is appropriate for HD pickups and vans. The agencies request comment on potential changes to the work factor curves and vehicle segmentation. The Phase 1 work factor was data-based using the then current US fleet sales of HD vans and pickup. Reweighting any of the terms or segmenting the fleet would require a full study, similar to that done in Phase 1, in order to ensure a feasible and fair framework for all OEMs and suppliers selling into this market. [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

*Cummins opposes revised payload/towing split* [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

The agencies request comment on revising the payload/towing split from 75/25 (Phase 1) to 80/20 (Phase 2) for HD pickups and vans. Cummins opposes any revision without a complete study to fully understand the implications of such changes. A similar activity was undertaken in Phase 1 when developing the HD pickup and van framework and would need to be repeated here. [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

**Organization:** Daimler Trucks North America LLC

• **Work Factor Attributes (80 FR 40335 et seq.)** - Daimler supports the work factor approach used in Phase 1 of the GHG regulation, as the footprint calculation does not adequately reflect Class 2b-3 vehicles and their real world purpose. Daimler also supports the approach of determining a vehicle's fuel consumption and GHG emission reductions based on the type of work the vehicle performs in the real world. As stated in the NPRM, payload and towing are key in characterizing the difference in the



design of Class 2b-3 vehicles. Payload plays an even greater role in vehicle design than towing does. It has been noted that some Class 2b-3 vehicle manufacturers unnecessarily increase towing, particularly for diesel-powered engines, in an effort to meet the GHG regulations, with no real benefit to end users in their normal day-to-day work. [EPA-HQ-OAR-2014-0827-1164-A1 p.112]

The agencies have requested comment regarding four proposed changes related to Work Factor Attributes:

1. Although towing is an important factor, Daimler supports the agencies' approach of weighting payload at 80% and towing at 20%. [EPA-HQ-OAR-2014-0827-1164-A1 p.112]
2. In an effort to prevent manufacturers from unnecessarily ramping up towing capacity with no real benefit to the end user, the agencies have proposed a towing cap. Although Daimler supports such a cap in principle, without knowing what the cap will be, Daimler cannot offer comment on the proposal. [EPA-HQ-OAR-2014-0827-1164-A1 p.112-113]
3. Changing the shape of the standard curve: Daimler does not offer vehicles with high towing capability. In our opinion changing of the shape seems not additionally necessary if the proposed revision of payload and towing rate weighting and the possible cap of high towing capability will be implemented [EPA-HQ-OAR-2014-0827-1164-A1 p.113]
4. With respect to applying different work factors for pickups and vans, Daimler does not currently offer pickups in the U.S. market and so does not offer comment at this point. Daimler would be interested in reviewing additional information on this proposal. [EPA-HQ-OAR-2014-0827-1164-A1 p.113]

**Organization:** Honeywell Transportation System (HTS)

### **Work Factor Should Follow Light Duty**

Concerning the work factor calculation for Class 2B/3, HTS supports the current approach that recognizes professional usage of these vehicles. However, looking at the evolution of the advertised towing capacity from different manufacturers, we see that towing capacity (and therefore work factor) has increased significantly over the past five years without substantial improvement in fuel economy. HTS believes these increases in work factor are beyond the demonstrated needs of most buyers, thus there is little corresponding reduction in miles traveled or improvement in transport efficiency associated with the higher towing capacity ratings. In a 2010 survey conducted at the Texas State Fair, 90 percent of pick-up truck users expressed that they had enough capacity on their truck and 50 percent said that the older truck generation was already enough. Yet, during the period 2010-2014, the number of vehicles with more than 7500lb of work factor increased by more than 1000 percent. [EPA-HQ-OAR-2014-0827-1230-A1 p.4-5]

We believe that a knee inflection at high work factor should be proposed following the footprint principle adopted for the GHG / CAFE standard for Light Duty vehicles. This would help ensure that the rule in fact reduces GHG emissions and doesn't merely result in vehicles with more unused capacity. HTS proposes that the inflection to the work factor begin at 7500lb. This proposed work factor "flattening" would impact less than 10 percent of all Class2B/3 vehicles sold. [EPA-HQ-OAR-2014-0827-1230-A1 p.5]

**Organization:** International Council on Clean Transportation (ICCT)

Pickup and van work factor. Due to the clear possibility of a shift upward in pickups' and vans' average work factor, we encourage that the agencies aim to prevent further market shift that would erode the regulatory program's intended and projected benefits. Similar to the light-duty vehicle standards, a horizontal CO<sub>2</sub> and fuel consumption kink, or cut point, as a maximum standard targets would be a necessary protection against potential runaway trends toward increased payload that undermines the program's objectives. We recommend that the agencies set the threshold CO<sub>2</sub> and fuel consumption standard targets at a work factor of 5,500 lbs. for gasoline trucks and 8,000 lbs. for diesel – based on these being near the 90th percentile for the model year 2014 fleet. [EPA-HQ-OAR-2014-0827-1180-A4 p.14]

**Organization:** Union of Concerned Scientists (UCS)

#### HEAVY-DUTY PICK-UP AND VAN TEST PROCEDURES

The central concern around the test procedures for heavy-duty pick-ups and vans is the way in which the work factor could provide an incentive for manufacturers to continue to add performance at the expense of fuel economy. We are already seeing very clearly that technologies such as lightweighting are being used to increase the payload of these vehicles. This has the perverse effect of reducing fuel economy targets for the vehicle, and thus a technology that could have been used to reduce fuel usage is instead being used to increase the performance of the vehicle. In order to minimize this effect, the agencies should consider an “elbow” in the work factor curve— above a specific work-factor, the fuel economy and greenhouse gas targets level off. This is similar to the features of the light-duty vehicle footprint curves, and it would eliminate the incentive more manufacturers to continue to add payload and towing capacity to game the system, regardless of whether or not it is being used by consumers. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]

#### **Response:**

After considering these comments, the agencies concluded that the work factor approach established in the Phase 1 rule appropriately accounts for the different utility aspects of heavy-duty vehicles. While trucks and vans may be used differently depending on the required job, the three main attributes of payload, towing and four wheel drive remain properly accounted for at this time in the work factor equation at the current weightings. While a small portion of the fleet may be considered to have excess towing capacity relative to the actual required towing capacity by the customer, the agencies determined that the work factor design does not necessarily result in an incentive for manufacturers to build excessive towing into the vehicle design. Towing capacity increases require improvements to vehicle powertrains, cooling and brakes, generally at the expense of payload, and therefore the work factor reasonably balances an increase in towing with a reduction in payload. Additionally, increases in vehicle weight for additional towing capacity may result in an increase in the emission test weight, further penalizing unnecessary towing capacity. Moreover, as AAPC discusses, towing and payload are effectively already capped by existing DOT safety requirements in this segment. Consumers will ultimately decide on the appropriate balance of payload and towing for their applications, and the agencies therefore believe that establishing a work factor cap for the small percentage of vehicles with the highest towing capabilities is not necessary and will not result in emission increases or fuel consumption reductions under the high towing conditions for which those vehicles were purchased.

AAPC commented that the payload, towing, and 4wd inputs do not fully represent the intended uses of cargo and passenger vans, where cargo or passenger volumes are of primary importance. AAPC recommended that the agencies add a volumetric term to the work factor for vans with high (208 cubic feet or greater) cargo and passenger volumes. Vans with high volumes would have higher work factors

and therefore less stringent targets with the AAPC recommended formula compared to the current formula. ACEEE commented that the work factor is a far better predictor of fuel efficiency for pickups than for vans and offered general support for adopting different work factor formulas for pickups and vans.

While it is likely valid that a portion of the vans are used exclusively for cargo volume and that towing is not an important attribute for these vans, the commenter failed to provide sufficient new information to support a new work factor metric specifically to address cargo focused vans. Most obviously, the suggested modification insufficiently represents the different van cargo volumes available to consumers today. A cargo volume based modification requires a complete industry van analysis of all available van cargo volumes and GHG and fuel economy performance levels from which a properly normalized adjustment would be determined, consistent with the approach used to establish the existing work factor equation for the attributes of payload, towing and four wheel drive. The agencies did not receive the level of detailed information required to determine the impact of cargo volume and establish a work factor correlation. Accordingly, the agencies are not incorporating the suggested change to the work factor for vans.

The agencies received a variety of comments on the details of the work factor approach. The agencies received comments from The American Council for an Energy-Efficient Economy (ACEEE) regarding the definition of payload and towing and manufacturer's discretion at determining GVWR, GCWR and curb weight of the vehicle. In response, the formula for payload, GVWR minus curb weight, is specified such that it uses the same definition of the input terms as those which have always been used by the agencies for light and heavy duty vehicle regulations, including criteria pollutant emission standards and safety related designations. The agencies feel that there is no ambiguity in the definition of these terms and therefore payload calculation remains clearly defined with little or no opportunity for manipulation. The agencies have successfully used the previously established definitions of GVWR and curb weight to implement emissions and safety related programs and have not experienced any adverse issues in applying these definitions. The same is true for the definitions of terms used to calculate towing -- GCWR minus GVWR. While this definition for towing capacity does not match the method used by manufacturers in their consumer advertising, the agencies determined that the inputs of GCWR and GVWR are clearly defined in our regulations and used for many other emission and safety related determinations and therefore also remain a clear and consistent method to define towing for the purposes of calculating work factor. Again, the agencies have successfully used the previously established definitions of GCWR and have not experienced any issues that would warrant a change to the definition or use of these parameters.

ACEEE commented on recent announcements from two manufacturers that reported increases in payload capacity in their pick-ups due to a decrease in the curb weight of the vehicles from changes to light-weight materials. A reduction in vehicle weight while maintaining the same GVWR will result in a higher payload capacity which will then increase that vehicle's calculated work factor and therefore result in a higher target GHG and fuel consumption standard. Work factor is defined as follows:

Work Factor =  $.75 * (\text{Payload} + \text{xwd}) + .25 * (\text{Towing Capacity})$ , where:  
xwd = 500 lbs., if the vehicle has 4WD  
xwd = 0 lbs., otherwise.

Similar to the light-duty (LD) footprint based approach which allows increases in GHG emissions and fuel consumption with increasing footprints, the work factor is designed to allow increases in GHG emissions and fuel consumption with increases in capability to do work, primarily hauling payload and towing. The HD pickup and van fleet has a different purpose than the light-duty vehicle fleet. These HD

vehicles are largely used for their towing and carrying capacity. Because consumers value the utility aspect of these vehicles more than footprint or some other attribute, the agencies set the standards based on work factor. While it does create a potential incentive for manufacturers to game the attribute-based standards, this could be a trade-off for creating standards that will preserve the utility of the heavy-duty fleet. The agencies partially addressed these concerns in the Phase 1 rule, by defining payload capacity as GVWR minus curb weight. *Id.* at 57162.

More generally, it is important to consider how these standards were developed. As alluded to above, payload, towing capacity, and drive type (all characteristics that are uniquely utilized in the heavy-duty fleet) are correlated with fuel efficiency. The work factor based targets were developed with this in mind. Since work factor and fuel efficiency can work in opposite directions, in order to game the standards manufacturers would have to decrease their fuel consumption target by more than they increase the achieved fuel consumption of a vehicle model by changing any component which influences work factor.

Further, by reducing curb weight, these manufacturers increase the work capability of their trucks specifically purchased by consumers to transport payload and (sometimes) to tow. Additional payload capacity is not always needed, but will sometimes allow the user to transport more goods and could result in fewer trips. Additionally, the reduction in curb weight will be beneficial in all other situations of unloaded and partially loaded transport of goods because a reduction in curb weight of the vehicle results in less energy wasted simply to move the vehicle regardless of payload. For this reason, the agencies included mass reduction as among the technologies on which the stringency of the final standards (as well as the Phase 1 standards) is based.

As established above, in most cases increases in work factor would be accompanied by an increase in fuel consumption. However, NHTSA has identified one case where this is not true. By applying mass reduction manufacturers can increase payload (and thereby work factor) and also decrease fuel consumption. The current version of the CAFE model includes both the decreases in the target of individual vehicle models, which occur from increased payload, and the decreases in fuel consumption when mass reduction is applied. These decreases in the standards are included in the projected average required fuel consumption levels of manufacturers, and associated decreases in average fuel consumption of the fleet due to mass reduction is included in the average achieved fuel consumption levels of manufacturers.

In summary, we have considered the possibility for manufacturers to game attribute-based standards. However, since most means by which a manufacturer might increase work factor would be accompanied by an increase in fuel consumption, we do not think the opportunities for manufacturers to game the standards are many. In the case of mass reduction application, where manufacturers could increase work factor and decrease fuel consumption to improve the position of individual vehicle models, we have included this in the model. We are open to suggestions on how we could further minimize the perverse incentives of the attribute-based standards, or to better capture them within the modelling results for future rule-makings. We will continue to monitor the possibility for manufacturers to game standards and re-evaluate how we might set future standards differently if the need arises.

### **7.2.3 Separate Gasoline and Diesel Vehicle Standards**

**Organization:** American Automotive Policy Council

**Maintain Separate Gas and Diesel Standards** - AAPC supports the agencies' proposal to continue maintaining separate, but comparably stringent, CO<sub>2</sub> and fuel consumption standards for compression ignition and spark ignition engines. [EPA-HQ-OAR-2014-0827-1238-A1 p.2]

### **Maintaining Separate Gas and Diesel Standards**

AAPC supports the agencies' proposal to maintain separate, but comparably stringent, CO<sub>2</sub> standards for compression ignition and spark ignition engines. This approach insures that manufacturers of either engine type will implement the latest CO<sub>2</sub> reducing technologies. As the agencies observed when the Phase 1 Heavy-Duty GHG rule was promulgated, significant technological and market-based differences exist between heavy-duty gasoline and heavy-duty diesel engines (76 Federal Register 51765). This will remain the case for the Phase 2 program (2019-2027), making a single standard commercially and technically impractical for both combustion technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

Maintaining separate but comparably stringent spark ignition and compression ignition standards will allow customers for specific applications to take advantage of the combustion technology that best meets their specific application requirements while assuring that their particular engine is equipped with the latest fuel efficient technology regardless of combustion type. Maintaining a viable heavy-duty spark ignition market is critical for customers considering total cost of ownership including utility, maintenance, and serviceability. [EPA-HQ-OAR-2014-0827-1238-A1 p.7]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

Reducing the gap between gasoline and diesel efficiency requirements would also be a step forward for the heavy-duty pickup and van standards. Given that the work factor parameter has been specifically designed to capture the utility of these vehicles as it relates to fuel efficiency, gasoline and diesel vehicles should in principle be subject to the same, performance-based standard for CO<sub>2</sub>.<sup>25</sup> As shown in Figure 2, there is a substantial difference at present in the performance of gasoline and diesel vehicles, which presents challenges for the adoption of a fuel-neutral standard at this time. However, reducing the gap between the diesel and gasoline standards by strengthening the gasoline standard, would help to address this problem. [EPA-HQ-OAR-2014-0827-1280-A1 p.24]

**Organization:** Cummins, Inc.

*Cummins does not support different standards between gasoline- and diesel-fueled HD pickups and vans* [EPA-HQ-OAR-2014-0827-1298-A1 p.34]

In Phase 1, the agencies set separate standards for gasoline- and diesel-fueled HD pickups and vans, with less stringency for gasoline vehicles. This offset in stringency was attributed to the short lead-time to implement Phase 1 versus the required time to develop and certify vehicles. Despite sufficient lead-time for Phase 2, the agencies have maintained the offset in stringency between gasoline and diesel vehicles (see Figure 13) through MY2027. As mentioned earlier, SwRI studies have demonstrated technologies that could be applied to both gasoline and diesel pickups and vans that achieve CO<sub>2</sub> reductions that exceed the proposed standards for these vehicles. With ample time to develop and validate these technologies for the start of Phase 2, it is plausible for the agencies to establish a path of converging stringency for all HD pickups and vans. Such a pathway would create fuel neutral standards and eliminate any competitive advantage or preference to a particular GHG/FE technology and maintain the environmental benefits envisioned by the regulation, regardless of operating fuel. [EPA-HQ-OAR-2014-0827-1298-A1 p.34-35]

[Figure 13 can be found on p.34 of docket number EPA-HQ-OAR-2014-0827-1298-A1]

**Organization:** Daimler Trucks North America LLC

**Gasoline and Diesel Standards (80 FR 40337)** - In Phase 1 and in the proposed Phase 2 regulations, there are large differences between the stringencies of the diesel and the gasoline standards, resulting in stricter requirements for diesel engines. This results a significant disadvantage for the more efficient diesel technology. Today, diesel engines meet the most stringent emission standards and are therefore as clean as gasoline engines. Moreover, diesel technology is more efficient than gasoline technology with regard to fuel consumption. With respect to GHG emissions, gasoline vehicles should not be treated in a less stringent way than diesel vehicles. Instead, the stringency of both standards should be harmonized in the Phase 2 regulation. [EPA-HQ-OAR-2014-0827-1164-A1 p.113]

**Organization:** Environmental Defense Fund (EDF)

### **A level playing field is required for gasoline and diesel vehicles**

Under Phase 1, EPA and NHTSA finalized weaker standards for gasoline pickups and vans than their diesel counterparts. As a result, the efficiency gap between gas and diesel trucks will grow over the timeframe of the Phase 1 rule (2014-2018). For Phase 2, the agencies have proposed standards for heavy-duty pickups and vans that require a 16% improvement beyond 2018 for both diesel and gasoline engines. These standards fail to close the efficiency gap between the different engine types and will instead perpetuate and increase the gap. [EPA-HQ-OAR-2014-0827-1312-A1 p.38]

The proposed standards are inconsistent with EPA's long-standing precedent of setting standards that are fuel neutral and based on the capabilities of the technological leader. By setting a weaker standard for gasoline vehicles, the agencies have not established a level playing field and are creating incentives to shift from lower CO<sub>2</sub> diesel vehicles to higher CO<sub>2</sub> gasoline vehicles. Recent sales data for this vehicle class suggests that this shift is already occurring under the Phase 1 program and it will only be exacerbated under the Phase 2 program. This shift will put at risk the ability of the overall program to deliver the environmental results expected from the Phase 2 program. We recommend that the agencies set strong performance-based fuel neutral standards based on the technological leader. At the very least, this final rule should begin to close the efficiency gap between gasoline and diesel pickups and vans. [EPA-HQ-OAR-2014-0827-1312-A1 p.38]

**Organization:** Honeywell Transportation System (HTS)

The proposed rule strives for lower GHG emissions and improved fuel economy in Class 2B/3. This could be done through advanced diesel engines, advanced gasoline engines (including electrification or hybrid technology), or through some combination of these. Establishing technology/fuel neutral regulations allows industry to develop the most cost effective solution that meets consumer expectations. Instead of setting separate gasoline and diesel vehicle standards, we suggest that the baseline overall fleet CO<sub>2</sub> emissions be calculated from the projected 2018 share of gasoline and diesel truck models, and that future emissions reductions are calculated from this baseline for the entire fleet independent of fuel type. [EPA-HQ-OAR-2014-0827-1230-A1 p.3-4]

Indeed, the EPA itself stated in the Phase 1 standard that "the agencies agree that standards that do not distinguish between fuel types are preferable where technological or market-based reasons do not argue otherwise," and "expect to reexamine the need for separate gasoline/diesel standards in the next

rulemaking.” Based on the review of the proposal, HTS does not see evidence that such a reexamination has occurred, and therefore we recommend that the standard not distinguish between fuel types. This would ensure that the goal of an overall reduction of GHGs and improved fuel efficiency are met without creating the unintended consequences that could occur from favoring one fuel type over another. For example, if a particular powertrain has a less stringent GHG target and is lower cost, the market could shift in that direction resulting in higher overall GHG for the industry – the exact opposite intention of the proposed rule. [EPA-HQ-OAR-2014-0827-1230-A1 p.4]

**Organization:** International Council on Clean Transportation (ICCT)

### **Fuel neutrality**

We note that the agencies appear to violate their own generally preferable principle of establishing fuel-neutral standards with their separate gasoline and diesel engine standards, pickup and van standards, and vocational standards (See, e.g., Lutsey, 2015c). In each case, the spark-ignited gasoline-related standards are set at less stringent levels than compression-ignition diesel. The gasoline standards miss opportunities to promote cost-effective efficiency technologies, and the standards are providing an incentive to shift the market from higher functionality, lower CO<sub>2</sub> diesel products to lower functionality, higher CO<sub>2</sub> gasoline products over time. This proposed approach would provide a sizeable incentive to manufacturers and consumers alike to shift to gasoline products, which often have lower CO<sub>2</sub> characteristics for the same or sometimes lesser utility. The standards ideally would be set based on environmental performance, without special protection for spark-ignited gasoline products. We recommend that the agencies consider greater technology penetration in all spark-ignited gasoline products to finalize standards that are more truly emissions and efficiency performance based standards. [EPA-HQ-OAR-2014-0827-1180-A4 p.16-17]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Ensure Technology-Neutral, Performance-Based Standards** [EPA-HQ-OAR-2014-0827-1274-A1 p.3]

With respect to the heavy-duty pickups and vans category, while MEMA supports the continued use of the work factor attribute that takes into account both payload and towing capacities, MEMA does not favor the continuation of separate targets for gasoline and diesel vehicles. Rather than have different standards under Phase 2 that depend on the fuel/engine type, the agencies should mirror the regulatory approach used for light-duty trucks under the light-duty vehicle National Program, as well as for light-duty trucks and complete Class 2b-3 vehicles under Tier 3, and put in place a uniform performance standard that does not differentiate between gasoline and diesel. An alternative to the proposed rule would be to simply require a 16 percent fleet average CO<sub>2</sub> emissions reduction.<sup>3</sup> Consequently, the industry and customers pick the fuel and technology combination that offers the best value while also meeting the requirement. [EPA-HQ-OAR-2014-0827-1274-A1 p.4] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.194.]]

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<sup>3</sup> Using MY2018 baseline

**Organization:** Robert Bosch LLC

Although not a “heavy-duty” (HD) engine or vehicle manufacturer,<sup>2</sup> Bosch has a keen interest in the Phase 2 proposed rule. [EPA-HQ-OAR-2014-0827-1466-A2 p.2]

Bosch has long advocated for policies that allow all technologies to compete on a level playing field in order to most effectively and fairly achieve societal objectives. We are puzzled with the lack of fuel neutrality in the proposed Phase 2 standards for HD pickup trucks and vans. By way of example, we observe that a model year (MY) 2021 diesel pickup truck with a work factor (WF) of 5,000 pounds would have a CO<sub>2</sub> target value that is 30.5 g/mile lower (i.e., more stringent) than the target value for an identical gasoline pickup (515 g/mile vs. 545.5 g/mile). We further observe that while the compression-ignition (CI) – spark-ignition (SI) gap would narrow slightly over time, in MY 2027 and all later model years there would still be a 26.5 g/mile difference between the more stringent CI/diesel standard and the less stringent SI/gasoline standard for a HD pickup with a 5,000 pound WF (442 g/mile vs. 468.5 g/mile). In Bosch’s view, a sustained – from MY 2014, the start of Phase 1, through MY 2027 and all later years – preference for one technology over another via the imposition of differential performance standards prevents industry from investing in and developing the best available technologies. It also appears unfair and unwarranted. [EPA-HQ-OAR-2014-0827-1466-A2 p.2-3]

EPA and NHTSA established the separate CI/SI standards in Phase 1, but emphasized in the 2011 final rule “that they are not committed to perpetuating separate GHG standards for gasoline and diesel heavy-duty vehicles and engines, and expect to reexamine the need for separate gasoline/diesel standards in the next rulemaking.”<sup>3</sup> A perpetuation of separate standards, however, is precisely what the agencies have proposed for Phase 2 HD pickups and vans, with the apparently only cursory reexamination having yielded a justification that is no different from the one proffered by the agencies in Phase 1 – the existence of technological distinctions between SI engines and CI engines. Not “until advanced research evolves the gasoline fueled engine to diesel-like efficiencies,” the agencies now posit, will the HD pickup truck and van sector be suited for fuel-neutral GHG emissions and fuel consumption standards. [EPA-HQ-OAR-2014-0827-1466-A2 p.3]

Bosch strongly disagrees with the proposed continuation of separate target values for gasoline and diesel, and notes that the agencies preface the proposed Phase 2 HD pickup and van standards by acknowledging that these particular vehicles “share both substantive elements and a regulatory structure much more in common with light-duty trucks than with the other heavy-duty vehicles.” EPA and NHTSA proceed to explain that: (i) “[o]ver 95 percent of the HD pickups and vans sold in the United States” are manufactured “by companies with major light-duty [pickup truck and van] markets” in the U.S.; (ii) “these companies typically base their HD pickup and van designs on higher sales volume light-duty truck platforms and technologies, often incorporating new light-duty truck features into HD pickups and vans at their next design cycle”; and (iii) the same chassis dynamometer test procedure applies to both HD and light-duty pickups and vans. Given all of these factors, as well as the agencies’ intent “to develop an overall analysis fleet spanning both the light-duty and HD pickup and van fleets,” Bosch strongly maintains that HD pickups and vans should be regulated under Phase 2 in the very same manner that their light-duty brethren are regulated – through performance standards that do not differentiate between SI/gasoline and CI/diesel. [EPA-HQ-OAR-2014-0827-1466-A2 p.4]

The GHG emissions and corporate average fuel economy standards for light trucks do not distinguish, and have never distinguished between gasoline and diesel. Rather, the same CO<sub>2</sub> target value applies to all types of light trucks manufactured in the same model year.<sup>9</sup> Similarly, EPA regulates light-duty trucks – and also complete Class 2b and 3 vehicles – under Tier 3 equally; the same exhaust emission standards apply to all vehicles regardless of the engine type.<sup>10</sup> Such an even-handed, fuel-neutral approach should be adopted for HD pickup trucks and vans under Phase 2, all the more so because it was not the approach taken under Phase 1, which represented the very first time HD vehicle GHG



emissions and fuel efficiency were regulated by the agencies. [EPA-HQ-OAR-2014-0827-1466-A2 p.4-5]

As in the Phase 1 proposed rule, EPA and NHTSA state that they “are not basing the proposed standards on a targeted switch in the mix of diesel and gasoline vehicles,” and “the proposed program is not intended to force, nor discourage, changes in a manufacturer’s fleet mix between gasoline and diesel vehicles.” This intent notwithstanding, Bosch believes that a market shift towards spark-ignited vehicles and away from HD pickups and vans powered by “fundamentally more efficient” CI engines would be a very real possibility under Phase 2 if the separate gasoline and diesel targets are finalized as proposed. Equally if not more important, any such shift would signify not only a move towards less efficient internal combustion engines, but would be counterproductive from a programmatic/environmental and energy standpoint in that the corollary necessarily would be an increase rather than a reduction in CO2 emissions from (and fuel consumption for) the HD pickup truck and van sector. [EPA-HQ-OAR-2014-0827-1466-A2 p.5-6]

In response to the agencies’ belief that “similar levels of technology development and cost” would be required for both types of vehicles, Bosch stresses that diesel engines, from a criteria pollutant (especially NOx) emissions perspective, have made far greater strides over the years than gasoline engines, and for that reason have incurred greater technological development costs than the latter. While equivalent CO2 target values may be more expensive, comparatively speaking, for SI engines to achieve (based on the agencies’ cost analysis), the additional cost imposed on these engines likely would not rise to the level of, much less overtake CI engines’ historically higher technological development and system costs (e.g., diesel particulate filters and selective catalytic reduction systems), which only figure to increase under Tier 3. [EPA-HQ-OAR-2014-0827-1466-A2 p.6]

For all of these reasons, Bosch calls on the agencies to apply to all Phase 2 HD pickup trucks and vans the same CO2 target values regardless of the engine technology (SI or CI). To the extent the agencies believe subjecting all vehicles to the same targets is unjustified due to “the potential disruption” from a market shift, Bosch maintains that it is equally unjustified, for precisely the same reason, to subject diesel vehicles to target values that are lower than those for gasoline vehicles. Bosch notes, too, that by setting uniform performance standards, all potential future technology packages compete on a level playing field in order to achieve the desired CO2 reduction in the most economical way possible for consumer acceptance. The preservation of a certain price differential between CI and SI engines must not become a target itself.<sup>15</sup> [EPA-HQ-OAR-2014-0827-1466-A2 p.6-7]

Ultimately, then, Bosch urges the agencies to issue a Phase 2 final rule that establishes, once and for all, GHG and fuel efficiency parity among all HD pickups and vans, i.e., a fair and level playing field for these vehicles irrespective of their technology (CI or SI), as is the case for light trucks under the light-duty National Program and Tier 3 (as well as the California Air Resources Board’s LEV III Program), and as EPA expressly indicated in the Phase 1 proposed rule it wanted to do.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1466-A2 p.7]

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<sup>2</sup> Throughout these comments, we use the term “heavy-duty” to apply to the same engines and vehicles referenced by EPA and NHTSA in the proposed rule. See 80 FR at 40145.

<sup>3</sup> 76 FR 57106, 57165 (Sept. 15, 2011); see also EPA, EPA Response to Comments Document for Joint Rulemaking, at 6-182 – 6-183 (Aug. 2011), available at <http://www.epa.gov/otaq/climate/documents/420r11004.pdf>. The agencies added in the comment response document that Phase 1 “differs from other recent rulemakings in this regard in that we are

regulating GHGs and fuel consumption for the heavy-duty sector for the first time, and so believe the goal of fuel-neutrality is best met by setting standards based on the market/technology situation as it exists today.” Id. (emphasis added).

9 See 40 CFR §§ 86.1818-12(c)(3).

10 See 40 CFR §§ 86.1811-17, 86.1816-18; 79 FR 23414, 23425 (Apr. 28, 2014) (Tier 3 emission standards “are fuel-neutral”). Notwithstanding technological differences (not to mention significantly higher compliance costs for CI (vs. SI) engines), fuel neutrality is, of course, also a key feature of the HD engine emission standards for NO<sub>x</sub>, non-methane hydrocarbons, and particulate matter under 40 CFR 86.007.11 and 86.008-10.

15 In this regard, Bosch emphasizes that while HD gasoline pickups and vans “are generally . . . less expensive than diesels” in terms of the upfront cost, 80 FR at 40514, a recent University of Michigan Transportation Research Institute (UMTRI) study underwritten by Bosch shows that from a total cost of ownership (TCO) perspective, one that takes into account not only the initial purchase price but also such factors as the costs of fuel, insurance, repairs, and maintenance and also resale value and depreciation, most HD diesel pickup trucks have a lower TCO than their gasoline counterparts. UMTRI, Total Cost of Ownership: A Diesel Versus Gasoline Comparison (2012-2013) (June 2015), available at [http://www.umtri.umich.edu/sites/default/files/Belzowski.Total\\_.Cost\\_.%20of.Ownership.Paper\\_.2015.Final2 .pdf](http://www.umtri.umich.edu/sites/default/files/Belzowski.Total_.Cost_.%20of.Ownership.Paper_.2015.Final2.pdf).

16 75 FR at 74213 (stating EPA’s desire “to revise the heavy-duty vehicle and engine regulations to make them consistent with the light-duty vehicle approach, applying standards for all regulated criteria pollutants and GHGs regardless of fuel type”) (emphasis added).

#### **Response:**

The agencies requested comment on both the level of stringency of the standards and the continued separate targets for gasoline and diesel HD pickups and vans. AAPC supported the agencies’ proposal to maintain separate targets noting that the approach ensures that manufacturers of either engine type will implement the latest CO<sub>2</sub> reducing technologies. AAPC further commented that significant technological and market-based differences exist between heavy-duty gasoline and heavy-duty diesel engines. According to the commenter, maintaining separate but comparably stringent spark ignition and compression ignition targets will allow customers for specific applications to take advantage of the combustion technology that best meets their specific application requirements.

Several commenters did not support the proposed approach but instead supported setting a single fuel-neutral set of targets. Cummins commented that there is sufficient lead-time and technology to create a pathway to fuel-neutral targets, and that fuel neutral targets would eliminate any competitive advantage or preference to a particular GHG/FE technology and maintain the environmental benefits envisioned for the program. Daimler, Honeywell, and MEMA similarly commented in support of fuel-neutral standards. Honeywell and Motor and Equipment Manufacturers Association (MEMA) suggested basing the standards on a 16 percent improvement from the projected MY 2018 gasoline/diesel combined baseline. ACEEE and ICCT commented in support of a single set of standards set at or close to the capabilities of diesel technology. These commenters suggested that gasoline engines should be subject to more stringent standards than proposed and that gasoline and diesel engines should be held to the same performance-based standards.

Bosch disagreed with maintaining separate targets for gasoline and diesel HD pickups and vans. Bosch recommended that targets be fuel neutral, as they are in the light-duty vehicle programs. Bosch commented that it “believes that a market shift towards spark-ignited vehicles and away from HD pickups and vans powered by “fundamentally more efficient” CI engines would be a very real possibility under Phase 2 if the separate gasoline and diesel targets are finalized as proposed.” Bosch continues that “any such shift would signify not only a move towards less efficient internal combustion engines, but would be counterproductive from a programmatic/environmental and energy standpoint. Bosch further commented that “diesels from a criteria pollutant (especially NO<sub>x</sub>) emissions perspective, have made far greater strides over the years than gasoline engines, and for that reason have incurred greater technological development costs than the latter. While equivalent CO<sub>2</sub> target values may be more expensive, comparatively speaking, for SI engines to achieve (based on the agencies’ cost analysis), the additional cost imposed on these engines likely would not rise to the level of, much less overtake CI engines’ historically higher technological development and system costs.”

The agencies generally prefer to set standards that do not distinguish between fuel types where technological or market-based reasons do not strongly argue otherwise. However, as with Phase 1, we continue to believe that fundamental differences between spark ignition and compression ignition engines warrant unique fuel standards, which is also important in ensuring that our program maintains product choices available to vehicle buyers. In fact, gasoline and diesel fuel behave so differently in the internal combustion engine that they have historically required unique test procedures, emission control technologies and emission standards. These technological differences between gasoline and diesel engines for GHGs and fuel consumption exist presently and will continue to exist after Phase 1 and through Phase 2 until advanced research evolves the gasoline fueled engine to diesel-like efficiencies. This will require significant technological breakthroughs currently in early stages of research such as homogeneous charge compression ignition (HCCI) or similar concepts. Because these technologies are still in the early research stages, we believe the separate fuel type standards are appropriate in the timeframe of this rule to protect for the availability of both gasoline and diesel engines and will result in roughly equivalent redesign burdens for engines of both fuel types as evidenced by feasibility and cost analysis in RIA Chapter 10. For the same reasons, the agencies are adopting separate standards for diesel and SI vocational engines.

In order to maintain the same overall level of stringency as proposed for the program, a fuel neutral standard would result in an increase in stringency for gasoline or spark ignition vehicles with a matching relaxation of stringency for diesel or compression ignition vehicles relative to the separate numerical levels established in the proposal for gasoline and diesel vehicles. Based on the analysis of available technologies for both types of vehicles, the agencies do not feel it is appropriate to adopt such a change for either gasoline or diesel vehicles. This change could lead to an undesirable reduction in penetration of fuel efficient technologies in diesels, particularly from manufacturers who produce predominately diesel vehicles, while requiring a higher penetration of advanced technologies like strong hybridization in gasoline vehicles, distorting consumer choice. Additionally, the agencies do not agree with the comment stating that maintaining separate gasoline and diesel targets of equal increases in stringency of 2.5 percent per year from the Phase 1 final standards will result in a shift to less efficient gasoline vehicles. The agencies determined that manufacturers have similar technology challenges and corresponding costs regardless of fuel type and therefore manufacturers do not have an easier or lower cost long term path to compliance by simply shifting production from one fuel type to the other.

Note further that a manufacturer’s fleet average standard is the production weighted average of *all* its targets, both gasoline and diesel. Thus, there is no separate gasoline vehicle standard, or separate diesel standard. Commenters may have been confused on this point (several of the commenters referred to gasoline ‘standards’, or diesel ‘standards’). This averaging feature of the standard further increases incentives to add advanced technologies to either gasoline or diesel vehicles if manufacturers perceive it

advantageous to do so, since the benefit is experienced fleet wide, not just for the gasoline or diesel segment of a manufacturer's production line.

The agencies also received comments that the standards should be based exclusively on the GHG capabilities of diesel vehicles. The commenters viewed the separate gasoline and diesel standards as preferential treatment of gasoline-powered vehicles which have inherently higher GHG and fuel consumption. As discussed in Preamble Section VI.B.1, the agencies are maintaining the separate gasoline and diesel standards for heavy duty pickups and vans. As discussed earlier, diesel engines are fundamentally more efficient than gasoline engines providing the same power (even gasoline engines with the technologies discussed above) while using less fuel. However, dieselization is not a technology path the agencies included in the analysis for the Phase 1 rule or the Phase 2 rules. Gasoline-powered vehicles account for nearly half of the heavy-duty pickup and van market and are used in applications where a diesel may not make sense from a cost or consumer choice standpoint. Commenters did not address the costs of extensive dieselization.

More stringent standards, including Alternative 4, could result in manufacturers switching from gasoline engines to diesel engines in certain challenging segments. EPA remains concerned that this pathway could cause a distortion in consumer choices and significantly increase the cost of those vehicles, particularly considering that more stringent standards are projected in the Method B analysis to require penetration of some form of hybridization. Also, the agencies did not consider the impact dieselization would have on lead-time, as shifting nearly half the market from gasoline to diesel engines would require substantial retooling of production. Commenters did not account for the costs or address the feasibility of such retooling in the lead time available under either Phase 2 or Alternative 4. In addition, if dieselization occurs by manufacturers equipping vehicles with larger diesel engines designed for broad coverage of applications typical of this sector rather than "right-sized" engines, the towing capability of the vehicles could increase, resulting in higher work factors for the vehicles, higher targets, and reduced program benefits. Bosch commented that holding gasoline vehicles to the same GHG standards as diesels would bring the costs of compliance with all emissions standards, including criteria pollutant standards, for gasoline vehicles more in line with diesels, considering the costs of complying with criteria pollutant standards are much higher for diesels compared to gasoline vehicles. In response, EPA's Method B analysis shows that significantly more stringent gasoline vehicle GHG standards may require high levels of hybridization which, as discussed above, may not be acceptable for this market segment. This, in turn, could lead to dieselization, as manufacturers would opt to phase out gasoline-fueled vehicles rather than opt for widespread hybridization of their product offerings. EPA continues to believe that it is reasonable to adopt Phase 2 standards that continue to preserve the opportunity for manufacturers to produce and consumers to choose gasoline-powered vehicles in this market segment.

#### **7.2.4 Test Procedures**

**Organization:** American Automotive Policy Council

**Test fuel changes and needed Agency adjustments** – Moving to Tier 3 E10 test fuel has impacts on octane and energy content of the test fuel. The agencies need to make test procedure adjustments to avoid unintended increases in greenhouse gas and fuel consumption standard stringency. Industry is so concerned about this adjustment that they have initiated a test program to quantify these effects in the light-duty arena. The AAPC recommends a similar program for the heavy-duty segment. [EPA-HQ-OAR-2014-0827-1238-A1 p.11]

**Class 2b/3 Truck and Van Test Weights**

The current methodology for Class 2b/3 CO2 testing limits the Equivalent Test Weights (ETW) to 500 pound increments. While this is appropriate in terms of defining a reasonable number of sub-configurations, it provides no incentive for implementing weight reductions less than amounts that would result in a change to the next lowest 500 pound ETW bin. For example, a manufacturer with a 7,200 lb. ALVW truck would be in the 7,000 lb. ETW class. Implementing an 800 lb. weight reduction would result in a 400 lb. change to the vehicle's ALVW (assuming that the full 800 lbs. is added to the vehicle's payload). This would lower the ALVW to 6,800 lbs., resulting in the same 7,000 lb. ETW class as the heavier vehicle. [EPA-HQ-OAR-2014-0827-1238-A1 p.25]

[Figure of ETW can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

While work factor targets are calculated to individual pounds, test weights are limited to 500 lb. increments. [EPA-HQ-OAR-2014-0827-1238-A1 p.26]

As a matter of public policy, the regulations should be designed to encourage incremental weight reductions by manufacturers whenever possible, not just large-scale weight reductions requiring huge investments of resources. AAPC recommends that a credit mechanism be defined that allows manufacturers to use the ADC formula found in § 86.1819-14 (g)(1) to account for weight reductions within an ALVW test weight class (actual ALVWs within 50 lb. increments). [EPA-HQ-OAR-2014-0827-1238-A1 p.26]

**Organization:** California Air Resources Board (CARB)

**Comment - The test weight bins should be changed in order to allow for more realistic testing of heavy-duty pickups and vans due to mass reduction**

CARB staff believes weight reduction can be a cost-effective technology that can achieve significant CO2 reductions. A prime example of the effectiveness of this technology is the recently redesigned F150 which makes extensive use of aluminum. In fact, all manufacturers are expected to incorporate vehicle weight reduction across their light-duty fleet (where emission test weight (ETW) bins are significantly smaller) in response to the 2017-2025 GHG requirements. As currently structured, the ETW bins for class 2b and 3 vehicles (500 lbs) tend to discourage the use of this technology since significant weight reduction is required before any benefit can be demonstrated over the applicable emission test cycles. Narrowing the ETW bins could encourage early implementation of vehicle weight reduction across a vehicle product line as well as providing manufacturers with increased flexibility in using weight reduction as part of their technology portfolio. Another benefit of reducing ETW bins is that the test results would more accurately reflect vehicle GHG emissions. Accordingly, CARB staff recommends restructuring the compliance process to encourage vehicle weight reduction by reducing the applicable ETW bins to 125 pound increments. [EPA-HQ-OAR-2014-0827-1265-A1 p.66]

**Organization:** Daimler Trucks North America LLC

**HD Pickup and Van Test Procedures (80 FR 40341)** - Daimler supports the agencies' approach of keeping the test procedures fundamentally the same and continuing regulations that create as level of a playing field as possible. Daimler also supports the agencies' proposals to change how vehicles are categorized into test bins. Creating smaller ranges decreases the chances of one manufacturer having an unfair advantage over another within a test bin. However, the potential increase in the number of bins as a result of this effort is cause for some concern. The agencies should promote opportunities for manufacturers to generate additional credits. At this time, Daimler does not offer comment as to

appropriate methods allowing for analytical adjustments of CO<sub>2</sub> levels and fuel consumption within vehicle weight class. [EPA-HQ-OAR-2014-0827-1164-A1 p.113]

**Response:**

The test procedures for HD pickups and vans currently specify using a fuel with properties established under the light-duty (LD) vehicle Tier 2 program. EPA recently finalized new emission standards under the Tier 3 program for both LD vehicles and HD pickups and vans which will begin to phase-in in MY2017 for LD vehicles and MY2018 for vehicles over 6000 pounds GVWR, including HD pickups and vans. As part of the Tier 3 program, new test procedures require the use of a new test fuel containing 10 percent ethanol which is more representative of in-use fuel that the vehicles will encounter. The agencies are investigating any potential impact of changes to the fuel properties on GHG emissions and fuel consumption and have committed to providing appropriate adjustment to the test procedures if necessary to ensure no change in stringency of the Phase 1 or the Phase 2 standards. Additionally, any potential regulatory action as a result of the findings from this investigation would also address provisions allowing for an appropriate phase-out of data generated on the current GHG emissions and fuel consumption certification fuel as to avoid an unnecessary disruption in manufacturer's long term planning and testing requirements.

AAPC commented that the current methodology of grouping vehicles by the Equivalent Test Weight (ETW) in increments of 500 pounds for determining their GHG and FE performance is too large to capture weight reductions that may occur within a 500 pound grouping. Under the current test procedures, vehicles are tested at 500 lb. increments of inertial weight classes when testing at or above 5500 lbs. test weight. For example, the commenter stated that all vehicles having a calculated test weight basis of 11,251 to 11,750 lbs. are tested at 11,500 lbs. (i.e., the midpoint of the range). However, for some vehicles, the existence of these bins and the large intervals between bins may reduce or eliminate the incentive for mass reduction for some vehicles, as a vehicle may require significant mass reduction before it could switch from one test weight bin to the next lower bin. For other vehicles, these bins may unduly reward relatively small reductions of vehicle mass, as a vehicle's mass may be only slightly greater than that needed to be assigned a 500-pound lighter inertia weight class. For example, for a vehicle with a calculated test weight basis of 11,700 lbs., a manufacturer would receive no regulatory benefit for reducing the vehicle weight by 400 lbs., because the vehicle would stay within the same weight bracket.

The agencies believe this (and similar comments) have some merit. In response, the agencies are finalizing an option allowing manufacturers to divide vehicle models into 50 pound increment groupings of vehicles for the different Adjusted Loaded Vehicle Weights (ALVW) for purposes of more precise calculation of CO<sub>2</sub> emissions performance within the 500 pound increment test weight classes. ALVW will vary within a single ETW largely depending on the varying models curb weights from customer option selection and other production variations. The calculation of CO<sub>2</sub> emissions performance for the 50 pound increment groupings is performed as described in 40 CFR 86.1819-14(g)) for analytically adjusting CO<sub>2</sub> (ADCO<sub>2</sub>) emissions. The test results at the existing 500 pound increment ETWs will be used to determine the CO<sub>2</sub> emissions performance level of the new groupings using the analytically derived equation. This new ADCO<sub>2</sub> emissions level is only used for this new grouping and cannot be used to extend determination of other ALVW groupings emission performance levels. The vehicle specific values used to determine the change in ETW in the ADCO<sub>2</sub> emissions calculation to estimate the performance of the smaller grouping should be consistent with value used to calculate the single work factor of that same grouping. This change does not impact the ETW of a group of vehicle models that are contained in the 500 pound increment of ETW when performing testing nor does it eliminate any vehicle in that grouping from being responsible for emission performance at

the 500 pound increment test weight classes. As described, this change only allows for more precise CO<sub>2</sub> emissions estimation for the potentially different curb weights of vehicles grouped in a single ETW class for purposes of fleet average calculation. If a manufacturer chooses to use the 50 pound increment approach, they are required to use this option for all of their HD vehicles that are chassis certified (including loose engines).

### 7.3 Projected Pickup and Van Technologies, Effectiveness, and Cost

**Organization:** American Chemistry Council (ACC)

A Lightweighting vehicle is one of the strategies to achieve reduced greenhouse gas (GHG) emissions and fuel consumption. This is an area where lightweight plastic polymer composites can play a significant role in designing new medium and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1147-A2 p.2]

Composites are a combination of tough plastic resins, reinforced with glass, carbon fibers and other materials. These plastic composites are lighter weight than traditional automobile materials, yet maintain high levels of strength and a high resistance to corrosion. Plastic and composite materials provide a way to lighten vehicles while maintaining passenger safety and the integrity of the vehicle. Additional properties of plastics and composites, including strength to weight ratio, energy absorption and flexible design, make these materials ideal for use in the manufacturing of medium and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1147-A2 p.2]

The chart labeled “Figure 1”<sup>1</sup> below provides data regarding the tensile strength and density of filled plastics, polymer composites, metals, and alloys. As shown in the chart, there are many plastics and polymer composites that are significantly less dense than most metals and alloys while offering similar tensile strengths. These data illustrate the fundamental physical advantage that many plastics and polymer composites can offer over metallic automotive materials: higher strength-to-weight ratios that can enable automakers to lightweight vehicles while maintaining safety and performance. As vehicles across the board begin reducing weight to comply with the new GHG emissions standards and fuel efficiency standards proposed by this rulemaking, new lightweight vehicle architectures will emerge. Lightweight plastic and polymer composites have the characteristics needed to help deliver energy saving results while supporting innovative designs that satisfy consumer preference. [EPA-HQ-OAR-2014-0827-1147-A2 p.2]

[Figure 1, 'Tensile Strength versus density for filled plastics, polymer composites, and metals and metal alloys', can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1147-A2]

Recent model year cars and trucks have greatly benefited from plastic and composite materials as well. In the last 47 years, the use of lightweight plastics in U.S. automobiles grew from an average of 60 pounds (27 kilograms) per vehicle to approximately 330 pounds (150 kilograms) per vehicle in 2014. More than 50% of a typical vehicle’s volume is composed of plastics and polymer composites, but these materials only account for approximately 10% of total vehicle weight. It is evident that medium and heavy-duty vehicles can reap the same benefits as the lightweight vehicle sector by embracing cutting edge plastic and composite technology which reduce weight and allow manufacturers to consolidate components. A timely example on a 2010 vehicle is illustrated by an all new plastic two-shot window lift carrier plate that replaces a metal-intensive assembly comprising 21 components produced with 16+ processing and assembly steps with a plastics-intensive, 10-component unit produced in 10 assembly steps.<sup>2</sup> [EPA-HQ-OAR-2014-0827-1147-A2 p.3]

The proposed rulemaking recognizes the use of lightweight plastic and polymer technologies, such as thermoplastics. ACC applauds this recognition, particularly considering the fact that the increasing interest in plastic and composites within the global automotive industry follows well-documented trends of composite usage to increase efficiency in the civilian and military aerospace industries. Choosing plastic and polymer composites to lightweight medium and heavy-duty vehicles is a decision supported by science that can pay immediate and long term dividends. [EPA-HQ-OAR-2014-0827-1147-A2 p.3-4]

### **Aerodynamic Benefits**

Aerodynamic enhancement features on trucks often utilize lightweight plastics that add very little weight while providing large aerodynamic gains. Lightweight plastic and polymer composites also have excellent durability with damage and corrosion resistance compared to the traditional steel and aluminum alternatives. Those characteristics, along with the benefit of low tooling manufacturing, makes plastic and polymer composites a viable material for aerodynamic technologies like side skirts and trailer end fairings. The function of aerodynamic technologies and lightweight plastic and composites go hand in hand for they both have the ability to reduce GHG emissions and fuel consumption. [EPA-HQ-OAR-2014-0827-1147-A2 p.4]

In 2014, ACC's Plastics Division published a detailed report titled "Plastics and Polymer Composites for Automotive Markets Technology Roadmap." 6 This road mapping process engaged technical experts and leaders from the automotive and plastics and polymer composites industries, including perspectives from original equipment manufacturers, tier suppliers, material developers, researchers, federal agencies, and consultants, to discuss the current limitations to the increased use of plastics and polymer composites and to identify industry-wide actions that can accelerate the increased widespread use of these materials in future vehicles. The roadmap synthesizes the findings from this effort through 2014 and sets a path forward for the plastics and polymer composites and automotive industries through 2030. This roadmap is designed to help the automotive and plastics and polymer composites industries maintain a strong foundation upon which to build partnerships and initiate collaborative programs that address changing market needs. Implementing this roadmap will require significant resources to accomplish both shorter-term priorities and the long-term vision for 2030 and beyond. We would be pleased to meet with the agencies to further discuss our roadmap implementation efforts so that the information can be effectively leveraged to meet the objectives of this Proposed Rule. [EPA-HQ-OAR-2014-0827-1147-A2 p.5]

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1 ACC. "Plastics and Polymer Composites for Automotive Markets Technology Roadmap," 2014, <http://plastics-car.com/Tomorrows-Automobiles/Plastics-and-Polymer-Composites-Technology-Roadmap>

2 "Two-Shot Window Lift Carrier Plate," [Plasticscar.blogspot.com](http://www.plasticscar.blogspot.com/2012/11/two-shot-window-lift-carrier-plate.html), November 21, 2012, <http://www.plasticscar.blogspot.com/2012/11/two-shot-window-lift-carrier-plate.html>.

**Organization:** National Automobile Dealers Association (NADA)

NHTSA and EPA estimate that the per vehicle average costs to comply with these new heavy-duty pickup and van standards will, due to potential fuel savings, result in a 3 year average payback period. However, many customers could face significantly higher actual costs and thus longer pay back periods. While not mandatory, the Phase 2 proposal clearly contemplates that compliance for this vehicle group will be achieved in part by engine stop start engine stop start engine stop start engine stop start engine stop start engine stop start engine stop start engine stop start and powertrain hybridization. [EPA-HQ-OAR-2014-0827-1309-A1 p.8]



**Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 242.]

the projected incremental cost for the heavy-duty pickup and vans, strong and mild hybrids, seem a little bit low. The heavy-duty pickup and van strong and mild hybrid cost projected in RIA tables 2-179 and 2-183 are based on weight scaling from the light-duty sector that do not adequately account for production volume differences between light-duty and heavy-duty sectors.

**Organization:** California Air Resources Board (CARB)

**Comment – The heavy-duty pickups and vans technology list should include battery electric or fuel cell electric technology, hybridization of diesel engines and dieselization**

CARB staff has significant concerns regarding the following assertion: [EPA-HQ-OAR-2014-0827-1265-A1 p.66]

As discussed in Section I, the agencies request comment on the proposed approach for the advanced technology multipliers for heavy-duty pickups and vans as well as the other heavy-duty sectors, including comments on whether or not the credits should be extended to later model years for more advanced technologies such as EVs and fuel cell vehicles. These technologies are not projected to be part of the technology path used by manufacturers to meet the proposed Phase 2 standards for heavy-duty pickups and vans. (page 40389 of the NPRM) [EPA-HQ-OAR-2014-0827-1265-A1 p.66-67]

A large population of heavy-duty pickups and vans are used as last-mile delivery vehicles that return to a yard or terminal on a daily basis. Last-mile delivery vehicles will be ideal candidates for zero-emission technologies, especially fuel cell electric technology. With this understanding, CARB staff is considering regulations that will incentivize and/or mandate zero-emission technologies in the heavy-duty sector within the Phase 2 timeframe. Specifically heavy-duty pickups and vans, especially in last-mile delivery applications, is an area that CARB staff considers fertile for greater adoption of zero-emission technologies in the near-term. CARB staff believes that the federal Phase 2 standard is important to incentivize early adoption and deployment of zero-emission technologies in this category. [EPA-HQ-OAR-2014-0827-1265-A1 p.67]

The NPRM requests comment on the proposed technology list that would be used by manufacturers to comply with the heavy-duty pickup and van standard. CARB staff recommends that the list include battery electric and fuel cell electric technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.67]

The list of technologies should also include hybrid diesel technologies as CARB staff believes strong hybrids in the heavy-duty pickup and van sector will be widely available in the 2025 timeframe. Currently, XL Hybrids and Crosspoint Kinetics have commercially-available hybrid systems for both new purchases and existing vehicle conversions. [EPA-HQ-OAR-2014-0827-1265-A1 p.67]

XL Hybrids currently has hybrid systems for box trucks (Ford E-350/E-450 cutaway, Ford E-450 strip chassis), Reach walk-in commercial vans (Isuzu/Utilimaster), cargo vans and passenger wagons (Chevy Express 2500/3500, GMC Savana 2500/3500, Ford E-150/E-250/E-350, Ford Transit), shuttle buses (Ford E-350/E-450 cutaway, Ford E-450 strip chassis, GM 3500/4500 cutaway (available September

2015)), and commercial stripped chassis (F59 super duty) for walk-in van fleets. [EPA-HQ-OAR-2014-0827-1265-A1 p.67]

Crosspoint Kinetics currently has hybrid systems for a variety of new class 3-7 trucks and buses, including a retrofit option for existing vehicles. Their systems have been tested and approved at Altoona and have been certified by the Federal Transit Administration. [EPA-HQ-OAR-2014-0827-1265-A1 p.67-68]

CARB staff believes that if there is a projected demand created by regulatory Phase 2 (Alternative 4) requirements, these two companies, and likely other companies, would make additional hybrid systems available for the targeted heavy-duty truck and van sector. Since the basic hybrid system designs from XL Hybrids and Crosspoint Kinetics have been proven in actual fleet operations, additional demands for their products would lower the price of hybrid technologies due to increased production. The technology could also be more economically designed for other vehicle platforms, creating additional growth and development for hybrids in general. [EPA-HQ-OAR-2014-0827-1265-A1 p.68]

Furthermore, U.S. EPA and NHTSA's own modeling on the projected level of hybridization penetration necessary by 2030 to comply with the different regulatory alternatives showed that for two companies (Daimler and Nissan), no hybridization is necessary to comply with Alternative 4 (Tables VI-25, page 40378 of the NPRM, and VI-26, page 40378-40379 of the NPRM, respectively). Another company, Fiat/Chrysler needs only 3 percent hybridization penetration to comply with Alternative 4 (Table VI-24, page 40376-40377 of the NPRM) and Ford needs to have 14 percent hybridization penetration to meet Alternative 4 requirements (Table VI-23, page 40375-40376 of the NPRM). Of the major manufacturers, only GM would need to have a significant level of hybridization penetration at 79 percent to comply with Alternative 4 (Table VI-22, page 40375 of the NPRM). This lends further support for the feasibility for Alternative 4, which CARB staff recommends. [EPA-HQ-OAR-2014-0827-1265-A1 p.68]

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41 See Attachment 4 for Active and Planned Fuel Cell Electric Vehicles Demonstrations. [Attachment 4 can be found on p.27-36 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

42 (NREL, 2015c) Eudy, Leslie, and Matthew Post, "Zero Emission Bay Area (ZEBA) Fuel Cell Bus Demonstration Results: Fourth Report," National Renewable Energy Laboratory, July 2015, <<http://www.nrel.gov/docs/fy15osti/63719.pdf>>.

43 See Attachment 4 for Active and Planned Fuel Cell Electric Vehicles Demonstrations.

44 Id

**Response:**

The agencies recognize there is a range of diversity and complexity for mass reduction and material substitution technologies and there are many techniques that automotive suppliers and manufacturers are using to achieve the levels of this technology that the agencies have modeled in our analysis for this program. We agree that there is an area where lightweight plastic polymer composites can play a significant role in designing new medium and heavy-duty vehicles. In our analysis, we discuss an overall vehicle mass reduction not specific to one part of the vehicle with cost estimates that are also not specific to any component or material that would be substituted.

The agencies also identified aerodynamic drag reduction as a technology that could be implemented to reduce the GHG emissions and fuel consumption. We agree that materials made from lightweight plastics could help provide aerodynamic reductions and in fact are already seeing significant use of these materials in the light-duty fleet. Many of the similar approaches to reduce aerodynamic drag in light duty, particularly in trucks and MDPVs are also applicable to the heavy-duty segment.

With regard to the comment regarding projected incremental cost for the heavy-duty pickup and vans, strong and mild hybrids, as discussed in the NPRM, the agencies utilized cost and technology estimates that originated from light duty vehicle MY 2017-2025 GHG rule cost analysis but were then adjusted upward for the heavy duty vehicles based on the increase in GVW between the light duty and heavy duty segment. The effectiveness of hybrid systems was reduced relative to the light duty levels because of the duty cycles of heavy duty vehicles tend to result in more loaded operation and reduced opportunity for hybrid system energy recovery. The hybrid systems in light duty have been evolving dramatically in the past few years and as such costs have been fluctuating with different designs, but there has been a general trend of reduction in cost, particularly in the batteries, with each new generation of hybrid system. It is difficult to precisely predict what the cost of a heavy duty hybrid system will cost when this rule begins to take place in MY2021 and phases in the years that follow as manufacturers determine what applicable level of hybridization they can incorporate into their heavy duty vehicle designs. For these reasons, the agencies feel that our estimates of the various hybrid systems discussed in the NPRM and FRM are appropriate estimates based on our research of light duty systems and then scaled for heavy duty vehicles.

During the development of the NPRM, the agencies worked closely with and communicated with CARB regarding our determination of technologies that were appropriate at this time for a Phase 2 national program and that would be included in the agencies' modeling in support of the final standards. In their comments, CARB discusses battery electric or fuel cell electric technology for heavy duty pickups and vans as a technology that could be included in the agencies' list of available technologies. These technologies are not projected to be part of the technology path used by manufacturers to meet the Phase 2 standards for heavy-duty pickups and vans. The agencies determined that while battery electric or fuel cell electric technology may be a viable technology option at some point in the future for this sector, insufficient information exist regarding the cost and effectiveness of these technologies in the heavy duty pickup truck and van sector in the time frame of this rule. They agencies instead chose to offer advanced technology multipliers for use of these technologies on all Phase 2 vehicles to incentivize the adoption of these technologies.

In their comments, CARB staff believes strong hybrids in the heavy-duty pickup and van sector will be widely available in the 2025 timeframe. According to CARB staff, XL Hybrids and Crosspoint Kinetics currently have commercially-available hybrid systems. The agencies included both mild and strong levels of hybridization in the modeling for the NPRM and the FRM. The Method B model predicted that some level of both mild and strong hybridization was appropriate and cost effective in the heavy duty pickup and van segment for the finalized standards, but that these levels would rise sharply if the standards were pulled ahead. As discussed above, EPA determined that Alternative 4 was inappropriate largely for these reasons, especially considering the adequacy of lead time to require higher levels of penetration of these advanced technologies by 2025 rather than 2027. In addition, as explained in response 7.2.1 above and Preamble section VI.E, the method B analysis indicates that the Phase 2 standards are projected to achieve the same final stringency increase as Alternative 4 at about 80 percent of the average per-vehicle cost increase, without necessitating the high penetration rates and short lead times for mild hybrids.

## 7.4 Flexibilities and Compliance Provisions for HD Pickup and Van Standards

### 7.4.1 Averaging, Banking, and Trading Credits Provisions

**Organization:** American Automotive Policy Council

Given the limited historical data available for medium- and heavy-duty engines and vehicles, we support the flexibilities noted as a means to address the inherent program uncertainties and ensure the program's continued success. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

**Credit Carry Forward and Transfers** - AAPC supports extending the carry-forward of banked, surplus credits by both Agencies until they are fully used to offset future debits and separately remove the restrictions for credit trading between the differing regulatory categories. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

#### **Credit Carry Forward and Transfers**

##### Carry Forward

The limited five year carry-forward mechanism for CAFE and GHG credits was apparently chosen because it mimics the current light-duty CAFE program, but this approach is neither optimal nor required for the heavy-duty program. Heavy-duty credits should have a longer life to better align the program with the realities of the heavy-duty fleet. The heavy-duty fleet differs fundamentally from the light-duty fleet for the following reasons: [EPA-HQ-OAR-2014-0827-1238-A1 p.13]

- Industry heavy-duty volumes are much smaller (only 5% of light-duty fleet volumes) [EPA-HQ-OAR-2014-0827-1238-A1 p.13]
- Individual manufacturers have fewer models to average for compliance (essentially a pickup and van with many variants) in the heavy-duty versus light-duty fleet. [EPA-HQ-OAR-2014-0827-1238-A1 p.13]
- With fewer models and longer renewal times for heavy-duty vehicles and powertrains, manufacturers have less frequent opportunities to implement significant fuel consumption / CO2 improvements. [EPA-HQ-OAR-2014-0827-1238-A1 p.14]
- The heavy-duty fleet has multiple "regulatory buckets" (2b/3 fleet, engine dyno, GEM, etc.) that further constrain a manufacturer's ability to balance credits and debits. [EPA-HQ-OAR-2014-0827-1238-A1 p.14]

AAPC supports extending the carry-forward of banked, surplus credits by both Agencies until they are fully used to offset future debits. While adopting an extended carry-forward time period provides greater flexibility in how manufacturers use credits they have generated, it does not change the overall effectiveness of the program. There are multiple reasons why adopting this policy would benefit stakeholders: [EPA-HQ-OAR-2014-0827-1238-A1 p.14]

- **Motivates Early Action** - Extending the life of credits provides greater flexibility for manufacturers in using the credits they have generated. As the agencies themselves have noted in the Light-Duty regulation (77 Federal Register 62666), carrying forward of credits beyond 5 years provides manufacturers a significant incentive to over-comply to present regulation in order to generate credits for future use. This rewards early investment and encourages adoption of additional CO2 reducing technologies that manufacturers would otherwise not be

incentivized to deploy. These credits would also help manufacturers resolve lead-time issues and manage uncertainties, such as future NOx reduction, while facing aggressively increasing standards from Phase 1 to Phase 2. [EPA-HQ-OAR-2014-0827-1238-A1 p.14]

- Consistent with Product - A long credit life is more consistent with how the vehicles and powertrains under this regulation are viewed by both manufacturers and customers. Manufacturers refresh these vehicles less often as smaller annual volumes drive longer investment amortization and customers view vehicles as functional tools that are oftentimes used by the first owner for a full vehicle lifetime. [EPA-HQ-OAR-2014-0827-1238-A1 p.14]
- Follows Precedent - There is precedent within the EPA regulations for extending the life of GHG credits. The EPA in the 2017-2025 Light-Duty GHG regulations established an extended carry-forward provision. The rationale given (76 Federal Register 74968) was that extended carry-forward “provisions are not expected to change the emissions reductions achieved by the standards, but should significantly reduce the cost of achieving those reductions.” This assessment is even more compelling in the context of the Heavy-Duty rule, as extended carry-forward would enable manufacturers to comply with the requirements of the Phase 2 proposal at an overall lower cost. EPA also notes (77 Federal Register 62789) that compliance features, such as extended carry-forward, are particularly valuable because, in contrast to the Light-Duty CAFE program, no option to pay fines in lieu of compliance exists under the Clean Air Act. In addition, the increasing stringency of Phase 2 program under Alternative 3 merits more flexibility. EPA’s action in the light-duty program establishes a precedent for providing this type of flexibility. As EPA noted in their *EPA Fact Sheet – August 2012*: “To facilitate the transition to the increasingly more stringent MYs 2017-2025 standards, EPA is finalizing under its Clean Air Act authority a one-time CO2 credit carry-forward provision beyond 5 years, allowing credits generated from MYs 2010 through 2016 to be used through MY 2021.” [EPA-HQ-OAR-2014-0827-1238-A1 p.14]
- Allowed by Statute – The agencies are allowed to make this change and are not constrained by the CAFE statute. The CAFE statute provides, in 49 USC 32902(k), that the Secretary of Transportation is to regulate commercial medium-duty and heavy duty on-highway vehicles, and work trucks, by developing test methods, measurement metrics, fuel economy standards, and compliance and enforcement protocols, that are: appropriate, cost-effective, and technologically feasible. This language leaves the design of the program to the Secretary’s discretion, and imposes no specific limitations on the life or usage of credits under the program. [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

All of the other CAFE provisions that address fuel economy and associated requirements are found in sections 32902(a)-(d). Sections 32903(a) and 32903(e) set forth CAFE’s 5-year carry-forward/3-year carry-back provision for passenger automobiles and non-passenger automobiles subject to the light-duty CAFE program. These provisions do not apply to the heavy-duty program promulgated by the Secretary pursuant to section 32902(k). Thus, the heavy-duty CAFE program is not subject to any statutory restrictions pertaining to credit life requirements. [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

NHTSA can, under the statute, establish any credit mechanism that is consistent with the overall directive to promulgate an “appropriate, cost-effective and technologically feasible” set of regulations for heavy-duty vehicles. For the reasons outlined above, our proposal to carry-forward credits until they are fully used to offset debits is consistent with these statutory directives. [EPA-HQ-OAR-2014-0827-1238-A1 p.15]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The UAW strongly supports an Averaging, Banking and Trading and Off-Cycle Technology credit program that “plays an important role in making the proposed technology-advanced standards feasible, by helping to address many issues of technology challenges in the context of lead time and costs.” [EPA-HQ-OAR-2014-0827-1248-A2 p.10]

The credit system works well and is essential in the heavy-duty pickup and van sector because the year-over-year stringency requirements do not reflect the reality of product cycle and the small number of platforms in the segment. Extended carry-forward time in light duty regulation, encourage manufacturers to make greater improvements sooner because surplus credits will not expire. This model should also be applied to the medium and heavy duty segments. We urge EPA and NHTSA to examine ways to enhance the existing credit program to account for the realities of the market. [EPA-HQ-OAR-2014-0827-1248-A2 p.10]

**Organization:** Nissan North America, Inc.

#### One Time Credit Carry Forward Through Model Year 2027

Nissan strongly supports allowing a longer, one-time carry forward from Phase 1 of the program to Phase 2. Similar provisions were made in the light duty program and the same reasoning applies to the HDPV program as well. Since companies such as Nissan are investing heavily in the near term and using the best and most advanced technology, the credits earned by adopting such advanced technologies now is essential to meeting the more stringent standards later. Credits earned during Model Years 2014 through 2020 should be allowed to be carried forward during the pendency of the Phase 2 program, through to Model Year 2027. Allowing such use of credits encourages companies to deploy investment in more advanced and costly technology earlier, obtaining significant greenhouse gas benefits, rather than simply meeting compliance and adding new technology later. [EPA-HQ-OAR-2014-0827-1026-A1 p.4]

#### **Response:**

As discussed in Chapter 1.4.7, the agencies received general comments regarding credit carry-forward in addition to the HD pickup and van specific comments shown above. The agencies received comments from CARB that the agencies should not allow Phase 1 credits to be carried forward into Phase 2. CARB commented that Phase 1 credits should be limited to a three year carry-forward or MY 2020 whichever is sooner. CARB is concerned that Phase 1 credits may reduce the efficacy of the Phase 2 program and delay technology development progress.

The agencies are retaining the 5 year credit carry-forward provisions for HD pickups and vans as proposed. As discussed in Section VI.C of the Preamble, the agencies believe that the standards for HD pickups and vans are feasible without extending the credit carry-forward provisions. The agencies continue to believe that credit carry-forward provides important flexibility to manufacturers especially in transitioning to more stringent standards and restricting the provision could be disruptive to manufacturer product plans. However, the agencies understand CARB’s concerns regarding Phase 1 credits being used to postpone technology progress if some manufacturers were to accumulate large credit banks under Phase 1. Large banks of Phase 1 credits combined with unlimited credit-forward could have the unintended effect of allowing some manufacturers to delay the application of Phase 2 technologies. CARB suggested that the agencies had not considered the Phase 1 credits, but the agencies’ modeling included credit carry-forward and credits that are expected to be banked from the Phase 1 standards. The modeling did not indicate that a 5 year credit carry-forward would result in a significant delay in the application of technology, but would provide flexibility to manufacturers in

implementing the Phase 2 standards which become more stringent year-over-year in MYs 2021-2027. Although some commenters supported longer credit carry-forward, the agencies did not receive comments that the proposed standards which are being finalized would not be feasible with only five year credit carry-forward. The 5 year credit carry-forward preserves needed flexibility for transitioning to more stringent Phase 2 standards by allowing manufacturers to mesh the phase-in with their product redesign cycles. The limit also helps to address concerns regarding delaying the introduction of technology in Phase 2 or market disruptions that could occur if a manufacturer saved credits over many years and achieving a cost advantage by using those credits in a single year.<sup>197</sup>

Further, Daimler and AAPC argue that credits be transferable between the light-duty and heavy-duty classes. However, EPCA and EISA does not allow for the transfer of credits between the light-duty and heavy-duty classes. Further, the agencies do not have enough data to conclude that allowing credit transfers between vocational vehicles, tractor trailers, and heavy-duty pickups and vans will not compromise the benefits of the program. These three classes are vastly different, and it may be easier to comply in one class and not to advance technologies in the other classes. Until more information is available the agencies have concluded that the credits generated in one vehicle class are not transferable with those generated in another class.

#### **7.4.2 Air Conditioning System Credits**

**Organization:** American Automotive Policy Council

**Acknowledge Mobile Air Conditioning Improvements** - AAPC recommends adopting a credit approach that acknowledges the greenhouse gas and fuel consumption benefits of direct and indirect A/C system improvements. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

#### **Acknowledge Mobile Air Conditioning (MAC) Improvements**

##### Light-Duty MAC Efficiency

During the creation of the 2012-2016 Light-Duty vehicle greenhouse gas regulation, EPA created a list of efficiency technologies (75 Federal Register 25428) which could earn a pre-defined and pre-approved credit in grams per mile of CO<sub>2</sub>. These credits could be applied to every vehicle that used the defined technologies. These were termed “indirect” mobile air conditioner credits since the emissions reduction did not result within the air conditioner system itself, but rather from the savings in fuel ultimately used to power the MAC system. This has proven itself to be a highly successful approach for gaining rapid implementation of air conditioner efficiency technologies. The following table shows the growth in MAC credits: [EPA-HQ-OAR-2014-0827-1238-A1 p.17]

[Table of credits in million of megagrams of CO<sub>2</sub> can be found on p.17 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

The table above shows that air conditioner efficiency technologies were not heavily used among vehicles sold in the U.S. at the beginning of the greenhouse gas regulatory period, with the total industry

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<sup>197</sup> Note that the agencies have accounted for potential windfall credits from Phase 1 in other areas of the Phase 2 program, in particular, increasing the stringency of the vocational engine standard (and other engines certified exclusively under the transient cycle). See Section II.D.5 of the FRM Preamble.

claiming only 2.1 million megagrams (i.e., metric tons) in CO2 credits in 2009. (See Appendix A for detailed history of Light-Duty MAC Credits 2009-2013). [EPA-HQ-OAR-2014-0827-1238-A1 p.17]

As the Alliance of Automobile Manufacturers noted in their comments on the 2012-2016 and 2017-2025 Light-Duty vehicle greenhouse gas and fuel economy rulemakings (EPA-HQ-OAR-2009-0472-6952 and EPA-HQ-OAR-2010-0799-9487, respectively), EPA based its MAC efficiency credits on estimates of each technology's percentage impact on the total fuel usage by vehicle air conditioner systems in the United States. However, EPA's estimate of baseline total air conditioner usage was well below the estimates of others, such as researchers from the National Renewable Energy Laboratory and Oak Ridge National Laboratory, as well as longstanding benchmarks used by industry. We continue to believe that this low baseline used by EPA, which was less than half the baseline MAC energy usage estimated by the other major sources, resulted in MAC efficiency credits which are far below the actual real-world fuel savings and CO2 reductions that are resulting from these technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.17]

MAC improvements in the light-duty fleet have been acknowledged by EPA as a significant source of real-world benefits, leading EPA to state in its 2012 MY report: [EPA-HQ-OAR-2014-0827-1238-A1 p.17]

“About 40 percent of these [credits] were accrued through the use of the optional credit programs for air conditioning systems, indicating a significant, real-world benefit as a result of the introduction of the technologies underlying these optional credit programs.” (EPA Manufacturer Performance Report for the 2012 Model Year, p. 11) [EPA-HQ-OAR-2014-0827-1238-A1 p.17]

#### MAC Efficiency in Class 7, Class 8, and Vocational Truck Regulations

EPA included fuel savings from improved air conditioner credits in setting the standards for Class 7 and Class 8 heavy trucks, as well as vocational vehicles: “Compared to 2017MY air conditioners, air conditioners with improved efficiency compressors will reduce CO2 emissions by 0.5 percent.” (80 Federal Register 40221). The difficulty of the standards was increased over time due to the forecast phase-in of these improved MAC systems (80 Federal Register 40228). [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

For regulatory compliance, an improvement factor of 0.5% is given to vehicles with “high-efficiency” air conditioner compressors, defined as either electric compressors or improved mechanical compressors. High-efficiency compressors are an input variable in the GEM model which results in a 0.5% fuel consumption reduction, thereby de facto giving Class 7, Class 8 and vocational trucks the benefit of a pre-defined and pre-approved off-cycle fuel consumption credit for these compressors (80 Federal Register 40631). (Note: reference to 86.1868-12(h)(5) in the NPRM appears to be incorrect since that section covers improved evaporators and condensers whereas the correct reference would be to compressors with reduced reheat 86.1868-12(h)(1).) [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

Clearly, the agencies recognize the environmental benefits that can be achieved from vehicle air conditioner efficiency improvements, and has included incentives within this NPRM for Class 7, Class 8 and vocational truck regulations to achieve these benefits through a simple pre-defined credit. To not acknowledge the potential environmental benefits and give credit for these same technologies on Class 2b/3 vehicles, with their significantly higher volumes, is inconsistent and counter-productive. [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

#### Class 2b/3 MAC Efficiency Pre-Approved Credit List



The proposed regulation also explicitly applies the pre-defined light-duty MAC and off-cycle credit pick lists to MDPV's (Medium Duty Passenger Vehicles). The result would be that all light-duty vehicles, MDPV's, Class 7, Class 8 and vocational trucks would have pre-defined credit lists for MAC and off-cycle technologies. Class 2b/3 trucks (non-MDPV's) would be the only remaining vehicles that would not have access to pre-defined credit lists for MAC and off-cycle technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

All the technologies from the light-duty vehicle MAC and off-cycle credits lists are applicable to Class 2b/3 vehicles, as are the additional technologies from the Class 7, 8 and vocational truck credit lists (e.g., automatic tire inflation, adaptive cruise control, electric steering and cooling, stop-start, neutral idle and extended idle). The advantages from a pre-defined credit list have already been thoroughly established with the rapid implementation of improved air conditioner technologies on light-duty vehicles, leading to the creation of the expanded light-duty pre-defined off-cycle credit list for 2014 (77 Federal Register 62737). The same successful template should be applied to all of the Class 2b/3 trucks, from the start of the Phase 1 program, in order to expand the options for cost-effective technologies with which to comply with this regulation. The result will be better environmental results, achieved quicker, and at lower cost. [EPA-HQ-OAR-2014-0827-1238-A1 p.18]

While light-duty and heavy-duty vehicles have similar air conditioning systems, the AC17 test has not yet confirmed its ability to usefully function in this regulatory role, and we would urge that it not be included in the MAC efficiency crediting provisions for heavy-duty vehicles until all inaccuracies are addressed via the ongoing collaborative agency/OEM development work. AC17 A-to-B testing in this segment would be very difficult and impractical given the magnitude of the AC17 differential relative to the test-to-test variability in large fuel consumption vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.18-19]

If the AC17 test is adopted, manufacturers should be permitted to use AC17 test results from light-duty versions of the same AC systems when similar. Given the proliferation of low-volume designs in the vocational vehicle category, AC17 testing requirements would be impractical for these vehicles and should not be required. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

#### Light-Duty MAC Refrigerant/Leakage

The table above documents the rapid reduction in refrigerant leakage resulting from the direct MAC credit program. Leakage reduction improvements increased 69% to 10.3 million megagrams in only three years, from 2009 to 2012. The increase on a per vehicle basis was from approximately 3.5 grams per mile of CO<sub>2</sub> per vehicle in 2009 to approximately 4.0 grams per mile in 2012 (EPA Manufacturer Performance Report for the 2012 Model Year, p. 29). [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

Although industry-wide statistics have not yet been published beyond 2012, production capacity for the new low-global-warming refrigerant R-1234yf has increased. Following its introduction on a few models in 2013, R-1234yf has been implemented on many important vehicle platforms totaling millions of vehicles. The incentive created by pre-defined MAC credits has accelerated the U.S. HFC reduction program into a leading position worldwide, laying the groundwork for eventual phase-out or dramatic phase-down of high GWP automotive refrigerants. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

#### Light-Duty SNAP Program

Based on the early start and clear incentives provided by the MAC provisions in the Light-Duty greenhouse gas regulation, EPA recently published a final rule (80 Federal Register 42870) under its

Significant New Alternatives Program (SNAP) which will remove high-GWP R-134a entirely from use as an air conditioner refrigerant in new light-duty vehicles by the 2021 model year. AAPC recommends that EPA approve R-1234yf and other low GWP refrigerants for use in heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

#### Class 2b/3 Pre-Defined Refrigerant Credit List

The experience from the Light-Duty vehicle program shows that a pre-defined list of credits for refrigerant improvements on heavy-duty vehicles would accelerate these improvements. Credits for low leak air conditioner systems and credits for low-global-warming refrigerants should both play a role, laying the basis for eventual industry-wide refrigerant replacements in systems with high refrigerant containment integrity. By using an incentive approach, rather than mandates, companies move as quickly as they can, according to their various constraints and capabilities, with the result that the most eager early actors break down barriers and reduce costs to smooth the path for an eventual industrywide switchover. [EPA-HQ-OAR-2014-0827-1238-A1 p.19]

The current rulemaking is an appropriate time to create this incentive structure in heavy-duty vehicles. At a minimum, given the similarities in the air conditioning systems between Class 2b/3 trucks and many light-duty trucks, as well as the experience of the light-duty vehicle manufacturers with these provisions of the Light-Duty regulation, a pre-defined credit list for refrigerants should be created for Class 2b/3 trucks. The credit levels and other provisions should be identical to the credit provisions for light-duty trucks in the same time period, through 2025 model year, including acknowledging further improving leakage and moving R-134a systems to low-GWP refrigerants. [EPA-HQ-OAR-2014-0827-1238-A1 p.20]

[Table of MAC credits can be found on p.20 of EPA-HQ-OAR-2014-0827-1238-A1]

**Organization:** FCA US, LLC

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 62.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 134.]

As far as A/C system improvements, we believe there is value in recognize the greenhouse gas and fuel consumption contributions from reducing the energy demand of the A/C systems. We also believe there's additional opportunity to further harmonize with the Light Duty Program and recognize the added greenhouse gas emission benefit beyond leak reduction. That's switching to a lower global warming potential a refrigerant can provide.

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 102-103.]

For example, the pre-defined and pre-approved list of mobile air conditioner greenhouse gas credits has incentivized a rapid improvement in the efficiency and leak integrity of light duty vehicle air conditioners. These incentives are now paving the way for an early transition to lower global warming

air conditioner refrigerants as millions of new vehicles are being produced with the new refrigerants, many years in advance of any mandate to make the switch.

**Organization:** Nissan North America, Inc.

#### Air Conditioning Credits

As in the light duty program, air conditioning improvements can assist in reducing greenhouse gas emissions and fuel consumption. Although the agencies did not provide air conditioning efficiency credits in Phase 1 and continued that approach in the proposal, the agencies should reconsider that position. [EPA-HQ-OAR-2014-0827-1026-A1 p.4]

The decision not to include such credits in the proposal was based on a conclusion that the CO<sub>2</sub> emissions in heavy duty vehicles due to air conditioning systems is likely minimal compared to their overall emission of CO<sub>2</sub>. While that comparison may be valid, air conditioning systems nonetheless represent an area where substantial CO<sub>2</sub> reductions can be had. The final rule should account for these opportunities and apply air conditioning efficiency credits as set forth below. [EPA-HQ-OAR-2014-0827-1026-A1 p.4]

The following figure reflects the CO<sub>2</sub> reducing potential of improving the efficiency of air conditioning systems in this market segment: [EPA-HQ-OAR-2014-0827-1026-A1 p.4]

[The figure, AC Impact (%) vs. SC03 CO<sub>2</sub> w/ AC On (g/mi), can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1026-A1]

In the light duty rule for Model Years 2017-2025, the agencies estimated the greenhouse gas reductions associated with small (5.6%) passenger car, medium (4.8%) passenger car, large (4.5%) passenger car, and light duty truck (3.5%). Based on SC03 emissions testing on Nissan light duty truck Model A with the air conditioning running, the impact of air conditioning efficiency improvements for a comparable 2b class heavy duty model is estimated to be 3.3%. The results and comparison with the light duty program are shown below: [EPA-HQ-OAR-2014-0827-1026-A1 p.5]

[The table, summarizing various SC03 cycle values for various car sizes, can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1026-A1]

Based on this analysis, the maximum air conditioning credit value would be 9.7 g/mile. Accordingly, the air conditioning system menu, and the associated credits, should be as follows: [EPA-HQ-OAR-2014-0827-1026-A1 p.5]

[The table, summarizing estimated CO<sub>2</sub> reduction for several technological advances, can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1026-A1]

As shown, there are in fact significant benefits that can be gained through improving the efficiency of air conditioning systems. Recognizing and encouraging the translation of air conditioning efficiency improvements from the light duty segment to this HDPV segments provides additional consistency in the technology to be deployed. The credits would provide a necessary tool towards compliance with the aggressive Phase 2 standards and would help achieve further reductions in GHG emissions. [EPA-HQ-OAR-2014-0827-1026-A1 p.6]

**Response:**

The agencies did not propose and are not adopting A/C efficiency credits for heavy-duty pickups and vans. AAPC suggests that the agencies could allow the same credits as are available in the light-duty vehicle program but no data is provided regarding the appropriateness of the credits. The EPA would need to resolve a number of open issues relating to environmental implications of A/C efficiency credits for these vehicles (among them, potential credit generation rate, whether credits would be windfall, implications for the standard stringency) before considering adopting an A/C efficiency credit regime. Also, the AC17 test is an integral part of the light-duty vehicle program serving as a confirmation that the credits are based on actual performance improvements. The agencies do not believe that it would be appropriate to provide credits based only on the presumption that systems similar to those used in light-duty trucks will provide the same improvements in heavy-duty pickups and vans with no confirmation through testing. AAPC suggested simply using the light truck list of A/C efficiency credits without providing any data. Nissan suggested revising the credits upward from the light truck level, based on limited light truck data and without any HD vehicle data to support its analysis. With regard to AAPC comments regarding credits provided in the other vehicle sectors, EPA notes that for other sectors any available A/C technologies and associated credits are considered as part of the feasibility analysis for setting the standards for the other sectors and not simply additional credits available to the manufacturers. A/C credits were not considered in the standard setting for HD pickups and vans.

AAPC also recommended that EPA provide credits for reduced refrigerant leakage and alternative refrigerant usage similar to the light-duty vehicle program. In response, EPA has already established standards in Phase 1 for refrigerant leakage. EPA does not believe that it would be appropriate to provide credits for items that are essentially required. Providing such credits without an increase in total program stringency similar to the light-duty approach to A/C efficiency and refrigerant leakage would result in an unwarranted loss of program benefits. See Section I.F of the Preamble and Chapter 1.7 of this Response to Comments document for how the Phase 2 program handles the use of alternative refrigerants.

**7.4.3 Off-cycle Credits for HD Pickups and Vans**

**Organization:** American Automotive Policy Council

**Acknowledge Off-Cycle Improvements** - AAPC recommends adopting a credit approach that acknowledges the greenhouse gas and fuel consumption benefits of off cycle technologies that are not completely captured on the current test cycles. [EPA-HQ-OAR-2014-0827-1238-A1 p.3]

**Acknowledge Off-Cycle Improvements**Off-cycle and Innovative Credits

In Phase 1 of the Light-Duty greenhouse gas regulation for 2012-2016, EPA used a “menu” of pre-defined and pre-approved credits for mobile air conditioners, but required individual approvals for each off-cycle credit. Off-cycle technologies were required to be “new and innovative” and “not in widespread use,” and could not also generate significant on-cycle benefits. Industry responded with rapid implementation of air conditioner technologies, but only two small off-cycle credit requests were approved for other technologies, each taking approximately six months for reviews and approvals. [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

EPA later stated that:

“These criteria have interfered with the goal of providing an incentive for the development and use of off-cycle technology that reduces CO2 emissions.” (77 Federal Register 62835) [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

For Phase 2 Light-Duty, EPA created an off-cycle technology “menu” or “pick list” of credits. EPA also eliminated the criteria that technologies be “new and innovative,” “not in widespread use,” and could not also generate on-cycle benefits. In order to encourage investment in these technologies, EPA also made clear that the credits would not expire, stating: [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

“EPA is also making clear that once approved, EPA does not intend to sunset a technology’s credit eligibility or to deny credits to other vehicle applications using the technology.” (77 Federal Register 62836) [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

Model Year 2014 was the first year for the new light-duty off-cycle credit menu. While 2014 reporting is only recently completed, there has been extensive industry interest in the new off-cycle program, and the provisions can be expected to be heavily used, resulting in rapid acceleration in implementation of these real-world fuel saving technologies. [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

With respect to off-cycle credits, Phase 1 of the Heavy-Duty vehicle rule resembled Phase 1 of the Light-Duty rule. Manufacturers could apply for credits for innovative technologies on a case-by-case basis using extensive documentation. To our knowledge, no innovative technology credits have been granted during Phase 1 under this regulatory template (for Class 2b/3 trucks). [EPA-HQ-OAR-2014-0827-1238-A1 p.21]

#### Off-Cycle Credits in Class 7, Class 8 and Vocational Vehicle Regulations

As with MAC high-efficiency compressors, the proposed Heavy-Duty vehicle regulation for Class 7, Class 8 and vocational trucks establishes de facto pre-defined and pre-approved off-cycle credits for a variety of technologies. This NPRM proposes that these technologies be included in the GEM simulation tool with pre-defined fuel efficiency values, with the result that vehicles including the technologies have lower fuel consumption. Some of the improvement might partially be experienced in conditions that would be on-cycle in the standard FTP test, but some of these improvements are clearly experienced in off-cycle conditions. Several examples are discussed on page 1063 of the NPRM: [EPA-HQ-OAR-2014-0827-1238-A1 p.21-22]

“(4) GEM applies a 2 % emission reduction for tractors with predictive cruise control. This includes any cruise control system that incorporates satellite-based global-positioning data for controlling operator demand. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(5) GEM applies a 0.5 % emission reduction for tractors with a high-efficiency air conditioning compressor. This includes mechanically powered compressors meeting the specifications described in 40 CFR 86.1868-12(h)(5), and all electrically powered compressors. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(6) GEM applies a 1 % emission reduction for tractors with electrically powered pumps for steering and engine cooling. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(7) GEM applies a 1 % emission reduction for tractors with automatic tire inflation systems. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(8) GEM accounts for emission reductions for reduced idle for the following technologies: [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(i) Stop-start technology for vocational vehicles. Phase 2 vocational vehicles qualify for reduced emissions in GEM modeling if the engine shuts down no more than 30 seconds after the onset of any of the following conditions: [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(A) The vehicle's brake is depressed at a zero-speed condition. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(B) A vehicle with automatic transmission goes into "Park." [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(ii) Neutral-idle technology for vocational vehicles. A Phase 2 vocational vehicle with an automatic transmission qualifies for reduced emissions in GEM modeling if the vehicle goes into neutral (or reduces torque equivalent to being in neutral) at a zero-speed condition. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

(iii) Extended-idle reduction. If your sleeper cab is equipped with idle reduction technology meeting the requirements of § 1037.660 that will automatically shut off the main engine after 300 seconds or less, GEM applies a 5 percent emission reduction for Phase 2 vehicles. For Phase 1, enter 5.0 g/ton-mile as the input (or a lesser value specified in § 1037.660); otherwise leave this field blank." [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

#### Class 2b/3 Pre-Approved Off-Cycle Credit List

As discussed previously with respect to MAC efficiency credits, the proposed regulation applies the pre-defined light-duty off-cycle credit pick list to MDPV's (Medium Duty Passenger Vehicles). The result would be that all light-duty vehicles, MDPVs, Class 7, Class 8 and vocational trucks would have pre-defined credit lists for off-cycle technologies. Class 2b/3 trucks (non-MDPVs) would be the only remaining vehicles that would not benefit from pre-defined off-cycle credit lists. [EPA-HQ-OAR-2014-0827-1238-A1 p.22]

All the technologies from the light-duty vehicle off-cycle credits lists are potentially applicable to Class 2b/3 vehicles, as are the additional technologies from the Class 7, 8 and vocational truck credit lists (e.g., automatic tire inflation, adaptive cruise control, electric steering and cooling, stop-start, neutral idle and extended idle), as well as additional technologies that are not yet on any of the lists. The advantages from a pre-defined credit list have already been thoroughly established with the rapid implementation of improved air conditioner technologies on light-duty vehicles, leading to the creation of the expanded light-duty pre-defined off-cycle credit list for 2014 (77 Federal Register 62737). [EPA-HQ-OAR-2014-0827-1238-A1 p.22-23]

AAPC recommends the same successful template be applied to all of the Class 2b/3 trucks, from the start of the Phase 1 program, in order to expand the options for cost-effective technologies with which to comply with this regulation. This will incentivize the early introduction of technology that will result in improved environmental results, achieved quicker, and at lower cost. [EPA-HQ-OAR-2014-0827-1238-A1 p.23]

#### Light-Duty Off-Cycle Technologies

All of the technologies on the light-duty off-cycle technology pick list can be expected to generate real-world emissions reductions for each heavy-duty truck at levels equal to or exceeding the light-duty truck credit values (i.e., this is a conservative starting point). In general, this would be expected based on the higher fuel consumption of heavy-duty engines. For perspective, note that in the EPA analysis for light-duty off-cycle credits, the light truck pick list credit is larger than the passenger car credit for all the technologies except lighting, engine heat recovery to generate electricity, and solar panels. These technologies where the credits are equal deal directly with vehicle electricity supply and usage, and are not closely tied to conventional engine operation. For the technologies more directly tied to conventional engine operation, the larger engines used in light trucks compared to passenger cars resulted in pick list off-cycle credits ranging from 25% to 133% larger. Comparing Class 2 and Class 3b trucks to the total light truck category would be expected to result in similar credit growth, since the light truck category includes many vehicles in the minivan, crossover or small SUV classes with smaller engines and more carlike design and performance. [EPA-HQ-OAR-2014-0827-1238-A1 p.23]

[Table, Light-duty Truck Off-cycle Pre-approved List, can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

[Table, Thermal control technology, can be found on p.24 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

In general, AAPC supports the analysis done by EPA in creating the light-duty credit list. For high efficiency lighting, exhaust gas heat recovery for electricity generation, and solar panels, the credit amounts could be left unchanged for a heavy-duty truck off-cycle pick list. Credits for thermal control technologies also could be left unchanged, or are at least a lower priority for re-analysis. The credits for active aerodynamic features, stop-start and active engine and transmission warm-up should be reassessed for a specific heavy-duty vehicle analysis, and pre-approved credits should be established for these technologies at a greater level than for light-duty trucks. (See Appendix B for full explanation of light-duty off-cycle credit pick list technologies, and methodologies used to calculate credits.) [EPA-HQ-OAR-2014-0827-1238-A1 p.24]

#### Implement an Off-Cycle Credit Pick List

For the reasons cited above, off-cycle credit opportunities similar to the light-duty fleet should be adopted for the medium and heavy-duty fleets. AAPC also recommends adding additional technologies to the pre-defined list of off-cycle technologies. These technologies are summarized immediately below. See Appendix B for a full explanation of these additional technologies and the methodology used to calculate credits. Constraining additions to technology list could have the unintended consequence of slowing innovation for technologies that save fuel in real-world driving and are of high importance to the powertrain/vehicle system. [EPA-HQ-OAR-2014-0827-1238-A1 p.24]

[Table, list of technologies and emissions, can be found on p.24-25 of docket number EPA-HQ-OAR-2014-0827-1238-A1]

For the reasons explained in detail above, AAPC requests that a “pick list” or “menu” be created to give Class 2b/3 vehicles regulatory credit for the real-world greenhouse gas emission and fuel consumption reductions that result from the use of various “off-cycle technologies.” A pick list has already been established for light-duty vehicles, and the current proposed regulation contains pre-assigned credits for the real-world benefits of various technologies used in Class 7 and 8 tractors and vocational vehicles. Our recommendations for the Class 2b/3 pick list include all the technologies on the pre-approved credit list for light-duty trucks (as a de minimus), as well as credits for several additional technologies that

give real-world benefits on these vehicles beyond the benefits on the standard fuel economy tests. We also request that these off-cycle credit provisions be kept simple and accessible, without extensive requirements for additional testing or for meeting other criteria, caps or thresholds, in order to encourage rapid innovation and experimentation in this promising area. [EPA-HQ-OAR-2014-0827-1238-A1 p.25]

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Available credit for solar control for heavy-duty pickups and vans**

For heavy-duty pickups and vans (class 2b/3), the NPRM requests comment on establishing a pre-defined technology menu list for off-cycle emissions, including solar control (see table VI-33, page 40390 of the NPRM). U.S. EPA and NHTSA consider these vehicles to be analogous to light-duty vehicles, since they use the same chassis test procedure. To determine the appropriate default level of credits for these heavier vehicles, the NPRM requests comments with supporting heavy-duty pickup- and van-specific data and analysis that would provide a substantive basis for appropriate adjustments to the credits levels. As with the light-duty vehicle program, U.S. EPA and NHTSA would also consider including a cap on credits generated under the pre-defined list. Such a cap addresses issues of uncertainty regarding the level of credits automatically assigned to each technology. [EPA-HQ-OAR-2014-0827-1265-A1 p.152]

CARB staff believes it is appropriate to include solar control in the pre-defined technology menu list for heavy-duty pickups and vans along with a preapproved credit. Credits for solar control are largely about reducing the heat build-up in parked vehicles, reducing the need to idle to stay comfortable, and reducing the load on the engine from operating the AC, since AC use generally reduces fuel economy. Class 2b/3 vehicles likely spend less of the workday parked than do light-duty vehicles although they probably do spend part of the work day parked with the engine off. They likely spend more time idling than light-duty vehicles, some of which time could be reduced if there was less need for comfort idling. The balance of the workday is spent in motion. Solar control has a benefit during driving operations as well, although the fuel economy of vehicles with larger engines are less affected by the use of an AC than are light-duty vehicles with smaller engines. The value established for light-duty trucks of 3.9 g CO<sub>2</sub>/mile could be used. However, CARB staff believes it would be appropriate to reduce this value by the assumed contribution from the backlite, since work vehicles often do not have substantial if any backlites. CARB staff assumed, based on an overview of the literature for its Cool Car proposal,<sup>58</sup> that 30 percent of the solar energy enters the vehicle through the backlite. Therefore, CARB suggests a pre-approved credit of 2.7 g CO<sub>2</sub>/mile for the 2b-3 sector. Manufacturers who believed that this underestimates the value that solar controls provide to their vehicle model could provide appropriate test data to substantiate a request for a greater off-cycle credit. [EPA-HQ-OAR-2014-0827-1265-A1 p.152-153]

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58 (CARB, 2009) California Air Resources Board, “Staff Report: Initial Statement of Reasons for Rulemaking - Cool Car Standards and Test Procedures,,” May 8, 2009, <<http://www.arb.ca.gov/regact/2009/coolcars09/coolcarsisor.pdf>>.

**Organization:** Ford Motor Company



[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, pp. 28-29.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 158-159.]

Ford supports expansion of the Phase 1 allowance to generate emission credits for CO2 improvements for technologies providing on road fuel consumption benefits that are not captured by the emissions test cycles or models.

**Organization:** General Motors

The success of these air conditioner provisions led to the expansion of this approach in 2014 for the light duty fleet with the introduction of an expanded off cycle list of pre-assigned and pre-approved credits for other technologies that reduce fuel usage and conditions not comprehended in the standard fuel economy test, such as colder weather, higher speeds, or extended idle times.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

#### Implementation of an Off Cycle Credit Pick-List

We support American Automotive Policy Council's proposal to implement an Off Cycle Credit Pick List. A "pick list" or "menu" would give Class 2b and Class 3 vehicles regulatory credit for greenhouse gas emissions reductions that result from the use of various "off cycle technologies." A pick list exists for light duty vehicles, and this proposal contains pre-assigned credits for the real world benefits of various technologies used in Class 7 and 8 tractors and vocational vehicles. A Class 2b/3 pick list give real world benefits on these vehicles beyond the benefits on the standard fuel economy tests. Finally, the off cycle credit provisions should avoid extensive requirements for additional testing or for meeting other criteria, caps or thresholds, in order to encourage further innovation. [EPA-HQ-OAR-2014-0827-1248-A2 p.10]

**Organization:** Nissan North America, Inc.

#### Off-Cycle Credits

The availability of off-cycle credits is critical. The agencies should include the same pre-defined pick-list that is used in the light duty program, and should also include a mechanism to add new technologies to the list. Again, off-cycle technologies on the light duty credit menu can be translated to the heavy duty and adjusted for use in that segment. Nissan calculated the benefits for Active Transmission Warm Up and Active Engine Warm Up. Using a 0.58% greenhouse gas reduction rate (at U.S. average temperature of 580 F) applied in the light duty rulemaking and Nissan Model B classified as Class 2b Heavy Duty, Nissan calculated the benefit from those technologies to be 3.2 g/mile. [EPA-HQ-OAR-2014-0827-1026-A1 p.6]

[The table, which displays the CO2 emission, impact and benefit of the Nissan Model B, can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1026-A1]

These technologies have the proven potential to reduce greenhouse gas emissions, and should be included in an off-cycle credit program which recognizes this benefit and assists towards compliance with the standards. [EPA-HQ-OAR-2014-0827-1026-A1 p.7]

**Response:**

Several commenters supported allowing manufacturers to use the light-duty vehicle off-cycle credit menu for HD pickups and vans. In their comments, AAPC referred to the two tables below. The tables provide the off-cycle credits available for light-duty trucks.

*Light-duty Truck Off-cycle Pre-approved List:*

| Technology                       | Truck (gCO <sub>2</sub> /Mile) | Truck Credit Over Car Credit |
|----------------------------------|--------------------------------|------------------------------|
| High Efficiency Lighting         | 1.0*                           | 0%                           |
| Engine Heat Recovery             | 0.7*                           | 0%                           |
| Solar Panels **                  | 3.3*                           | 0%                           |
| Solar Panels with ventilation ** | 2.5*                           | 0%                           |
| Active Aerodynamic Improvements  | 1.0*                           | 67%                          |
| Engine Stop-Start                | 2.9                            | 93%                          |
| Electric Heater Circulation Pump | 1.5                            | 50%                          |
| Active Transmission Warm-Up      | 3.2                            | 113%                         |
| Active Engine Warm-Up            | 3.2                            | 113%                         |
| Thermal Control                  | Up to 4.3                      | 43%                          |

\* = Scalable

\*\* = Hybrids only

| Thermal Control Technology           | Trucks (gCO <sub>2</sub> /mile) | Truck Credit Over Car Credit |
|--------------------------------------|---------------------------------|------------------------------|
| Glass or glazing                     | ≤3.9                            | 34%                          |
| Active seat ventilation              | 1.3                             | 30%                          |
| Solar reflective paint               | 0.5                             | 25%                          |
| Passive cabin ventilation            | 2.3                             | 35%                          |
| Active cabin ventilation             | 2.8                             | 40%                          |
| <b>Total Thermal Control Allowed</b> | <b>4.3</b>                      | <b>43%</b>                   |

AAPC commented that at minimum, the light truck list (i.e. the off cycle technology menu providing default values for enumerated off-cycle technologies from the light-duty vehicle GHG rules) should be made available for HD pickups and vans. AAPC comments that for thermal control technologies credits could be left unchanged, or are at least a lower priority for re-analysis. AAPC further commented that the credits for active aerodynamic features, stop-start and active engine and transmission warm-up

should be reassessed for a specific heavy-duty vehicle analysis, and pre-approved credits should be established for these technologies at a greater level than for light-duty trucks. We note, however, that AAPC provided no data supporting why the light truck default level would be appropriate for HD pickups and vans, or data on which to establish an appropriate level of credits for HD pickups and vans. AAPC suggests that EPA perform an analysis to adjust the credit levels for HD pickups and vans, but again, provided no data to support such an analysis. EPA believes off-cycle credits must be supported adequately by data for the applicable vehicles to ensure that the credits realistically reflect actual technology performance. EPA’s request for comments in the NPRM on the topic of off-cycle credits emphasized the need for data in support of any recommended credits. Therefore, EPA is not extending the light truck menu credits to HD pickups and vans as requested by AAPC. Manufacturers may generate off-cycle credits for these technologies through the off-cycle credit provisions established in Phase 1.

AAPC further provided a list of technologies in addition to the light truck list above and requested associated off-cycle credits for the technologies, shown below. AAPC provided a further description of these technologies and recommended credits in Appendix B of their comments.

| Technology  | Truck (gCO <sub>2</sub> /Mile)      | Source         |
|---|-------------------------------------|----------------|
| High efficiency alternator  | 1.0 g/mile per 0.1% VDA improvement | GM/Ford/FCA/EU |
| Cylinder deactivation   | 1.5 g/mile                          | GM/FCA         |
| Cooled EGR  | 1.0 g/mile                          | FCA            |
| Transmission thermal valve  | 2.0 g/mile                          | GM             |
| Neutral drive idle  | 10.7 g/mile                         | Ford           |
| Automatic tire inflation  | 0.5% of GHG level                   | SAE J2452      |
| Adaptive cruise control   | 1.9% of GHG level                   | euroFOT        |
| Electric accessory systems  | 3% of GHG level                     | TIAX           |
| Variable pressure DEF pump  | 0.7 g/mile                          | Ford           |
| Variable low pressure in-tank fuel pump                                       | 0.7 g/mile                          | Ford           |
| Variable pressure engine oil pump   | 1.4 g/mile                          | Ford           |
| Variable pressure transmission oil pump                                       | 0.7 g/mile                          | Ford           |
| Clutched vacuum pump  | 0.6 g/mile                          | Ford           |
| Air conditioning compressor with variable crank case suction valve technology | 1.1 g/mile                          | GM             |

For the technologies listed in the table above, there are three primary reasons that the agencies are not adopting credit levels recommended by commenters. In many cases, the analysis provided by commenters did not include sufficient real-world heavy-duty vehicle data on which to base the recommended menu credit value. Thus, in several cases, the analysis provided by commenters was based on light-duty vehicle data or on simulations with little detail provided, which analysis is not directly applicable to heavy duty pickups and vans for purposes of technology performance

quantification. Second, in several cases, the technologies recommended for off-cycle credits for HD pickups and vans provide significant on-cycle benefit. Such technologies are considered to be adequately captured by the test procedures (within the meaning of section 86.1819-14 (d)(13))<sup>198</sup> and are therefore not considered to be eligible for off-cycle credits. Examples of adequately captured technologies that commenters recommended for off-cycle credits include cylinder deactivation and cooled EGR. Moreover, these are technologies the agencies expect to be in the mix of technologies used to meet the standards (and are projected to be used in the respective analyses of compliance paths on which the stringency of the final standards are predicated). EPA has already indicated that off-cycle credits are not available for technologies that form part of the technology basis for the greenhouse gas standards because these technologies' benefits would already be reflected in the standard's stringencies (and costs), since the technologies would not even be under consideration unless their benefits were "adequately captured" in two-cycle space. 77 FR 62835 (Oct. 12, 2012). Likewise, many of these technologies are inherent to vehicle design and so are similarly ineligible. *Id.* at 62732, 62836. Finally, a few other recommended technologies are considered safety-related technologies not eligible for credits because they could reasonably be expected to fall under vehicle safety standards in the future and so would be adopted in any case. Granting off-cycle credits for these technologies for HD pickups and vans consequently would amount to an unwarranted windfall. Adaptive cruise control and forward collision warning systems are examples of these technologies.

Each technology and the reason EPA is not providing credits is provided below:

- High Efficiency Alternator – AAPC provides only data from light-duty vehicle applications in their credit analysis, many of which are passenger cars. The EU approach referred by AAPC is also based on light-duty vehicle applications (AAPC only suggests part of the EU approach as appropriate while rejecting other aspects of the program that they view as problematic) and it is unclear if it would be appropriate for HD vehicles. While AAPC provides one simulation of a HD vehicle which is supportive of the recommended credit, EPA believes more data is needed upon which to establish the appropriate credit level. EPA rejected establishing menu credits for high efficiency alternators in the light-duty vehicle program. See 77 FR 62730. AAPC acknowledges this noting "We agree that the situation may be complicated since real-world efficiencies can be very vehicle specific and alternator specific, and average vehicle real-world electrical loads are not well documented, and probably vary considerably between vehicles." EPA continues to view the assessment of off-cycle credits for high efficiency alternators as complex and requiring data to support the off-cycle credit level. This technology may be eligible for credits under the off-cycle credits provisions established for Phase 1 which would require a model-specific demonstration of the credit level requested.
- Cylinder Deactivation – As noted above, EPA views cylinder deactivation to be adequately captured by the test procedures (within the meaning of section 86.1819-14 (d)(13)) and therefore ineligible for off-cycle credits. EPA also questions AAPC's rationale that cylinder deactivation should be eligible for an off-cycle credit based on the amount of time the vehicle is driven in an unloaded condition without also acknowledging times when the vehicle is driven in a highly loaded condition which would make cylinder deactivation relatively less effective than over the 2-cycle test. Also, the suggested credit is based on simulation data only.
- Cooled Exhaust Gas Recovery –EPA views cooled EGR to be adequately captured by the test procedures (within the meaning of section 86.1819-14 (d)(13)) and thus ineligible for off-cycle

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<sup>198</sup> This provision states that an off-cycle credit must be for a technology that is "not adequately captured on the Federal Test procedure (FTP) and/or the highway Fuel Economy Test (HFET)."

credits. As with cylinder deactivation, EPA questions AAPC's rationale supporting the recommended credit. With cylinder deactivation, AAPC argued that off-cycle credits are appropriate to capture benefits when the vehicle is driven in lightly loaded conditions without discussing what happens in highly loaded conditions. For cooled EGR, AAPC argues the opposite, that vehicles are "frequently used" in highly loaded conditions where cooled EGR is more effective compared to the 2-cycle test, without discussing the technology's performance under lightly loaded conditions. AAPC only provides that their estimated credit is based on simulations performed by FCA on its heavy-duty pickup.

- Transmission Bypass Valve – This credit is not supported by HD vehicle test data and it is not clear that the credit is derived in a way that is applicable to HD vehicles or is reflective of the performance of the technology in real world operation. Also, this technology has been used for several years in HD vehicles and would not likely be considered innovative under the HD off-cycle regulatory provisions found at 40 CFR 86.1819-14 (d)(13) (previously 40 CFR 1037.104 (d)(13)).
- Neutral Drive Idle – AAPC does not provide data for HD pickups and vans supporting their effectiveness estimate, on-cycle benefit, or real-world idle. More data, including model specific data would be needed to support the requested 10.7 g/mile credit.
- Automatic Tire Inflation – AAPC does not provide HD pickup and van specific data to support the significant (~ 5 g/mile) requested credit.
- Adaptive cruise control – As noted above, adaptive cruise control is not eligible for credits because it could reasonably be expected to fall under vehicle safety standards in the future and so would be adopted in any case. Granting off-cycle credits for these technologies consequently would amount to an unwarranted windfall.
- Electric Accessory Systems – Electric accessory improvements provide on-cycle benefits and are included in the technologies that the agencies expect to be used to meet the standards. Since these standards are part of the basis for the standards, they would not be eligible for off-cycle credits. Moreover, the credit level suggested by AAPC of 3 percent of a vehicle model CO<sub>2</sub> level would result in a relatively large credit (e.g., in the range of about 12 to 16 g/mile for a MY 2027 gasoline-fueled vehicle), and data would be needed on HD pickups and vans if EPA was going to consider the credit further. Also, the credit would need to be considered as part of the standard setting process since, as noted above, electric accessories are among the technologies the agencies expect to be used to meet the standards. For Class 7 and 8, these technologies and their effectiveness values are built into the GEM model and are therefore considered in the feasibility analysis for establishing the level of the standards.
- Vacuum, DEF, engine oil, transmission oil, fuel and coolant pumps – AAPC notes only that the credit values requested for all pumps listed were calculated using the VMT difference between MOVES and the weighted metro highway cycle using the Alpha model to compute the benefit. No data or further explanation is provided and EPA does not believe the credit request was adequately supported for these technologies.
- Air Conditioning Compressor with Variable Crank Case Suction Valve Technology – AAPC discusses EPA's approval of off-cycle credits for this technology in the light-duty vehicle program for certain GM vehicles and requests the same level of credits as provided for some of GM's light-duty vehicles for all HD pickups and vans. No data on HD pickups and vans is provided to support the credit request. EPA believes that HD vehicle data and perhaps model-specific data would be

needed to support the credit request. EPA notes that manufacturers could apply for credits for this technology for HD vehicles under the off-cycle credits program established in the Phase 1 rule.

EPA also notes that taken as a whole, AAPC requested off-cycle credits that could total in the range of 40 to 50 g/mile. This represents a significant fraction of the overall reductions expected for the Phase 2 program for this vehicle class and would need to be supported by substantial data. Further, with respect to those technologies which are not already part of the basis of the Phase 2 standards for HD pickups and vans, if EPA had sufficient data on which to base such credits and were to provide the credits, the off-cycle credits could then potentially be considered in the feasibility assessment that is integral to the standard setting process, as they were for the other sectors. This could lead to an assessment that more stringent standards are feasible for the HD pickup and van sector. It is unlikely that the credits would simply be available for use by manufacturers in lieu of making other changes to the vehicles that are projected to be made to meet the standards. Also, because off-cycle credits have not been considered in the feasibility assessment of the final standards, EPA does not view the credits as critical or essential in meeting the standards being finalized.

Nissan also commented in support of providing the same menu of off-cycle comments for HD pickups and vans as is provided for light-duty vehicles. Nissan suggested that the credits from the light-duty program could be adjusted for use in the HD segment. Nissan provides an example for active engine and active transmission warm-up where the credits from the light-duty program are increased by assuming the technology will reduce HD CO<sub>2</sub> emissions by the same percentage and applying that percentage improvement to an example Nissan heavy-duty vehicle CO<sub>2</sub> level. No HD effectiveness or other data is provided. As noted above, EPA is not extending the use of the light-duty vehicle off cycle credits menu to HD pickups and vans. EPA believes off-cycle credits need to be sufficiently supported by real-world data and Nissan does not provide data necessary to establish a general credit for all HD pickups and vans. System design and effectiveness could vary significantly from vehicle model to vehicle model. Manufacturers may generate off-cycle credits for these technologies through the off-cycle credit provisions established in Phase 1.

CARB staff commented in support of including off-cycle credits for solar thermal controls in particular. CARB notes that there are some differences in vehicle operation and design between light-duty vehicles and HD vehicles and suggests a credit adjustment for those differences. EPA agrees with CARB staff that solar thermal controls are likely to provide a benefit for HD vehicles as well as light-duty vehicles. EPA is not establishing a menu credit for solar thermal control or other credits due to the lack of HD vehicle specific data on which to base the credit levels. Indeed, CARB staff comments point out that adjustments to credit levels would be needed to account for vehicle operation and design differences. CARB suggests an adjustment but does not provided HD vehicle data to support the adjustment. As previously noted for other technologies on the light-duty vehicle off-cycle credit menu, manufacturers may generate off-cycle credits for these technologies through the off-cycle credit provisions established in Phase 1.

#### **7.4.4 Compliance Provisions**

**Organization:** Cummins, Inc.

*Cummins supports alignment of GHG useful life with LEVIII/Tier 3 criteria emissions useful life [EPA-HQ-OAR-2014-0827-1298-A1 p.35]*

Cummins supports alignment of the GHG useful life with the criteria emissions useful life promulgated in the LEVIII/Tier 3 rules. Cummins also supports adjusting Phase 1 credits used in Phase 2 to account

for the differences between the useful life definitions for each phase. [EPA-HQ-OAR-2014-0827-1298-A1 p.35]

**Organization:** Daimler Trucks North America LLC

**In-Use Standards (80 FR 40342)** - Daimler has no comment regarding the proposed change in the current useful life of 11 years and 120,000 miles to reflect EPA's useful life of 15 years and 150,000 miles. Daimler encourages the agencies to ensure that there will be a fair credit exchange process from Phase 1 to Phase 2. [EPA-HQ-OAR-2014-0827-1164-A1 p.113]

**Organization:** Nissan North America, Inc.

EPA's proposal, moreover, to adjust the credits from Phase 1 to Phase 2 to account for the changes in the Useful Life of the vehicles is appropriate, and will ameliorate any asserted diminution in benefits arising from the extension of Phase 1 credits through the pendency of the Phase 2 program. [EPA-HQ-OAR-2014-0827-1026-A1 p.4]

**Response:**

EPA is finalizing the adjustment to credits to account for the change in useful life from Phase 1 to Phase 2 so that credits are not devalued due to the credit calculation equation which includes a useful life factor. This issue is discussed above in Chapter 1.4.7.

## **7.5 Proposed Non-CO2 GHG Standards for Pickups and Vans**

**Response:**

EPA did not receive any comments specific to HD pickups and vans regarding N<sub>2</sub>O and CH<sub>4</sub> standards. Comments regarding air conditioning system credits for HD pickups and vans are discussed above in Chapter 7.4.2.

## **7.6 DOT HD CAFE Model**

**Organization:** General Motors

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 104.]

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, pp. 122-123.]

Finally, the program must attempt to minimize the potential for unintended consequences, especially for the consumer. The heavy duty fleet does not benefit from the years of data that have been collected and analyzed for the light duty fleet. Indeed, comprehensive data for this private segment is only now being accumulated and analyzed for the 2014 model year, which is the first year of Phase 1 of the medium and heavy duty truck regulations.

Year-end reports for 2014 were due to EPA by the end of March 2015, so this first year of comprehensive industry-wide data is still fairly new. This new data should be carefully evaluated and

then compared to the estimates and assumptions that form the basis for both Phase 1 and the proposed Phase 2 of the heavy duty regulations.

Further, the utility provided and the duty cycle of these vehicles is completely different from the light-duty fleet. And any attempt to force more stringent regulations, such as alternative 4, would be extremely detrimental to manufacturers, consumers, the U.S. economy, and the millions of transportation-related jobs. Indeed, comprehensive data for this product segment is only now being accumulated and analyzed for the 2014 model year, which is the first year of phase 1. The data should be carefully evaluated by the technical experts at the agencies and compared to the estimates and assumptions that form the basis for both phase 1 and the proposed phase 2 regulations.13861386

**Response:**

GM expresses concern about the utility difference between the light-duty and medium-/heavy-duty fleets. The agencies have noted the difference between these fleets and have designed the standards to take into consideration the difference in utility. Where the light-duty fleet has varying vehicle targets by footprint, the heavy-duty pickup and van fleet has targets that vary by work-factor (determined by payload, towing capacity, and drive type). The agencies believe that constructing the vehicle targets from work factor ensures that consumer choice will be maintained.

GM further express concerns about using the most current data available in considerations of phase II standards. Method A uses the MY 2015 fleet as its reference fleet. Section 6.C(2) of the Preamble and Chapter 10.2.2 compare the distribution of the 2014 work factor to the distribution of the 2015 work factor. GM, Daimler, and Ford show some shifts of the distribution towards higher work factors, while Nissan and Fiat/Chrysler have very similar work factor distributions for the two MY fleets. While this data is preliminary, it seems to suggest that there have not been significant changes in the distribution of work factor for each OEM which would eliminate consumer choice of high-utility vehicles. While the standards have not adversely affected the utility of heavy-duty pickups and vans, preliminary evidence might suggest the possibility that manufacturers may “game” the standards and create vehicles that are more powerful than consumers may otherwise demand. This is an issue we will continue to investigate in future rulemakings as more data from the Phase I and Phase II rulemakings become available. As it stands, the agencies believe that the work factor based standards maintain the utility of vehicles, which we agree with GM, is a priority for the heavy-duty vehicle class. See response 7.2.2 above.

GM also suggests that alternatives more stringent than Alternative 4 could have negative impacts on the economy, consumers and manufacturers. We have considered these and other concerns about the stringency of standards. As discussed in other comment responses and in both documents, we have determined that the lead-time under Alternatives 4 and 5 would be such that it may require manufacturers to add additional redesigns. Since this would be a costly endeavor, the regulations on this class of vehicles are relatively new, and manufacturers will have to split available capital to respond to these regulations between all regulatory classes, the agencies have determined that Alternative 3 is the maximally feasible alternative, and the appropriate standard under the Clean Air Act, and are adopting this alternative as the final standard for heavy duty pickups and vans. See response 7.2.1 above.



## **8 Regulatory Alternatives and General Stringency**

### **8.1 General Comments 1387**

**Organization:** Allison Transmission, Inc.

In deciding how stringent the Phase 2 rule should be, EPA and NHTSA should be mindful that their authority to regulate MD/HD vehicles is not unbounded; costs and the feasibility of new standards are key statutory considerations. EPA and NHTSA must also take into account the complex medium- and heavy-duty (“MD/HD”) marketplace; the agencies must allow sufficient time for new technology to be integrated into commercial fleets which require high reliability and continuous vehicle availability. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

#### **EPA and NHTSA Should Rely on Market Forces to Drive Improvements in Greenhouse Gas Emissions and Fuel Efficiency; Alternative 3 Is Most Appropriate**

##### **EPA and NHTSA Must Take Into Account Structure of Commercial Truck Market**

Since the Phase 1 rule was promulgated in 2011, Allison has supported efforts by EPA and NHTSA to increase the agencies’ knowledge of the MD/HD commercial truck sector and the effect of transmission systems on GHG and FE. During multiple meetings and presentations, we have emphasized the importance of aligning regulatory standards with real world operating conditions of commercial vehicles. Allison has participated in the testing of different transmission systems and fully supported the agencies’ efforts to make the Greenhouse Gas Emission Model (“GEM”) more accurate and aligned with the various work requirements and road conditions experienced by MD/HD vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.8]

The Phase 1 rulemaking is projected to conserve 530 million barrels of oil and avoid 270 million metric tons of GHG emissions. In the current rulemaking, EPA and NHTSA seek to make additional gains in GHG and FE extending well into the next decade. Allison believes that additional improvements are possible; Allison is a leader in the development of advanced transmission systems, including hybrid systems, and believes that standards can be strengthened to “account for ongoing technical advancements.” We also believe that it is possible to build upon the regulatory structure established in the Phase 1 rule and that the GEM can serve as the primary certification methodology, helping to alleviate the burden of testing literally hundreds of different vehicle variants. But EPA and NHTSA must recognize that there are limits to how fast the commercial truck market can incorporate new technology, or perhaps more importantly, maybe willing to pay for such technology. [EPA-HQ-OAR-2014-0827-1284-A1 p.8]

EPA and NHTSA indicate that the Phase 2 standards are intended to “represent a more technology-forcing approach than the Phase 1 standards.” The agencies state that the proposed standards “will effectively require manufacturers to develop new technologies (or significantly improve technologies).” That is assuredly so, but there are realistic limits to how the purchasers of commercial vehicles will react. For this and other reasons, Allison believes that adoption of Alternative 3 is most appropriate and that advancing technology requirements by 2-3 years as accomplished by Alternative 4 is not appropriate or supported in the record of this rulemaking. [EPA-HQ-OAR-2014-0827-1284-A1 p.8]

With regard to projecting the adoption of new technology, EPA and NHTSA cannot rely on any precedent, whether regulatory or judicial, that may have been established with respect to regulations that may have been applied to the light duty vehicle (“LDV”) sector. The MD/HD market shares little in common with the LDV market. Combination tractors and vocational vehicles are almost exclusively used for commercial purposes and there is no incentive to operate inefficiently or waste fuel; there is little or no “leisure use” of commercial vehicles aside from the discrete market for motor homes. In addition, the MD/HD market operates to closely match engines and vehicles with intended use; purchasers specify combinations of engine and vehicle technologies which will accommodate the work to be done by the vehicles at lowest operational cost. Finally, as the agencies acknowledge, the MD/HD manufacturing sector is extremely diverse consisting of various engine, vehicle and component manufacturers, body builders, trailer manufacturers and other suppliers. Thus, attempts to “drive” technological innovation must take this structure into account when promulgating standards. [EPA-HQ-OAR-2014-0827-1284-A1 p.8-9]

EPA and NHTSA project that Phase 1 standards would result in emission reductions of 9 to 23% as compared with 2010 standards for combination trucks and 6 to 9% in emission reductions for vocational vehicles. The Phase 2 rulemaking projects an 18 to 24% reduction as compared with MY 2017 standards, which would yield roughly 24 to 47% emission reductions from vehicles subject to this regulation through MY 2027. Thus, simply on a basis of relative stringency, these reductions could theoretically exceed the 2030 projected reductions for electric power plants under the recently promulgated Clean Power Plan by 32%.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1284-A1 p.9]

In determining stringency, EPA and NHTSA must assess how costs will be imposed on various entities affected by this rulemaking. The agencies propose regulatory flexibility with respect to emergency vehicles and low-volume chassis manufacturers to address the concerns of small businesses.<sup>6</sup> Certain banking and trading opportunities may be available to larger manufacturers, allowing for flexibility in phasing in new technology. But the broader assessment of stringency (and the resulting costs borne by manufacturers and consumers) relies on the projected adoption of numerous technologies resulting in a projected per vehicle cost impact of \$11,680 for tractors and \$3,380 for vocational vehicles in MY 2027. The agencies then rely on the market to respond by valuing the “payback” of future decreases in fuel cost to the upfront cost of purchasing the new technology (an assumption which may be especially challenging in the vocational vehicle market since such “payback” would not occur for six years). [EPA-HQ-OAR-2014-0827-1284-A1 p.9]

Alternative 3 therefore must be viewed as an aggressive program to decrease GHGs and increase fuel economy in MD/HD vehicles, especially given that meeting the standards is only possible through continuous technological improvement, an assumption which the agencies concede is itself uncertain. Alternative 3 is comparable in stringency to EPA’s efforts to control GHGs from electric generating units under CAA section 111(d) but could be viewed as more aggressive since costs in the MD/HD sector cannot be embedded into the product in the same manner as electricity. [EPA-HQ-OAR-2014-0827-1284-A1 p.9]

EPA must therefore read its authority under CAA section 202 in the context of the commercial truck market and commercial and economic restraints that are operative in this market. NHTSA must similarly recognize that its EISA authority is separate and apart from its authority with respect to LDVs and that it is to be guided specific language incorporated into the Energy Independence and Security Act of 2007, as noted below in Section I.D. [EPA-HQ-OAR-2014-0827-1284-A1 p.9-10]

5 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule, prepublication copy signed August 3, 2015.

6 RIA at 12-6.

**Organization:** Curl, Tilden

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 186.]

There are other unmandated alternatives to achieve good fuel economy. My pre-emissions truck worked more efficiently, partly due to my driving skills. If those driving skills were taught to others, fuel economy would improve. Highway congestion is another unaddressed proven waste of fuel every year. I estimate that in one day of a recent trip, I burned an extra ten gallons of fuel due to congestion, the point being those two suggestions do not involve concerns of unproven technology or unknown costs of the new technology.

**Organization:** Daimler Trucks North America LLC

Further, the analyses presented within the Alternatives section of the Preamble should separate the costs and benefits of tractors and trailers as lumping those two categories together does not allow for comparison to these unique and different sectors between alternatives. Without being able to look at the costs and benefits of the alternatives for just tractors or just trailers, we are not given enough information to be able to comment on the alternatives. [EPA-HQ-OAR-2014-0827-1164-A1 p.73]

**Organization:** National Automobile Dealers Association (NADA)

In fact, for all the reasons discussed above, serious concerns exist as to whether Alternative 3 is appropriate, cost-effective, and technologically feasible. Given the proposal's long lead time and with an eye toward avoiding untoward market disruptions, NADA/ATD suggests that the final rule include a formal review process to reassess key assumptions and variables (e.g., new technology feasibility and cost, uptake rates, freight demand, fuel prices, and interest rates, customer creditworthiness) in order to verify whether the structure and stringency of Alternative 3 still makes sense for MYs 2024 and beyond. [EPA-HQ-OAR-2014-0827-1309-A1 p.11]

**Organization:** Odyne Systems LLC

While Scenario Three, which results in full compliance by 2027 for all truck classes would represent a positive guidepost for the industry, Odyne believes that cost effective technologies exist to meet timelines and technology adoption scenarios laid out in Scenario Four, or a new Scenario with increased stringency using the Scenario Three timeline. [EPA-HQ-OAR-2014-0827-1239-A1 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-08267-1372, p.229.]]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

The agencies preferred alternative, Alternative 3, proposes a ten year lead time for manufacturers to meet the Phase II standards by MY 2027, "which the agencies believe is adequate to implement the technologies...to meet the proposed standards. For some of the more advanced technologies production

prototype parts are not yet available.” Again, the livelihood of millions of truck drivers and thousands of small business owners should not be predicated on the agencies belief that Alternative 3 and its ten year lead time is adequate to meet the Phase II standards. No matter how great the hoped for benefits of any technology may be, if it’s not ready for prime time, it can be a business killer for owner-operators and small fleets which make up the vast majority of the US truck fleet. [EPA-HQ-OAR-2014-0827-1244-A1 p.10]

The objective for this rulemaking is to provide more fuel efficient trucks while also reducing both GHG and non-GHG emissions. Nevertheless, this goal will be ruined, along with the careers of those employed throughout the trucking industry, if the agencies do not heed the concerns of the drivers concerning appropriate lead time, stringency, and testing. Although agencies have stated that they desire to avoid disrupting the market, such as the infamous “pre-buys” in 2007, it appears as if the warnings of drivers, and original engine manufacturers (OEMs) have again fallen on deaf ears. [EPA-HQ-OAR-2014-0827-1244-A1 p.10]

As noted by the agencies in their proposed rule, they received warnings from a number of industry stakeholders that owner-operators, as well as large fleets, often plan to purchase their trucks more than a year in advance. Therefore, if they fear a reduction in reliability, increased operating costs, reduced residual value, or large increases in purchase prices, they will adjust their purchase plans to avoid these business killing aggravations. The agencies stated, “The proposed Phase 2 standards would represent a more technology-forcing approach than the Phase 1 approach, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. The agencies are proposing standards for MY 2027 that would likely require manufacturers to make extensive use of these technologies. For existing technologies and technologies in the final stages of development, we project that manufacturers would likely apply them to nearly all vehicles.” (Emphasis added). The agencies are approaching Phase II with the belief various technologies will experience high market penetration rates. However, an overestimation of adoption rates will negatively affect the cost and benefit analysis. For example, Alternative 3 assumes that 90% of the market will adopt auxiliary power units (APUs) by MY 2024, which is simply not realistic, as many trucking operations have absolutely no need for an APU. Moreover, the agencies have assumed that waste heat recovery (WHR) technology, which is still in prototype stage, will have a market penetration of 15% by MY 2027 under Alternative 3. The OEMs have stated very clearly that WHR has numerous technical challenges for which no solutions have been discovered as yet, therefore the technology is still unproven. The complexity and the cost for such a technology would create positive conditions for a pre-buy situation, as owner-operators will not risk their livelihood on unproven technologies. [EPA-HQ-OAR-2014-0827-1244-A1 p.10-11]

The agencies have proposed an overall level of fuel economy stringency labeled as Alternatives 3 for all engines, vehicles, and most categories of trailers. Unlike in Phase I where the agencies projected that manufacturers could meet the Phase I standards with off-the-shelf technologies only, the agencies project that Alternative 3 standards could be met through a combination of off-the-shelf technologies applied at higher market penetration rates and new technologies that are still in various stages of development and not yet in production. However, as previously mentioned in the comments above, the agencies cost and benefit analysis of Alternative 3 is founded upon unrealistic and inappropriate adoption rates, which have effectively skewed the benefits proposed as part of NPRM and RIA. While the agencies do “recognize that there is some uncertainty in projecting costs and effectiveness, especially for those technologies not yet widely available, but believe that the thresholds proposed for consideration account for realistic projections” (emphasis added), the livelihood of hundreds of thousands of small business owners depends on affordable and reliable equipment to compete and survive in a highly competitive industry. [EPA-HQ-OAR-2014-0827-1244-A1 p.34-35]

While the proposal does not mandate any specific technologies, the proposed performance standards of Alternative 3, which require a 10.4 percent fuel and CO<sub>2</sub> emission reduction by MY 2027 for long-haul tractor-trailers, along with a 17.9 percent reduction in tire rolling resistance, a 26.9 percent reduction in aerodynamic drag, and a 304 lbs. reduction in weight, require the adoption of unproven and unreliable technologies, such as WHR. Though the agencies seem to be congratulating themselves for allowing 10 years of lead time in order for OEMs to comply with Alternative 3, the manufacturers have clearly stated in their comments that such stringency is not conducive to producing affordable and reliable tractors and trailers. [EPA-HQ-OAR-2014-0827-1244-A1 p.35]

According to OOIDA President and CEO Jim Johnston, as well as OOIDA Board Members, who have made their living by driving a truck, “We know that it’s the manufacturers’ responsibility to make the equipment to accomplish that [the fuel efficiency and GHG standards], but it is the EPA that sets the rules. And it’s setting them at a pace that does not allow for enough time to road test the equipment. This results in expensive repairs and time-consuming breakdowns that are wrecking profit margins and interfering with operations.<sup>35</sup>” “There’s no time to figure out the standards, to see what works, and how to fix it before the government is putting out new rules...When you are a one-truck business, being down for repair is a real problem. And failures with this technology can keep a truck in the shop all the time. Fleets on the other hand, aren’t running all their trucks at the same time and they have the ability to simply pull another truck out while one truck is down...When you [EPA] are developing these rules, you must keep in mind that most of the freight is moved by small-business trucking operations, not the big companies.” [EPA-HQ-OAR-2014-0827-1244-A1 p.35-36]

OOIDA strongly believes that the market should drive fuel efficient technologies instead of expensive mandates. The agencies stated in their proposed rule that “both public and confidential historical information shows that tractor trailer fuel efficiency improved steadily through improvements in engine efficiency and vehicle aerodynamics over the past 40 years.” In fact, since 1949 and even earlier, truck manufacturers have sought to increase the fuel efficiency and performance of heavy-duty diesel engines and trucks, and these improvements have been driven by fleet owners and owner-operators seeking fuel efficient trucks, as fuel is the number one expense of every trucking operation. [EPA-HQ-OAR-2014-0827-1244-A1 p.36]

OOIDA proposes that agencies’ preferred alternative, Alternative 3, as well as Alternatives 4 and 5, are unrealistic and if adopted as part of this rulemaking process, will severely compromise the agencies’ praiseworthy objectives to increase the fuel efficiency of medium-and heavy-duty trucks and reduce GHG emissions. Truck drivers certainly desire fuel efficient trucks and appreciate cleaner air to breathe. While various governmental agencies and environmental groups tend to paint owner-operators as individuals who do not care about the environment, nothing could be further from the truth. It is crucial to understand that owner-operators are not only hardworking Americans who help to move our economy, but that they also spend a majority of their life around tractor-trailers. Therefore, it is in their best interest, as well as in the interest of the public, to operate clean and efficient trucks. [EPA-HQ-OAR-2014-0827-1244-A1 p.36-37]

Ultimately however, OOIDA believes that Alternative 1 would be the best alternative to reach the agencies goals, as this will allow for the healthy development of technologies without the possible risk of a pre-buy or a no-buy situation. Additionally, this will help prevent the forcing of unreliable and costly technologies that could easily put an owner-operator out of business. According to FMCSA, 96 percent of motor carriers operate 20 trucks or less, while 90 percent of carriers operate 6 trucks or less. The owner-operator represents approximately half of all motor carriers. [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

Alternatives 3 or 4 very well could put many owner-operators out of business, and thus would have a major unintended consequence on the nation's economy, as 70 percent of all freight is moved by a truck. [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

Finally, OOIDA proposes that the agencies also include as part of their Alternatives an option which contains driver training. According to the NAS:<sup>39</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

- Driver training offers potential savings for the trucking industry that rival the savings available from technology. [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

- Indications are that this could be one of the most cost-effective and best ways to reduce fuel consumption and increase fuel productivity of the trucking sector [EPA-HQ-OAR-2014-0827-1244-A1 p.39]

- Establish a curriculum and process for certifying fuel-saving driving techniques as part of commercial driver certification and to regularly evaluate the effects of such curriculum [EPA-HQ-OAR-2014-0827-1244-A1 p.39]

The agencies failed to address truck driver training as a possible Alternative, which could realize greater benefits at a significantly lower cost. A study done by SmartDrive, an innovative solutions company, conducted a study of 695 Class 8 truck drivers to determine the effect of fuel efficiency training. The study results showed that 80% of fuel waste involves acceleration, deceleration, speeding and turning. Furthermore, the study found that by following eco-driving best practices, drivers could improve fuel economy on average up to 22%. That average reduction in fuel consumption could save fleet operators as much as \$12,553 per vehicle in fuel cost annually.<sup>40</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.39]

In fact, by simply changing the driving habits to improve smooth driving performance, driving at appropriate speeds and reduce unnecessary idling, fleets affirmed that eco-driving can realize significant improvement in fuel mileage and reduce operating expenses, and reduce emissions. Within two months of driver training, the fuel economy increased to an average of 6.73 mpg from a baseline of 5.92 mpg, which is a 14 percent increase. The top 25 percent performing drivers improved their fuel economy to 7.98 mpg after two months of training. [EPA-HQ-OAR-2014-0827-1244-A1 p.39]

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35 Sandi Soendker, "EPA takes notes on OOIDA concerns," Landline Magazine (April 2014)

39 Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles

40 Fuel Efficiency Study: Commercial Transportation, SmartDrive (May 2011).

**Organization:** Truck Renting and Leasing Association

Other unintended, adverse impacts may arise if the mandated technologies are not mature and reliable. Based on our discussions with OEMs and others, we understand that it is unclear if the proposed Alternative 3 targets – which include a number of unrealistic technology penetration rates – can be achieved. Pushing even faster, as would be the case with Alternative 4, or revising the stringencies -- especially on engines -- would most certainly create downstream issues for the purchasers or lessees of

the vehicles. Our understanding is that the OEMs believe that the time required to develop and test the technologies that will be needed to meet the Proposed Standards is already limited, suggesting that even shorter deadlines may be impossible to satisfy. [EPA-HQ-OAR-2014-0827-1140-A1 p.5-6]

**Response:**

The agencies address the technical basis for each of the standards in the respective Preamble sections, and in Chapter 2 of the RIA. With respect to pulling ahead those standards by two years (Alternative 4 at proposal), or pulling them ahead with additional stringency (Alternative 5 at proposal), the agencies are distinctly conscious of OOIDA's point that new technologies must be proven reliable in-use before they are widely deployed, and also that small businesses can be disproportionately harmed if controls are unreliable and lead to vehicle downtime. It is for this reason that the final standards are carefully phased in, that application rates of most technologies are less than 100%, that application rates are carefully geared to appropriate vehicle drive cycles to best assure that the standards will result in in-use reductions, and that the rules contain various exemptions and flexibilities for small businesses. The agencies are revising certain of the proposed standards based on comments which persuasively indicated that further stringencies were feasible at reasonable cost, but are largely rejecting Alternative 4 largely due to inadequate lead time which could result in the harms mentioned in OOIDA's comment. Alternative 5 not only lacks sufficient lead time, but is for the most part simply not feasible.

At the same time, the agencies reject the comment that no further regulatory action (Alternative 1) is appropriate (or even legal). The record here shows that there are substantial available, cost-effective emission reductions available for each of the categories covered by the phase 2 rule which would not occur but for the rule. Section IX.A of the Preamble to the final rule and RTC Section 11.2.2 also discuss the various reasons such substantial emission reductions remain possible even though the target industry is commercial with an incentive to reduce fuel-related operating costs

## **8.2 General Comments on Stringency1393**

**Organization:** Advanced Engine System Institute (AESI)

AESI strongly supports setting a final Phase 2 greenhouse gas standard that will strongly encourage innovative companies to develop new technologies and systems that can help medium- and heavy-duty vehicle and engine makers to quickly, cost-effectively, and reliably reduce or eliminate carbon pollution and still over perform on criteria pollutants. We appreciate the delicate balance that the agencies must consider between setting an engine standard that appears feasible using technology available now or in the very near term and under current fuel price conditions versus setting a slightly more stringent technology driving standard that will prompt even faster evolution and greater consumer savings in the long run. [EPA-HQ-OAR-2014-0827-1152-A1 p.1-2]

**Organization:** Allison Transmission, Inc.

EPA and NHTSA should not finalize standards that are more stringent than those contained in Alternative 3. The Proposed Rule lacks sufficient rationale and a demonstrated technical basis for the levels of stringency contained in Alternative 4. [EPA-HQ-OAR-2014-0827-1284-A1 p.2]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

ACEEE strongly supports EPA and NHTSA's work to establish Phase 2 greenhouse gas and fuel efficiency standards for heavy-duty vehicles and engines. The proposed rule, built on the success of the first phase, represents another important step toward major reductions in fuel consumption and greenhouse gas emissions of the heavy-duty sector. We recommend that the agencies strengthen the proposed rule in several areas to ensure that the Phase 2 program achieves maximum economic and environmental benefits. [EPA-HQ-OAR-2014-0827-1280-A1 p.31]

**Organization:** American Lung Association

We believe that the joint proposal provides an important first step in the process toward protecting the public from harmful pollutants in this vehicle sector, but that the proposal must be strengthened to address greater pollution reductions needed in Southern and Central California. [NHTSA-2014-0132-0087-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.142.]

**In closing, the American Lung Association urges you to strengthen the final rule and clean air protections by:** [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.146.]

o implementing a stronger standard more rapidly; [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.146.]

o beginning immediately the process to set a national low-NOx standard; [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.146]

o maintaining a greater focus on advanced technologies; [NHTSA-2014-0132-0087-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.146.]

Therefore, the American Lung Association supports the strongest possible greenhouse gas and other emission standards on the nation's trucks, buses and other polluting sources. We support EPA's efforts to update all standards to match the scientific understanding of the harms we face from the widespread air pollutants, toxics and climate change. For these reasons, we believe that greater protections and stronger emission reductions are needed in the final Phase 2 rules for medium and heavy-duty engines and vehicles. [NHTSA-2014-0132-0087-A1 p.2]

**Organization:** Business for Innovative Climate & Energy Policy

As major U.S. businesses representing nearly two million American jobs and nearly \$400 billion in annual revenue, we are writing to urge EPA and NHTSA to strengthen the proposed Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. BICEP supports the adoption of stronger standards that require a 40% reduction in truck fuel consumption by 2025. Strict standards will save businesses money, catalyze investment in high efficiency truck technologies, and reduce climate risk. Most of our companies depend on trucks to transport our products, and an efficient trucking industry will be critical to our future success. [NHTSA-2014-0132-0095-A1 p.1]

The environmental imperative for action is clear. Freight trucks already account for over 450 million tons of global warming emissions each year. As trucks represent the fastest growing single source of GHG emissions, it is critical that we adopt the strongest possible standards in order to check that growth



and ensure the availability of fuel efficient trucks. Strong GHG standards for heavy trucks will provide a level playing field for companies seeking to reduce their carbon footprint and help avoid the significant costs associated with climate change. [NHTSA-2014-0132-0095-A1 p.2]

As successful American businesses, we know the importance of recognizing and seizing opportunities. This rulemaking is a rare opportunity to strengthen our economy, save businesses and consumers money, create jobs, and mitigate climate risk. Thus, we urge the agencies to adopt stronger Phase 2 fuel efficiency and GHG standards, and call for regulations requiring a 40% reduction in truck fuel consumption by 2025. [NHTSA-2014-0132-0095-A1 p.2]

### **Oppose/Requested Change Comment**

#### **Comment – GHG emissions reductions of proposed regulation in California**

CARB staff consulted with both U.S. EPA and NHTSA throughout the development of the proposed federal Phase 2 Heavy-Duty Program and fully recognizes the potential benefits that would result should CARB harmonize California’s future Phase 2 GHG regulation with the proposed Phase 2 rulemaking, namely, nationwide consistency for engine and vehicle manufacturers. [EPA-HQ-OAR-2014-0827-1265-A1 p.20]

However, as explained in further detail below, CARB staff believes that U.S. EPA and NHTSA’s proposed adoption of emission standards corresponding to “Alternative 3” does not adequately serve California’s needs to reduce both greenhouse gas emissions and petroleum usage from heavy-duty vehicles, and therefore urges its federal partners to adopt the emission standards corresponding to the “Alternative 4” option. [EPA-HQ-OAR-2014-0827-1265-A1 p.20]

We recommend Alternative 4 be the preferred standard across all vehicle categories – tractors, (see comment on page 30), vocational vehicles (see comment on page 36), pickups and heavy-duty vehicles (see comment on page 52) and trailers (see comment on page 57), and in fact in several instances recommend tightening the final stringency also. We recommend tighter standards for tractor and vocational engines as well. In general, CARB staff believes that the NPRM is overly pessimistic about the outlook for the implementation of advanced technologies such as BEVs and FCEVs, as well as the ability of engine and truck manufacturers to engineer solutions that are needed to meet global GHG goals. Generally, CARB staff believes that U.S. EPA and NHTSA should be more willing to push the technology envelope, and have confidence in the ability of industry to meet far reaching environmental goals. As discussed at length in other comments, we believe that more stringent standards for both compression ignition and spark-ignited engines and vehicles are appropriate and could be met in a cost-effective manner. Our recommended reinstatement of Advanced Technology Credits would make Alternative 4 even more attractive and attainable. The projected balances of Phase 1 credits, discussed further below, supports our belief that the engine and truck industry can and will do its part to curb global GHG emissions if more stringent standards are set. [EPA-HQ-OAR-2014-0827-1265-A1 p.20-21]

The benefits of adopting the Alternative 4 standards across all vehicle categories are critical to California for meeting our GHG and petroleum reduction targets for 2030 and 2050.<sup>6</sup> Alternative 4 standards would result in an additional 4 MMT carbon dioxide (CO<sub>2</sub>) benefit by 2030 in California which is equivalent to removing about 3,300 class 8 long-haul tractor-trailers off the road.<sup>7</sup> This reduction would be a critical first step towards California meeting its goal of reducing petroleum use by 50 percent in 2030. [EPA-HQ-OAR-2014-0827-1265-A1 p.21]

**Organization:** California Interfaith Power and Light

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p.104.]

The EPA and NHTSA clean truck standards would be a huge step in addressing all of the above. And the standards can be even stronger. The draft rule, as it stands, 36 percent reduction of fuel consumption in trucks by 2027 is a good start. However, we urge EPA and NHTSA to adopt standards that will achieve a 40 percent target by 2025.

With existing technologies and future innovation in the works, especially here in California, we can surely reach much better than an average of six miles per gallon for most heavy-duty vehicles.

**Organization:** California State Senator Ricardo Lara

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 57.]

In order to meet our reduction goals, we must invest in cleaner transportation technologies with a technology-neutral approach that incentivizes improvements in air quality along with reductions in greenhouse gases. We have made that commitment in California, investing millions of cap and trade dollars to the development of clean truck technology. However, we need an ambitious federal standard that complements and supports these efforts with stringent rules that will be implemented as soon as possible.

**Organization:** CALSTART

We are concerned the current proposed stringency is unlikely to drive advanced technology important for future needs and the plans of key regions [EPA-HQ-OAR-2014-0827-1190-A1 p.1]

We offer some possible approaches to consider: [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

– Increase stringency AND add more flexibility to achieve it [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

**Organization:** Center for Biological Diversity

We strongly support a significant increase in the stringency of the greenhouse gas and fuel standards for medium- and heavy-duty trucks, in particular: the addition of trailers to the regulated sectors; the inclusion of powertrain and driveline efficiency improvements for vocational vehicles; and the closure of the “glider” loophole. The proposed standards would require greater reductions than imposed by Phase 1 standards, with about 40 percent<sup>1</sup> more greenhouse gases avoided in 2030 than would otherwise be achieved through Phase 1 standards alone. While there is no question that enhanced fuel and greenhouse gas regulations are an important step, the Proposed Rule fails to capture significant, additional savings and leaves open a significant loophole for natural gas engines. [EPA-HQ-OAR-2014-0827-1460-A1 p.1-2]

The agencies intentionally set “soft” standards during Phase 1, indicating that the first set of standards was intended to be achievable with available technologies and that greater technology innovation would

be required in Phase 2.<sup>11</sup> As we previously commented, this tepid Phase 1 requirement left many reduction opportunities on the table. Specifically, the Center strenuously urged the agencies to promulgate more stringent standards; to improve the cost-benefit analysis to better reflect the actual costs of climate change; and to remove a number of the credits, averaging and banking provisions that would have weakened the actual emissions reductions and fuel savings resulting from the Phase 1 standards.<sup>12</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.3]

Now it is time for the agencies to prescribe the stringent, maximal reductions that were neglected during Phase 1. The currently-proposed standards are an improvement, but still fall far short of what is maximally feasible and necessary to best protect against climate change and ensure energy security. [EPA-HQ-OAR-2014-0827-1460-A1 p.3]

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1 Ben Sharpe, *What is at stake in the U.S. truck efficiency rule* at Figure 1, International Council on Clean Transportation, Aug. 12, 2015, <http://theicct.org/blogs/staff/what-stake-us-truck-efficiency-rule>.

11 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Final Rule, 76 Fed. Reg. 57,106, 57,133 (Sept. 15, 2011).

<sup>12</sup> Center for Biological Diversity, *Comment letter re: Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles*, Proposed Rule, Docket Nos. NHTSA-2010-0079 and EPA-HQ-OAR-2010-0162 (Jan. 31, 2011).

**Organization:** Center for Neighborhood Technology

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 125.]

We'd like to speak in support of the previous recommendation from the Union of Concerned Scientists that would recommend going to a standard that would reach 40 percent reduction, improvement in fuel efficiency by 2024.

**Organization:** Climate 911

Our concern is that the proposed standards fall short of what is achievable and that the difference between what is proposed and what is possible will be counted in human lives and suffering and the permanent loss of a habitable planet. [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

The need to lower diesel consumption is urgent, the cost of failure unthinkable high and there is no justification for delay or half measures. We strongly urge you to tighten the proposed standards and shorten the implementation timetable. [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

**Organization:** Climate Resolve

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 231.]

And we urge you to strengthen these standards to ensure the greatest reductions in oil use and global warming emissions.

**Organization:** Coalition for Clean Air/California Cleaner Freight Coalition

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 215.]

While the proposed standards are a good first step, I urge you to strengthen these

**Organization:** Coalition on the Environment and Jewish Life

To help address climate change and its negative impacts to vulnerable communities, we urge the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) to finalize the strongest possible standards to improve heavy-duty truck fuel efficiency. These standards will reduce oil consumption and global warming emissions while protecting God's earth and the most vulnerable populations from the worst impacts of climate change. [EPA-HQ-OAR-2014-0827-1249-A2 p.1]

While the proposed fuel efficiency standards are a strong step in the right direction, more could be done to protect God's creation from the impacts of climate change. We urge you to strengthen the proposed standards in order to reach the full fuel efficiency potential in the least amount of time possible. [EPA-HQ-OAR-2014-0827-1249-A2 p.2]

**Organization:** Consumer Federation of America (CFA)

#### A. DID EPA/NHTSA UNREASONABLY ROB CONSUMERS OF POTENTIALLY BENEFICIAL COST SAVINGS?

Throughout these comments we have identified the central tension in the otherwise excellent proposed rule. Did EPA/NHTSA leave too much energy savings on the table by underestimating the feasibility of adopting extremely beneficial technologies? EPA/NHTSA have said they are concerned that specific technologies cannot enter the market or cannot penetrate sufficiently to be allowed to influence the level of the standard, but they have not actually provided any evidence to support those conclusions. The fact that the industry has been a technological laggard for decades is an excuse, not an explanation. [EPA-HQ-OAR-2014-0827-1336-A1 p.58]

Two aggregate perspectives on the decision of the agencies to choose a relatively low level of energy savings – one internal, one external – shed light on this dilemma. Figure VII-1 shows the cost curves implicit in the analysis. If one accepts their cost curves, they have done a pretty good job. They have chosen to set the standard at the point where the marginal benefits starts to decline (the inflection point). The level of the standard chosen for both 2030 and 2050 captures about 80% of the benefits at about 60% of the cost. [EPA-HQ-OAR-2014-0827-1336-A1 p.58-59]

[Figure VII-I 'EPA/NHTSA Cost of saved energy curves for tractor trailers', can be found on p.59 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

One can argue that under both statutes the agencies are not required to “optimize” the benefit in this way. The Clean Air Act (under which EPA sets standards) calls on EPA to advance the technology. The Energy Conservation and Production Act (ECPA), under which NHTSA sets standards, only requires it

to be technically feasible and economically practicable. The regulatory analysis and technical support documents raise the constraint that NHTSA faces in terms of practicability. The cost estimates note that they do not include potential costs of accelerating technology and the regulatory discussion explicitly says that there is concern that a higher standard which requires a more rapid incorporation of untested technology may not be feasible. [EPA-HQ-OAR-2014-0827-1336-A1 p.59]

Figure VI-4 shows the external analysis. It plots the Phase I and Phase II standards energy savings and costs in the same axes as the third party studies discussed in Section IV. The graph highlights the anomaly. To make the cost curves comparable, we have included both Phase I and Phase II and have stated all costs in 2009\$, which would be equivalent to the third party analyses. [EPA-HQ-OAR-2014-0827-1336-A1 p.59-60]

[Figure VII-2,'EPA/NHTSA tractor trailer technology cost and fuel savings (Phase I and II) compared to external estimates', can be found on p.60 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

EPA/NHTSA have developed cost curves that show relatively low costs for the smaller increases in efficiency. The graph also shows a clear shift in cost as one moves to higher levels. This would be consistent with the EPA/NHTSA concern about feasibility. [EPA-HQ-OAR-2014-0827-1336-A1 p.60]

Figure VII-2 also puts a recent analysis by the ICCT in perspective. Responding to some claims by members of the industry that the proposed standards exceed even the super truck projects, the ICCT analysis shows that the super combining all the elements of the super truck program (engine, aerodynamics and tires), the improvement in fuel economy would be 2.4 times larger. They do not give costs, however. Moreover, that includes every truck maxing out on each technology, not something regulatory agencies generally require. If we consider two bundles, better engines or aerodynamics plus tires, the improvement would be 1.7 times as large. The ICCT is certainly correct in concluding that “if the US standards are going to require technology-forcing SuperTruck-like standards for tractors, it is more likely this would be in some future Phase 3 rulemaking for perhaps 2030 and beyond.” The issue for regulatory analysis comes down to what would the much more aggressive standards cost? And how hard can the agencies push the industries under the statute? That is not a question that can be answered by simply identifying the technological frontier. [EPA-HQ-OAR-2014-0827-1336-A1 p.60-61]

**Organization:** Daimler Trucks North America LLC

The agencies must allow for reasonable lead-time and stability. In particular, the agencies must recognize that Alternative 4 is too stringent and accelerating an already very stringent proposal is unworkable. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

The agencies must correct unrealistic technology Fuel Consumption Reduction (FCR) values and penetration rates for technologies used in standard setting. [EPA-HQ-OAR-2014-0827-1164-A1 p.6]

#### 1. Stringency and Standards

**DTNA is interested in Getting the FCR Values Correct** – As we noted in our Vehicle Stringency section above, we think the agencies took the correct approach of trying to determine the FCR benefits of technologies and the reasonable penetration rate of each. We do, however, have concerns with the FCRs that the agencies assumed. We want to make sure those numbers are correct, as errors could lead to regulations crediting or penalizing technologies differently than should happen, based on real-world FE benefits. To that end, we have a lot of data that we wish to share with the agencies. Below is a

summary, but we wish to have further discussions in a confidential setting. [EPA-HQ-OAR-2014-0827-1164-A1 p.80]

**Organization:** Daimler Trucks North America LLC

The result is that we need to make a dozen assumptions, any one of which could be wrong, before we even see a path to 2027 compliance. In turn, we think that the 2027 standards are overly aggressive. [EPA-HQ-OAR-2014-0827-1164-A1 p.69]

**Organization:** Dignity Health

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 203.]

We strongly support the adoption of regulations requiring a 40 percent decrease in fuel consumption by 2025.

**Organization:** East Yard Communities for Environmental Justice (EYCEJ)

The proposed standards are a step in the right direction in increasing efficiency and reducing oil use, but they can be further strengthened. We support the analysis from the Union of Concerned Scientists and urge the EPA to finalize stronger standards that reduce trucks' fuel use by 40% by 2025. [EPA-HQ-OAR-2014-0827-0843 p.1]

There is an opportunity here to go beyond the bare minimum. From benefiting the economy by reducing business costs, to saving thousands of barrels of oil per day, to reducing global warming emissions by millions of metric tons. We implore you to go above and beyond your call of duty for the sake of this nation and its myriad of communities - finalize standards that reduce trucks' fuel use by 40% by 2025. Thank you. [EPA-HQ-OAR-2014-0827-0843 p.2]

**Organization:** Environment America and other local citizens across America

However, we can accomplish more. According to analysis by experts, by 2025 we have the potential to cut fuel consumption of new trucks by at least 40 percent compared to 2010 levels. Standards that extend beyond 2025 could achieve even larger savings.[4] [EPA-HQ-OAR-2014-0827-1295-A1 p.1]

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[4][http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Fuel-Savings-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Fuel-Savings-Factsheet.pdf)

**Organization:** Environment California Research and Policy Center, Environment America Research and Policy Center

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 161-163.]

We applaud the Obama administration for proposing standards that will over the lifetime of trucks affected by the rule avoid one billion metric tons of global warming emissions. While this is a strong

step in the right direction, we urge you to strengthen these standards to ensure the greatest reductions in oil use and global warming emissions

This stronger proposal would mean a triple win for clean air, the climate, and consumers. And I urge you to go the extra mile and finalize stronger standards to reduce trucks' fuel use by 40 percent by 2025.

**Organization:** Environment California Research and Policy Center, Environment America Research and Policy Center

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 162.]

Specifically, Environment California and Environment America support strengthening the standards to achieve 40 percent fuel savings by 2025, which would save an additional 200,000 barrels of oil per day in 2035 and avoid an additional 40 million metric tons of global warming emissions annually according to analysis by our colleagues at the Union of Concerned Scientists. That is the equivalent of shutting down not 1, not 2, but 12 coal-fired power plants. And it would save the average big rig driver \$30,000 in annual fuel costs in 2025. It is new technology that pays for itself in just over a year.

**Organization:** Fuller, Tony

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 148-149.]

However, these standards need to be strengthened to achieve at least a 40 percent reduction by 2025. The science shows that the technology exists to do this. Strong 40 percent reduction standards are what I call really a no-brainer decision.

**Organization:** General Motors

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 122.]

While we are cautiously supportive of this plan for future emissions reduction standards, it is important to note that alternative 3 increases the effective stringency far beyond what is a cursory analysis at 2.5 percent per year would suggest. A combination of procedural, modeling, and fuel changes results in a more stringent regulation.

**Organization:** Gentherm, Inc.

In our view current regulation does not sufficiently encourage application of new technologies which would improve fuel efficiency at the engine level. The proposed rule, in its current form, requires only modest improvements from engine manufacturers and it does not have a mechanism which would promote implementation of new technologies such as electrification of accessories, improving alternator efficiency and installation of other devices for direct generation of electricity such as waste heat recovery devices. [EPA-HQ-OAR-2014-0827-1133-A1 p.1]

**Organization:** Gilroy, JD

With all these positive aspects to the standards, I can only think of two sorts of reservations I have. One is the inevitable one with any proposed standards that some might think them not progressive enough. While I am certainly no expert to make that case, I can at least convey the claim of the UCS that more stringent standards could achieve greater reductions in fuel consumptions---40% versus 36%---and do so two years earlier---by 2027 instead of 2029, if the standards, for example, were to apply not only to combination tractors but to the trailers they haul. [EPA-HQ-OAR-2014-0827-0751 p.2]

On balance then, I am extremely in favor of the proposed standards, wishing only that even stronger standards be considered, if technologically feasible, along with similar new pollution reduction standards for air and rail vehicles. [EPA-HQ-OAR-2014-0827-0751 p.2]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

Medium and heavy truck manufacturers have overcome challenges meeting Phase 1 stringency requirements that were developed assuming market adoption of existing off the shelf technology. Phase 2, in contrast is technology forcing. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

The UAW supports developing and bringing new technology to the fleet as long as the technology is reliable, cost effective and manufacturers have more than one technology path to comply with stringency requirements. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

We strongly agree with the EPA and NHTSA's warning that poorly crafted regulations forcing unproven technology can lead to: [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

**Organization:** Investor Network on Climate Risk

As long--term investors representing over \$86 billion in assets, and as members of the Investor Network on Climate Risk (INCR), we are writing to urge EPA and NHTSA to strengthen the proposed Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium-- and Heavy--Duty Engines and Vehicles—Phase 2. We support strong standards that go beyond EPA and NHTSA's proposed rule, and require a 40% reduction in heavy truck fuel consumption by 2025. Strong standards are feasible, cost effective, and represent a significant opportunity to drive economic growth by shielding us from oil price volatility, catalyzing investment in advanced truck technologies, and reducing climate risk. [NHTSA-2014-0132-0113-A1 p.1]

In sum, strong standards will strengthen our economy, spur innovation, and reduce both our dependence on oil and climate risk. Accordingly, we urge the agencies to adopt strong Phase 2 fuel efficiency and GHG standards requiring a 40% reduction in truck fuel consumption by 2025. [NHTSA-2014-0132-0113-A1 p.2]

**Organization:** MacLaughlin, Douglas

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 225.]

Administration's proposals are a good first step, but the UCS and other organizations, as I have heard today, have shown that they can be strengthened. They have analyzed this issue in detail and made specific additional proposals. They and other organizations have shown that new technology and new



trucks can reduce fuel consumption by a number we have heard quite a bit, 40 percent, by 2025. That is more and faster than the administration's proposed goal to date, at any rate, of 36 percent reduction by 2027.

**Organization:** Manufacturers of Emission Controls Association (MECA)

Technology development has a 15-20 year cycle from the lab to commercialization. This is why stringent standards are a critical signal to industry to make investments today for technologies that will be needed in the future. MECA members are engaged in developing a large portfolio of efficiency technologies that will directly or indirectly impact CO2 emissions. These technologies include advanced SCR catalysts, passive NOx adsorbers (PNA) and substrates, waste heat recovery, turbochargers, turbo-compounding, EGR coolers, EGR valves and other air management technologies, thermal management strategies including insulated dual wall manifolds and exhaust systems, active thermal management approaches, advanced fuel injection and ignition systems. Technologies, like turbo-compounding and advanced air management strategies are already being commercialized in Europe whereas others such as Rankine cycle systems and advanced high pressure injection, are under demonstration and technologies with still longer term horizons, such as thermoelectric generators are still in the laboratory. MECA members estimate that using the proposed Alternative 3, 2027 engine efficiency standards, some of these technologies, such as waste heat recovery, will fall significantly short of the penetration rates forecasted in the proposal. [EPA-HQ-OAR-2014-0827-1210-A3 p.2]

**Organization:** Mass Comment Campaign sponsored by anonymous 1 (email) - (23)

But these vital emissions reductions don't go far enough. They must be strengthened to better protect our communities and families. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by anonymous 3 (email) - (308)

From aerodynamic trailers to automated manual transmissions and advanced engines, the technology exists to cost-effectively meet stronger standards. Analysis shows that we can reduce new truck fuel consumption 40 percent by 2025, compared to 2010 trucks. It is critical that the agencies strengthen these standards, particularly the engine standard, to ensure efficiency improvements throughout freight trucks. [EPA-HQ-OAR-2014-0827-1477-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by Center for Biological Diversity (web) - (4,429)

I am writing to urge you to strengthen your proposed emissions standards for medium- and heavy-duty trucks with a rule that will take us confidently into the future. The current proposal addresses our needs but doesn't do nearly enough. We need serious cuts to avoid the worst effects of climate change and increase energy security and protect public health, especially among vulnerable communities who are disproportionately located near highways and industrialized zones. [EPA-HQ-OAR-2014-0827-1167-A1 p.1]

Please -- do everything in your power to see that our climate and health are protected with a rule that requires serious emissions cuts and strong standards for big trucks. [EPA-HQ-OAR-2014-0827-1167-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by CREDO Action (web) - (56,914)

“The EPA’s proposed heavy truck fuel efficiency standards are a strong step toward cutting carbon emission from trucks and addressing climate change. But they must be made even stronger. I urge you to set a standard that achieves a 40 percent reduction in fuel consumption by 2025.” [EPA-HQ-OAR-2014-0827-1117 p.1]

**Organization:** Mass Comment Campaign sponsored by Sierra Club (email) - (26,917)

While the proposed standards are a good first step, I urge you to strengthen these standards to ensure the greatest reductions in oil use and carbon pollution. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

From aerodynamic trailers to automated manual transmissions and advanced engines, the technology exists to cost-effectively meet stronger standards. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

I urge you to strengthen these standards as you move forward. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by the Environmental Defense Fund (email) - (60,831)

But these vital emissions reductions must be strengthened to reflect the safeguards that available technology can provide for our communities and families. [EPA-HQ-OAR-2014-0827-1229-A1 p.1]

Medium- and heavy-duty vehicles currently account for about 20 percent of greenhouse gas emissions and oil use in the U.S. transportation sector, but only comprise about five percent of vehicles on the road. These trucks are also the fast-growing single source of climate pollution in the U.S. Improving fuel efficiency and emissions standards on these vehicles is achievable with proven technology options and highly cost effective and will provide significant savings to truck drivers and consumers. In fact, a leading technical evaluation found these trucks can reduce fuel consumption 40% by 2025, compared to 2010 levels. [EPA-HQ-OAR-2014-0827-1229-A1 p.1]

And it has wide public support. According to the Consumer Federation of America (CFA), a large majority of Americans (71 percent) favor requiring manufacturers to increase the fuel efficiency of heavy-duty trucks. [EPA-HQ-OAR-2014-0827-1229-A1 p.1]

Please finalize stronger standards that take effect no later than model year 2024 to protect our communities from the harmful emissions discharged by big freight trucks and buses. Our communities, our families and our children are counting on your leadership. [EPA-HQ-OAR-2014-0827-1229-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by The League of Conservation Voters (LCV) (web) - (6,603)

Please implement the strongest possible fuel efficiency standards for heavy duty trucks [EPA-HQ-OAR-2014-0827-1228-A1 p.1]

Thank you for proposing new standards to significantly improve freight truck fuel efficiency. These standards are a strong first step, but EPA and DOT must strengthen these standards to ensure the greatest reductions in oil use and carbon pollution. [EPA-HQ-OAR-2014-0827-1228-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by Union of Concerned Scientists (email) - (28,135)

The technology exists to cost-effectively meet stronger standards sooner than you have proposed. It is critical that the proposal be expanded to capture the full suite of cost-effective solutions available for each type of heavy-duty vehicle, including improved aerodynamics on trailers, more efficient engines in tractor-trailers, and new technologies such as hybrid and electric drive trains. [EPA-HQ-OAR-2014-0827-0913-A1 p.1]

**Organization:** Moms Clean Air Force

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 63.]

But while the proposed standards are a good first step, I urge you to strengthen these standards to ensure the greatest reductions in oil use and global warming emissions.

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

**Provide More Flexibilities to Ensure Engine Technologies are Utilized** [EPA-HQ-OAR-2014-0827-1274-A1 p.4]

Overall, the engines and engine technologies available in the near-term and in the pipeline are feasible. The proposed stringencies are achievable and going in the right direction, but there are opportunities to further utilize feasible engine technologies. Programs like the Department of Energy's "SuperTruck" have shown there are efficiency improvement possibilities – but there is still a long leap between what is possible and what is feasible. If the agency desires to push performance – which, in turn pushes technologies, then the answers reside somewhere in between what is possible and what is feasible. To be clear, MEMA is not prescribing a specific or different stringency. We only note that there might be some opportunities for the agencies to add more flexibilities to ensure that engine technologies are utilized and adopted. Some examples are: friction reduction, parasitic loss reduction (including on-demand oil and coolant flow control), improved thermal management, higher efficiency after treatment, electrification of auxiliaries and application of on-demand approaches and engine breathing improvements (such as higher efficiency turbochargers and variable valve actuation). MEMA members will address their product lines and technologies in their individual company comments. [EPA-HQ-OAR-2014-0827-1274-A1 p.4-5] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.193.]]

**Organization:** Moving Forward Network

Our Network is deeply concerned that both agencies put forward the strongest regulation possible since this regulation address harmful climate pollution. [EPA-HQ-OAR-2014-0827-1130-A2 p.1]

**Organization:** National Association of Clean Air Agencies (NACAA)

With respect to aspects of the proposal NACAA believes should be improved, we offer the following comments. [EPA-HQ-OAR-2014-0827-1157-A1 p.2]

In a March 18, 2015 letter to your respective agencies,<sup>2</sup> NACAA provided our recommendations for essential components of a Phase 2 rule. In those recommendations, we urged for a rule that would reduce GHG emissions and fuel consumption across the entire fleet by at least 40 percent, on average, compared to 2010. Unfortunately, we find the overall effectiveness of the Phase 2 proposal to fall short of our recommendation and, more importantly, significantly short of what can and should be achieved. Accordingly, we believe the overall stringency of the proposal should be enhanced to take advantage of missed opportunities that, if incorporated into the final rule, would drive technology and ensure that maximum emission reductions and reduced fuel consumption are achieved. [EPA-HQ-OAR-2014-0827-1157-A1 p.2-3] [These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.52-53.]

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2 NACAA Letter to EPA and NHTSA providing recommendations on a Phase 2 regulatory proposal (March 18, 2015), [http://www.4cleanair.org/sites/default/files/Documents/NACAA-Letter\\_to\\_EPA\\_DOT-Ph2\\_HD\\_Fuel\\_EffGHG\\_Std-031815.pdf](http://www.4cleanair.org/sites/default/files/Documents/NACAA-Letter_to_EPA_DOT-Ph2_HD_Fuel_EffGHG_Std-031815.pdf).

**Organization:** Natural Resources Defense Council (NRDC)

In finalizing the rule, we urge the agencies to incorporate our recommendations to strengthen the program beyond what the agencies have proposed. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

### **Increase the Standard Stringency throughout the Phase-in Period**

NRDC believes that stringency of the overall standards should be strengthened beyond the proposed levels. The proposed Phase 2 standards (described as Alternative 3) reduce fuel consumption and carbon dioxide (CO<sub>2</sub>) emissions by 24 percent relative to the Phase 1 standards by 2027. The agencies have described cost-effective standards in Alternative 4 that achieve the same reductions in 2024. Prior to the proposal, analysis by the American Council for an Energy Efficiency Economy (ACEEE), the Union of Concerned Scientists (UCS) and NRDC showed that overall medium- and heavy-duty fuel consumption could be reduced by at least 40 percent from 2010 levels and approximately 28 percent from 2017 levels by 2025<sup>5</sup> – a level and timeframe that is more consistent with Alternative 4 than Alternative 3. Upon further evaluation, NRDC believes standards that achieve fuel consumption and emissions reductions of at least 24 percent by 2024 and at least 31 percent by 2027 would meet the agency obligations for setting standards that are maximum feasible (for NHTSA) and appropriate (for EPA). [EPA-HQ-OAR-2014-0827-1220-A1 p.3-4]

Achieving standards stronger than those proposed by the agencies will clearly result in larger and sooner reductions in petroleum consumption and carbon pollution. The agencies analysis shows that Alternative 4 reduces oil consumption and carbon pollution by 13 percent and increases net benefits by over \$24 billion compared to the proposed Alternative 3. In this comparison, the Alternative 4 standards ended in 2024. By extending more stringent, technology-forcing standards beyond 2024 the agencies can provide valuable market certainty for manufacturers that will encourage companies to make on-going investments in fuel-saving innovations that will further reduce carbon pollution. [EPA-HQ-OAR-2014-0827-1220-A1 p.4]

While the 2027 proposed standards provide a long timeframe, they are too modest to spur all cost-effective technology deployment. Significant improvements can be made to the proposal stringency, particularly in the areas of tractor engines and vocational vehicles. [EPA-HQ-OAR-2014-0827-1220-A1 p.4]

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5 Kahn, S., Cooke, D., Tonachel, L. "Fuel Savings Available in New Heavy-Duty Trucks in 2025," TRB Paper 154977, November 14, 2014. Available at <http://docs.trb.org/prp/15-4977.pdf>.

**Organization:** Navistar, Inc.

The Proposed Rule is not economically practicable as it is currently written. In addition, the standards are not the maximum feasible, but exceed the maximum feasible standards in stringency. We urge both agencies to address the concerns in these comments as well as those filed in EPA's docket. [NHTSA-2014-0132-0094-A1 p.3]

**Organization:** Nelson, Dennis

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 93-94.]

Secondly, I will offer my constructive criticism for improvement. The heavy duty vehicle fuel economy and carbon emissions standards should be made even stronger in order to achieve about 40 percent in fuel savings by 2025. This would use cost-effective technologies that are now being deployed or demonstrated. An additional 40 million metric tons of climate disrupting pollution would be avoided each year by 2035, which would be the equivalent of closing down around 12 coal-fired stations.

**Organization:** North American Die Casting Association (NADCA)

However, should the Administration move forward with the Phase II standards, we encourage regulators to adopt a nationwide ceiling with achievable standards rejecting Alternative 4. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

The rule as proposed, however, does not take full advantage of available and proven technologies and should be made stronger in several areas. [EPA-HQ-OAR-2014-0827-1221-A1 p.1]

**Organization:** Orange EV

We support the efforts by EPA and NHTSA to address greenhouse gas emissions and fuel efficiency in this proposed rule, but encourage the agencies to adopt stronger standards and full implementation as soon as possible. [EPA-HQ-OAR-2014-0827-1135-A1 p.1]

Stricter emission standards can be achieved with existing technologies that have been proven to meet operational demands while making financial sense. To speed adoption we encourage the offering of

incentives that defray the cost of initial purchase and implementation to at or below the cost of current alternatives. [EPA-HQ-OAR-2014-0827-1135-A1 p.1]

**Organization:** PACCAR

Although some engine manufacturers may support a greater improvement in fuel efficiency/GHG emissions under Alternative 4, the full benefit of the technologies needed to achieve that reduction appears only in certain applications. Even if it were possible to reduce fuel consumption and GHG emissions by greater amounts in all applications and duty cycles, that level of improvement will require the use of technologies that are not familiar to customers and may be undesirable to them. In a number of cases, these technologies do not exist in the marketplace and may not have even reached the stage of prototype with some OEMs. Vehicle Stop-Start systems, dual clutch transmissions, and waste heat recovery are three examples of technologies that customers have no experience with today. If customers do not purchase engines and vehicles with newer technologies, then the overall emission reduction goal may not be achieved and is unlikely to be cost effective. The accelerated timeline of Alternative 4 also does not allow for technology reliability demonstrations and may result in technologies being rushed to market. For commercial vehicles, it is imperative that new technologies are sufficiently robust and reliable across the broad range of applications for this market to allow the vehicles to operate throughout their work day. Downtime due to product unreliability negatively impacts the viability of companies and the economy. PACCAR therefore strongly supports the adoption of Alternative 3, taking into account the revisions suggested in these comments. [EPA-HQ-OAR-2014-0827-1204-A1 p.4]

**Organization:** Proterra

Proterra is already exceeding these desired results for heavy duty public transportation buses and would encourage EPA and NHTSA to be even more aggressive in setting GHG and Fuel Efficiency targets by adopting more stringent standards, as proposed in the Alternative 4 standards. Among other benefits of the proposed Phase 2 Program, including reducing carbon pollution and improving energy security, these higher standards will save transit operators money. Proterra customers have already saved close to \$1M in fuel and maintenance costs. [EPA-HQ-OAR-2014-0827-1160-A1 p.2]

**Organization:** Quealy, Kevin

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 172-174.]

However, I do believe that significant progress will not be made in a timely manner if the EPA does not implement a full-fledged attack on carbon pollution released by the truck fleets that fill our Nation's roadways.

Strong standards to reduce trucks' fuel use by 40 percent by the year 2025 should be a top priority of the Agency.

**Organization:** Respiratory Health Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p.131.]

Every barrel of oil burned means more carbon dioxide in the atmosphere, further increasing global warming. Reducing fuel consumption through greater efficiencies and through the development of non-fossil fuel technologies that eliminate carbon emissions are needed to address these health threats. For those reasons, we believe strong EPA greenhouse gas tailpipe standards are necessary. And while we strongly support the direction of proposed EPA climate rules for new trucks, we also believe the proposed standards should be strengthened, and that EPA should increase its goal to achieve a 40 percent fuel savings by 2025.

The ability to gain additional reductions is there. The agency should go beyond its very conservative approach to capture additional fuel reductions, a strategy we believe will benefit public health for many years to come.

**Organization:** Sierra Club

Our organizations urge the agencies to strengthen the proposed standards to ensure the greatest possible reductions in oil use and carbon pollution and to finalize the standards as soon as possible. [EPA-HQ-OAR-2014-0827-1277-A1 p.3]

**Organization:** Transportation Power

[We] encourage the agencies to adopt stronger standards and full implementation by 2024. [EPA-HQ-OAR-2014-0827-1149-A1 p.1]

The rule, as is, would lock in the status quo for technology until 2030. Please consider strengthening the proposed standards and revising the timeline for full implementation to 2024. [EPA-HQ-OAR-2014-0827-1149-A1 p.1]

**Organization:** Truck Renting and Leasing Association

However, TRALA has several concerns about the Proposed Standards, which we have set forth below: (3) the agencies' technology assumptions are overly optimistic [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Organization:** Union of Concerned Scientists (UCS)

However, with a projected increase in freight miles from this sector more must be done to curb growth in emissions and fuel usage, and we believe there are a number of ways in which the proposal can be strengthened to ensure that EPA and NHTSA are meeting their statutory obligations. [EPA-HQ-OAR-2014-0827-1329-A2 p.1]

The analysis noted above highlights the simple fact that while the agencies have put forward a comprehensive proposal, the regulation can be strengthened significantly. Improving this regulation will help maximize the feasible reductions in the timeframe of this rule and set the industry on a more sustainable path for decades to come. [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

**Organization:** Volvo Group

As currently drafted the proposal grossly underestimates the actual efficiency improvements required to meet the proposed targets for several reasons. First, the baseline efficiency from Phase 1 vehicles is significantly overestimated. Second, the lack of margins for aerodynamic and engine map audits would force us to understate our certified efficiency inputs to ensure passing a subsequent audit. Third, the aerodynamic measurement procedure overstates the aerodynamic drag and the targets fail to account for the impact of a non-aerodynamic test trailer. Collectively, these issues amount to an increase in stringency by approximately 17%, e.g. from 32% to 49% for high-rise sleeper tractor-trailer combinations, based on the MY 2027 targets, as shown in the chart below. [EPA-HQ-OAR-2014-0827-1290-A1 p.10]

Excessive stringency results in uncertainty that the proposal can be implemented, excessive cost, unreliable products, delays in new vehicle purchases, production disruption, lay-offs, and delays in achieving benefits. Volvo supports comments by EMA relative to stringencies and we elaborate on our concerns below. [EPA-HQ-OAR-2014-0827-1290-A1 p.18]

For reasons set forth below, due to numerous errors in setting stringency levels in the rule, there is substantial uncertainty that manufacturers can even comply with the agencies' proposal. Unless these errors are corrected, there is substantial uncertainty that, among other things, the proposal would accomplish its intended purpose. Furthermore, as a result of these errors, the proposal lacks an adequate factual basis. In addition, the excessive stringency resulting from these errors will result in excessive cost, unreliable products, delays in new vehicle purchases, product disruption, lay-offs, and delays in achieving benefits, if such are even achievable under the proposal as drafted. For these reasons Volvo believes EPA must revisit and correct its assumptions before proceeding with the proposed rule. [EPA-HQ-OAR-2014-0827-1290-A1 p.18]

#### Stringency and Technology Penetration Summary

As noted above, the significant errors in assumptions made for purposes of setting stringency levels renders these levels highly suspect and likely unachievable. The agencies have failed to provide adequate explanation or evidence to demonstrate that the stringency levels are achievable and justified. Moreover, the assumptions (penetration levels and feasibility) relied on to set the established stringency levels do not support those levels. Finally, due to these errors, there is substantial uncertainty that the rule, if adopted as proposed, would even achieve its intended purpose. As a result, the proposal is not the product of reasoned decision making, and should be revisited and revised to address these errors. [EPA-HQ-OAR-2014-0827-1290-A1 p.29]

#### **Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 240.]

We are very appreciative of the efforts of the federal government team in developing the phase 2 draft rules and agree with the basic principles and structures that have been proposed. And, as currently proposed, we support the preferred alternative.]

#### **Response:**

The agencies considered all of the general comments associated with the proposed Alternative 3 and Alternative 4 standards, as well as other comments on overall stringency. We believe there is merit in many of the detailed comments received regarding technologies. These are discussed in detail in



Sections II through VI of the FRM Preamble and Chapter 2 of the RIA. Instead of merely choosing from among the proposed alternatives, the agencies have developed a set of final standards that reflect our reevaluation of the ability to pull ahead certain technologies, the limitations in adoption rates and/or effectiveness of other technologies, and consideration of additional technologies.

As can be seen from the comments, there is uncertainty and a wide range of opinions regarding the extent to which these technologies can be applied. Vehicle manufacturers tended to take the conservative position for each technology and argue that the agencies should not project effectiveness or adoption rates beyond that which is certain. Many other commenters took a more optimistic view. Some merely cited the 40 percent reduction supported by a wide variety of NGOs. Whether explicitly or implicitly, these commenters argued for the agencies to assume that each potential technology will be highly effective in most applications. However, the agencies believe the most likely outcome will be that some technologies will work out better than expected while others will be slightly more challenging than projected. Thus, the agencies have tended to make balanced projections for the various technologies, although some may be slightly optimistic while others are somewhat conservative. We believe the overall effect of this approach will be standards that achieve large reductions with minimal risks to the industry of unreliable or under-performing technology.

Comments on the engines standards are addressed in Section 3 of this RTC. However, since many of the commenters highlighted the engine standards, it is also worth addressing them briefly here to highlight the changes from the proposal. On the vocational side, we changed the baseline engine to reflect the most recent certification data, which significantly strengthens them relative to the NPRM. The detailed analysis of vocational engine stringency and the baseline engine standards is addressed in Chapter 2.7.4 of the RIA. We also made changes to the tractor engine standards. We decreased the dis-synergy assumed in the analysis from 15 percent to 10 percent, and significantly increased the projected market penetration for WHR Rankine cycle technology. As a result of these and other updates, the projected improvements over the baseline for the 2027 tractor engine standards increased from 4.2% estimated at proposal to 5.1%. Chapters 2.3 and 2.7 of the RIA provide detailed justification of these changes from proposal.

Comments on the need for compliance margins are addressed in Section 1.4 of this RTC.

### **8.2.1 General Comments on Phase-in 1411**

**Organization:** California Air Resources Board (CARB)

In this NPRM, U.S. EPA and NHTSA have set forth a broad range of compliance strategies and technologies that they anticipate engine and vehicle manufacturers will utilize in order to comply with the emission standards associated with both Alternatives 3 and 4. Such compliance strategies and technologies vary from well-established control technologies that are currently widely available (essentially “off-the-shelf” technologies) to control technologies that are only utilized in certain industry segments or that will likely require substantial development before they will be commercially available on a widespread basis throughout the industry (e.g., Rankine-cycle engines and strong hybrid pickups and vans). [EPA-HQ-OAR-2014-0827-1265-A1 p.25]

As demonstrated below, CARB staff believes that for each regulated category of engines and vehicles, U.S. EPA and NHTSA have identified specific technologies that will be commercially available and that will enable manufacturers to comply with the proposed emission standards within the time frames associated with Alternative 4. [EPA-HQ-OAR-2014-0827-1265-A1 p.25]

In *NRDC*, the court upheld U.S. EPA's PM standards for MY 2005 light-duty diesel vehicles that U.S. EPA had promulgated in 2000. The court stated: [EPA-HQ-OAR-2014-0827-1265-A1 p.25]

“Given this time frame, we feel there is substantial room for deference to the EPA's expertise in projecting the likely course of development. The essential question in this case is the pace of that development, and absent a revolution in the study of industry, defense of such a projection can never possess the inescapable logic of a mathematical deduction.”<sup>12</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.25]

**Organization:** California Air Resources Board (CARB)

The benefits of adopting the Alternative 4 standards across all vehicle categories are critical to California for meeting our GHG and petroleum reduction targets for 2030 and 2050.<sup>6</sup> Alternative 4 standards would result in an additional 4 MMT carbon dioxide (CO<sub>2</sub>) benefit by 2030 in California which is equivalent to removing about 3,300 class 8 long-haul tractor-trailers off the road.<sup>7</sup> This reduction would be a critical first step towards California meeting its goal of reducing petroleum use by 50 percent in 2030. [EPA-HQ-OAR-2014-0827-1265-A1 p.21]

Adopting Alternative 4 standards across all vehicle categories would also result in the Phase 2 program being fully phased in by 2024 (by 2025 for pickups and vans), three years earlier than if Alternative 3 standards are adopted. This would allow manufacturers to take action on reducing NO<sub>x</sub> emissions from the heavy-duty vehicles addressed in this rulemaking in a timelier manner. This is especially important since heavy-duty vehicles are responsible today for one-third of California's NO<sub>x</sub> emissions. The South Coast Air Basin will need nearly a 90 percent reduction in heavy-duty vehicle NO<sub>x</sub> emissions by 2031 from 2010 levels to attain the 2008 National Ambient Air Quality Standards (NAAQS) for ozone. Additionally, on November 25, 2014, U.S. EPA issued a proposal to strengthen the ozone NAAQS. If a change to the ozone NAAQS is finalized, California and other areas of the country will need to identify and implement measures to reduce NO<sub>x</sub> as needed to complement federal emission reduction measures. [EPA-HQ-OAR-2014-0827-1265-A1 p.21]

**Organization:** CALSTART

We are concerned the current proposed stringency is unlikely to drive advanced technology important for future needs and the plans of key regions [EPA-HQ-OAR-2014-0827-1190-A1 p.1]

We offer some possible approaches to consider: [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

– Increase stringency AND add more flexibility to achieve it [EPA-HQ-OAR-2014-0827-1190-A1 p.2]

Therefore, we strongly support increasing the stringency requirements of these vocational segments, with a minimum target of 20% (though varied by different segment). In terms of the rule timeline, we remain sensitive to both OEM and fleet desires for a longer investment horizon and a more measured, stair-step regulatory approach to ensure quality product delivery. However, we believe any longer regulatory timeline (2027) would only make sense in the context of increased stringency, with some commensurate added flexibility. We will discuss flexibility in a following section. [EPA-HQ-OAR-2014-0827-1190-A1 p.4]

**Organization:** Environmental Law and Policy Center

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 218.]

Regulations should be fully implemented by 2024 rather than 2027 as proposed. My understanding is that EPA's own analysis shows that this deadline is achievable.

Delaying the final phase-in of today's rule to 2027 means we won't be able to respond to any of these changes until at least 2030. Faster implementation of today's rule means flexibility to respond sooner to tomorrow's opportunities.

**Organization:** National Automobile Dealers Association (NADA)

The Phase 2 proposal largely phases-in beginning with MY 2021, culminating in standards for MY 2027. Regulated truck trailer manufacturers must begin compliance in 2018 for EPA and 2021 for NHTSA.<sup>10</sup> Such a long lead time benefits OEMs by allowing them to plan their compliance strategies well ahead of time. On the other hand, setting rules up to 12 years into the future necessarily raises questions on the assumptions involving for critical variables like fuel price, interest rates, and freight demand. [EPA-HQ-OAR-2014-0827-1309-A1 p.5]

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<sup>10</sup> NADA/ATD will not comment on the proposed trailer standards.

**Organization:** Navistar, Inc.

Finally, the cost estimate in the NPRM significantly underestimates the vehicle program costs for Alternative 3, which is only made worse by the acceleration of the standard proposed in Alternative 4. The cost/benefit analysis estimates that vehicle program costs will be approximately \$113 million per year between 2018 and 2020. Alternative 4 would drive significant additional stringency into the 2024 MY, which would require greater investment over the same time period. This would further undermine the cost estimate in the NPRM and would drive significant price increases in MY2021 and MY 2024 as manufacturers struggled to meet the accelerated time table. [EPA-HQ-OAR-2014-0827-1199-A1 p.18]

**Organization:** Navistar, Inc.

The NPRM proposes three tiers of emission standards in 2021, 2024 and 2027. However, as we note, the engines actually need to be developed over a year before to the vehicle. As a result, the rule envisions a near constant state of development for nine years in order to meet the regulatory requirements. That is if only GHG rules apply. If future NOx, OBD or other rules also come into play, the complexity increases well beyond even that in this Proposed Rule. Notwithstanding, given the aggressive nature of the standards, we think the three tier approach is the minimal lead time that will be required. At the very least, the agencies also must consider the cumulative impact of potential regulations on feasibility and costs. However, we see little indication that this has been considered in the NPRM. [EPA-HQ-OAR-2014-0827-1199-A1 p.9]

As a result of the Proposed Rule, then, there is a significant risk that the industry will be in nearly continuous development from 2019 through 2027. The result of this complexity will be added costs, including as a result of aggressive timeframes and constricted validation periods between product launches. From a customer's perspective, there may be additional costs and also potentially additional

down time as new technologies come on continuously for a 17 year period. [EPA-HQ-OAR-2014-0827-1199-A1 p.9]

We also like to point out that phase 1 is not fully even mature, having only become mandatory beginning in MY2014. That is only about 21 months ago and there is over a year until the final tier of Phase 1 in MY2017. Therefore, this represents a very aggressive regulatory pace, with new Proposed Rule adding a tremendous amount of added complexity. Also, as a result, the Proposed Rule has had little chance to learn from the experience that will be gained from full implementation of Phase 1. [EPA-HQ-OAR-2014-0827-1199-A1 p.9]

The new emission standards adopted by Phase 1 should not be changed in this rule prior to the date the new emission standards go fully into effect. Not only is this an imperative of the Clean Air Act and the need for adequate notice, it is also key to feasibility and simple fairness. The proposal includes a modification to the wind-average drag calculation for model year 2018 (calendar 2017) and later vehicles.<sup>12</sup> This would impact the current Phase 1 certifications and adjust the aero bin down for many vehicle configurations. This reduction in the aero bin effectively lowers the Phase 1 emission standard. This would be inappropriate, arbitrary and capricious and should be stricken or modified to take effect in alignment with the MY2021 standard. We also fully agree with EMA comments on this issue. [EPA-HQ-OAR-2014-0827-1199-A1 p.9]

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12 40 C.F.R. Eq. 1037.525-6. This is a new equation applicable after MY2017, thus it will be used while Phase 1 is still in effect.

**Organization:** Triple Decker Transport Ltd.

Based on our first hand experiences with the 2004-10 diesel engine emission regulations I would URGE PATIENCE!!!! [EPA-HQ-OAR-2014-0827-0908-A1 p.1]

In ending I would PLEAD FOR PATIENCE!!! We cannot go thru an expedited acceleration of regulations (as in the 2004-2010 diesel engine emission regulations) WITHOUT proper testing of the new technologies. So please choose Alternative 3. [EPA-HQ-OAR-2014-0827-0908-A1 p.3]

**Organization:** Walsh, Michael and Charlton, Stephen

1. Retain the current phase-in schedule, while increasing stringency in 2021 and 2024 proportional with the final step proposed in bullet 1 above:

|  |                       |                    |
|--|-----------------------|--------------------|
| <b>MY 2024-2026 HD Tractor Engines</b>                                   | <b>405 gCO2/HP-hr</b> | <b>(48.5% BTE)</b> |
| <b>MY 2021-2023 HD Tractor Engines</b><br>[NHTSA-2014-0132-0102-A1 p.10] | <b>435 gCO2/HP-hr</b> | <b>(45.1% BTE)</b> |

**Response:**

The agencies noted in the proposal that the Phase 2 standards represent a more technology-forcing approach than the Phase 1 approach, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. 80 FR 40154. As such, we recognized that assuring

proper lead time would be very important and requested comment on this issue. Many commenters, including most non-governmental organizations, supported more stringent standards with less lead time. Vehicle manufacturers did not support more stringent standards and emphasized the importance of lead time. Although some technology and component suppliers supported more stringent standards, they also supported the proposed lead time. To the extent these commenters provided technical information to support their comments on stringency and lead time, it is discussed in Sections II through VI of the Preamble, and in Chapter 2 of the RIA. However, the vast majority of the comments summarized here addressed the issue of lead time from a broader view. This issue is addressed in more detail in Section 1.5 of this RTC.

### **8.3 Comments on the Baselines 1415**

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

#### **Greenhouse Gas and Fuel Consumption Impacts**

##### **Baseline**

The agencies request comment on their choice of baseline scenario (p.40166). To analyze the benefits of the proposed standards, the agencies compare the expected outcomes of the standards to those of two distinct baseline scenarios: the less dynamic baseline and the more dynamic baseline. The less dynamic baseline represents a reasonable attempt to incorporate the effects of existing policies (California Air Resources Board's Tractor-Trailer Greenhouse Gas regulation and EPA's SmartWay Transport Partnership) on box trailers' adoption of aerodynamic technologies and low rolling resistance tires (RIA p.5-12). However, the more dynamic baseline relies on the assumption that pickups and vans and tractor technologies that pay back within the first six months of ownership will be taken up in the market (p.40492 and RIA p.5-12). This is an arbitrary assumption. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

In general, assumptions regarding the trajectory of fuel efficiency in the absence of standards are necessarily highly speculative, given the many complex factors that can produce rising or falling fuel efficiency over time. The agencies' assumption in earlier fuel efficiency rulemakings of constant fuel efficiency in the baseline scenario best maintains the transparency of the analysis. [EPA-HQ-OAR-2014-0827-1280-A1 p.26]

*Recommendation: Baseline*

- Assume flat fuel efficiency in the baseline scenario unless there is strong evidence that another assumption is more plausible. Alternative baseline assumptions are appropriate for a sensitivity analysis. [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

**Organization:** California Air Resources Board (CARB)

#### **Comment on Topic Where NPRM Requests Comment**

##### **Comment – Flat vs. dynamic baseline scenario**

The NPRM requests comment regarding which alternative baseline scenario is most appropriate (flat baseline scenario vs. dynamic baseline scenario). Historically, for modeling and emission projection purposes, CARB staff assumes manufacturers would not go beyond regulations' requirements except

where we have data that shows otherwise. CARB staff does not have data that suggests that manufacturers, in the absence of further, stricter standards, would make vehicles more fuel efficient than required by the Phase 1 standards. As a result, our EMFAC 2014 emissions inventory database does not project fuel economy improvements or CO2 emission rate reductions beyond what is required by Phase 1, and CARB staff has been using a flat baseline for our Phase 2 emissions analysis. In the absence of certainty regarding how manufacturers would behave if no Phase 2 program were adopted, CARB staff believes the approach taken in the NPRM and RIA to examine both a less dynamic and more dynamic baseline is valid and reasonable. [EPA-HQ-OAR-2014-0827-1265-A1 p.132]

**Organization:** Center for Biological Diversity

The Proposed Rule omits any comparison with emission levels in 1990, the internationally agreed-upon emission baseline year. That omission must be corrected, as the effect of the rulemaking on the climate problem would otherwise remain opaque rather than transparent. Reductions from business as usual are meaningful only in context, and that context has not been supplied. Crucially, CO2 emissions from heavy-duty vehicles increased 71 percent between 1990 and 2013 and constituted over 7 percent of all US greenhouse gas emissions,<sup>3</sup> highlighting the importance of reducing greenhouse gas emissions from this sector to the maximal extent possible. The goal of the rulemaking must be not only to do better than Phase I, but to also actually drive down overall emissions as quickly as possible. [EPA-HQ-OAR-2014-0827-1460-A1 p.2]

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<sup>3</sup> US EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990 – 2013 3-19 (Apr. 15, 2015).

**Organization:** Daimler Trucks North America LLC

**Real-World Adoption Rate of Technologies** – The agencies request comment on their hypotheses about the causes of slow adoption of readily available and apparently cost-effective technologies for improving fuel efficiency. HDV owners have limited capital to spend on new vehicles, plus they need reliable equipment so that they do not suffer breakdowns while trying to operate. These owners typically decide whether to buy a new technology based on the change in price of a truck, change in fuel economy, payback, current economic cycle and outlook, profitability, used equipment values, credit availability, and regulatory awareness. Only some of these concerns are captured in the agencies’ conceptual framework. Many of the factors to slow adoption of new technologies discussed in the reference cited by EPA. See Klemick, Heather, Elizabeth Kopits, Keith Sargent, and Ann Wolverton (2014). “Heavy-Duty Trucking and the Energy Efficiency Paradox.” US EPA NCEE Working Paper Series, Working Paper 1402. Slow adoption can be traced back to customers’ experiences with the rollout of EPA 2004/2007/2010 emission standards which created many issues including: reliability issues, downtime, increased maintenance – all of which caused missed and late loads and driver dissatisfaction. Customers’ experiences taught them to be cautious, especially smaller operators. EPA needs to carefully research customer experiences from these earlier regulations to understand the motivation of customers and the consequences of mandating new standards that could have the same effects. [EPA-HQ-OAR-2014-0827-1164-A1 p.87]

**Ref. Case against which Costs and Benefits are calculated** – The agencies request comment on which alternative baseline scenarios would be most appropriate for analysis in the final rule. 80 FR 40166. While DTNA appreciates that EPA attempted to take a thorough and comprehensive look at analyzing the baseline, in order to more easily understand the multiple approaches to “No Action” for tractors, a

table summarizing the details of the assumptions would be appropriate and helpful. Regarding the assumptions made in developing the different baseline scenarios, first of all, DTNA appreciates that the agencies' recognition of how we have focused on fuel economy improvements in the past. However, judging our industry's success based on pre-Phase 1 market conditions is not the appropriate baseline by which to measure due to the extraordinary increase in the price of trucks around that time due to other EPA regulations. In 2011, when the agencies were promulgating Phase 1, trucks had just finished undergoing a [redacted]% increase in price due largely to emissions regulations. In addition, having undergone earlier experiences with downtime and increased maintenance due to similar emissions regulations in 2004 and 2007, customers were on "high alert" with regards to new technology likely contributing to their "slow" process to assess technologies and adopt them. In addition, during this time truckers were experiencing poor profitability, weak freight, and limited access to credit made worse by the recent end of a major recession, limiting their ability to spend more on fuel efficiency technologies given the three year [redacted]% increase in the price of criteria emission technologies required to meet emission standards. EPA2010 emissions standards, which essentially forced the use of SCR, resulted in recovering some of the fuel efficiency gains lost due to earlier EPA NOx rules. So SCR could be viewed as one of the most expensive fuel efficiency technologies adopted by customers. While fuel efficiency gains from SCR were not enough to get similar efficiency to pre-2004 model year vehicles, the gains were an improvement over 2007 performance (DTNA can provide information about this in a confidential setting). Given the complexities surrounding customer decisions, it does not seem appropriate to simply use a 6-month payback period as a proxy for all of these considerations. Rather, the agencies should investigate the effects of the high costs of criteria pollutant standards on customer decisions within this industry and within this timeframe to determine a more accurate picture of customer behavior absent regulation, to better understand whether or not customers truly were just not rejecting fuel efficient technologies, and to better estimate the baseline technology market penetration assumptions. [EPA-HQ-OAR-2014-0827-1164-A1 p.130]

Further, DTNA does not agree that while the agencies estimated the cost and efficacy of fuel efficiency technologies that performance and utility should have been held constant, and that payload should have been modeled as being preserved. If low rolling resistance tires were required to be on vehicles that, for example, go off-road a majority of the time, utility will be lost. If heavy technologies, such as battery APUs are required as a result of stringency, payload will likely be lost. The agencies seem to rely heavily on the concept that absent regulation, fuel efficiency will remain stagnant as manufacturers simply trade ever cheaper fuel efficiency technologies to maintain a certain level of efficiency and work to reduce cost. While there is an economic efficiency in reducing cost by choosing or not choosing certain technologies, and replacing certain technologies (e.g. predictive cruise control capturing some the benefit that hybrid technology would have, as discussed with our Super Truck comments in the Hybrid and ePTO section of our Technology Penetration Rate discussion, above) this does change the historic demand of our customers to continually improve their total cost of operations. [EPA-HQ-OAR-2014-0827-1164-A1 p.130-131]

**Organization:** Gilroy, JD

A second reservation is about future extensions of these standards. Should there be any declarations now in the standards of longer-term goals in fuel efficiency? These standards may well succeed in reducing fuel usage and corresponding pollution to near 2010 levels, but we emitted a huge amount of pollution in 2010. [EPA-HQ-OAR-2014-0827-0751 p.2]

**Organization:** He, Leard, McConnell

Heavy-duty trucks are an increasingly important source of greenhouse gas emissions in the transportation sector. In 2011, U.S. Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) announced the final rule of Phase 1 fuel economy standards for medium and heavy-duty vehicles with model year from 2014 to 2018. The second phase of the regulations call for reduction in fuel consumption (gallons of fuel/1,000 ton payload mile) by 24% for combination tractors and 16% for vocational vehicles from 2018 to 2027. This is equivalent to about 3.09% and 1.96% per year improvement in fuel economy for combination trucks and vocational vehicles respectively. How challenging will such fuel economy improvements be? There is little information about fuel economy from trucks – it is not reported at the time of truck sale or during operation. One important source of data, the Vehicle Inventory and Use Survey (VIUS), a random sample of the truck fleet in the U.S., provides valuable evidence about fuel economy of different types of trucks and how fuel economy has changed over time. This study looks at the evidence about fuel economy and other truck attributes from this survey, and provides implications for a dynamic baseline of improvements in fuel economy. [NHTSA-2014-0132-0115-A1 p.1-2]

We find that the annual rate of technological progress from 1973 to 2002 is about 0.93% for combination trucks, and 0.83% for vocational vehicles. That is to say, absent of regulations, we can expect a business-as-usual improvement in fuel economy by 8.71% for combination trucks and 7.70% for vocational vehicles in 10 years. [NHTSA-2014-0132-0115-A1 p.2]

Additional improvements in truck fuel economy may be made through vehicle design changes. Most forms of aerodynamic designs are used to reduce drag, minimize noise emission and prevent undesired lift forces. Tires with less rolling resistance, such as radial tires, can also improve fuel efficiency. Various onboard idle reduction equipment help shorten idle time at truck stops, terminals and delivery sites, and therefore reduce energy loss. Other technologies include (but are not limited to) electrification of accessories, reducing frictions in bearings, valve trains, and the piston-to-liner interface. [NHTSA-2014-0132-0115-A1 p.2-3]

Theoretically, the trade-off relationship between MPG and truck attributes, can be illustrated as follows (take MPG and weight for example). As Figure 1 shows, the tradeoff between MPG and vehicle weight is a downward sloping curve. The exogenous technological advances introduced in section 2.1 push the production curve upward. If vehicle weight remains the same, fuel economy is improved as technological progress occurs. [NHTSA-2014-0132-0115-A1 p.3-4]

[Figure 1, 'Theoretical illustration: trade-off between MPG and vehicle weight', can be found on p.4 of docket number NHTSA-2014-0132-0115-A1]

### **3 Data and Graphical Evidence**

The Vehicle Inventory and Use Survey was conducted by the Census Bureau from 1963 to 2002. We use data collected every five years from 1982 to 2002. Random samples are generated for every state, with surveys asking for detailed information about trucks' physical and operational characteristics. [NHTSA-2014-0132-0115-A1 p.4]

The trade-off relationship between MPG and vehicle weight (including cargo), as well as between MPG and engine displacement, for combination trucks can be illustrated in the two graphs below. [NHTSA-2014-0132-0115-A1 p.4]



[Figure 2, 'Trade-off between MPG and vehicle weight for class 7, 8 combination trucks', and 3, 'Trade-off between MPG and engine displacement for class 7, 8 combination trucks', can be found on p.5 of docket number NHTSA-2014-0132-0115-A1]

## 5 Policy Implication and Conclusion

In this study, we examine the trade-off relationship between fuel economy and vehicle attributes (weight and engine displacement, in particular). We also explore a dynamic baseline in fuel economy improvements by estimating the technological progress in the absence of regulations. We find that technological progress in MPG for combination trucks is about 30.87% from 1973 to 2002. It can be translated to 23.59% reduction in fuel consumption (gallons/1,000 ton payload mile). The annual rate is about 0.92%. If the progress of business-as-usual stays the same, from 2018 to 2027, approximately 8.01% reduction in fuel consumption can be expected, even without regulation. While the proposed rule calls for a 20% reduction, the remaining 11.99% will have to come from either more technological advances or changes in trade-off attributes, such as vehicle weight and engine power. For vocational vehicles, the technological progress in MPG is about 27% within 30 years, equating to a 21.26% reduction in fuel consumption. If technological advances remain the same from 2018 to 2027, fuel consumption will be reduced by 7.15%, just under half of the target.

Our findings suggest that it is important to count for the business-as-usual technological progress in improving fuel economy as analyzing the impacts of the new fuel efficiency standards for heavy-duty trucks. We recommend the agencies to consider such dynamic baseline in the final rule of phase 2 standards, as ignoring it may result in an overestimation of both the cost of the regulation, as well as the fuel consumption savings and greenhouse gas emissions reductions due to the new rules.

**Organization:** International Council on Clean Transportation (ICCT)

### Market factors

Available data and historical trends indicate the agencies include a flat reference truck efficiency baseline, with the sole exception of improvements in trailers that are linked to California's regulations that affect trailers. The agencies' continued consideration of fleet-wide vehicle efficiency improvements in the absence of new regulatory standards is unwarranted. The ICCT has supported many governments around the world in collecting and analyzing data. Based on our work to date, although technology improves and fleet-level efficiency improvements occur, there is no evidence to support the assumption of a new sales-fleet-averaged heavy-duty vehicle fleet CO<sub>2</sub> or fuel consumption reduction in the absence of regulations. In the case of analyzing the impact of the Phase 2 standards, including reference trailer improvements that are linked to the California regulations on trailer efficiency devices is warranted; however, otherwise retaining flat efficiency characteristics for all engines, trucks, and tractors for scenarios would best reflect the evidence on historical trends in the U.S. [EPA-HQ-OAR-2014-0827-1180-A4 p.17]

There are pervasive market barriers in the market, that have long prevented the uptake of even technologies with very attractive payback periods—for example, 6 months up to 2 years (see, e.g., Vernon and Meier, 2012; Roeth et al, 2013). Routinely, just small fractions of the fleet – a handful of technology-leading companies, representing a small fraction of the fleet, adopt technologies. The agencies consideration of technology adoption based on precise payback periods in the absence of regulation does not appear to be based on any empirical analysis of fleet-wide shifts. [EPA-HQ-OAR-2014-0827-1180-A4 p.17-18]

**Organization:** Natural Resources Defense Council (NRDC)

### **Technology and Cost Analyses Should Use Less Dynamic Baseline**

The agencies should compare the costs and benefits of new standards to a baseline of new vehicles that show little or no fuel efficiency or emissions improvements in the absence of the new standards. A more dynamic baseline should not be used as a basis for setting standards. NRDC believes that it is the existence of fuel consumption and carbon pollution standards that will cause manufacturers to invest and deploy significant amounts of fuel efficiency and low emissions technology. The Energy Information Administration shows that the heavy truck fleet showed almost no fuel efficiency improvements during years without efficiency standards. From 1966 to 2006 the average year-over-year improvement for heavy trucks was 0.2 percent and from 2007 to 2013 the improvement rate was 0.0 percent.<sup>22</sup> [EPA-HQ-OAR-2014-0827-1220-A1 p.9]

In the Executive Summary of the proposal, the agencies summarize the proposed rule impacts on fuel consumption, GHG emissions, benefits and costs as a range defined by the less and more dynamic baselines. The Executive Summary presentation leaves the impression that the two baselines are equally probable. NRDC disagrees; the Executive Summary and main analysis should utilize the less dynamic baseline. The more dynamic baseline should be constrained to a sensitivity analysis. [EPA-HQ-OAR-2014-0827-1220-A1 p.10]

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22 Improvement rates are calculated over two date ranges because of changes in the types of trucks included in the data. Data is from Energy Information Administration, *Monthly Energy Review*, Table 1.8 Motor Vehicle Mileage, Fuel Consumption, and Fuel Economy. Viewed September 28, 2015.

**Organization:** Sierra Club

### **Accurately consider market forces**

We urge the agencies not to consider fleet-wide efficiency improvements in the absence of new standards. Although small segments of the fleet do adopt fuel saving technologies, there are entrenched market barriers that have prevented the adoption of many fuel saving technologies, even those that have quick payback periods. According to organizations such as the International Council on Clean Transportation, evidence does not support the assumption that fleet oil consumption and carbon pollution would decrease without regulations. [EPA-HQ-OAR-2014-0827-1277-A1 p.3]

### **Response:**

The No Action Alternatives for today's analysis, alternatively referred to as the "baselines" or "reference cases," assume that the agencies did not issue new rules regarding MD/HD fuel efficiency and GHG emissions. These are the baselines against which costs and benefits for these standards are calculated. The reference cases assume that model year 2018 engine, tractor, vocational vehicle, and HD pickup and van standards will be extended indefinitely and without change. They also assume that no new standards would be adopted for trailers.

NHTSA considered its primary analysis to be based on the dynamic baseline, where certain cost-effective technologies are assumed to be applied by manufacturers to improve fuel efficiency beyond

the Phase 1 requirements in the absence of new Phase 2 standards. EPA considered both reference cases. The results for all of the regulatory alternatives relative to both reference cases, derived via the same methodologies discussed in this section, are presented in Section X of the FRM.

Some commenters expressed support for a flat baseline in the context of the need for the regulations, arguing that little improvement would occur without the regulations. Others supported the less dynamic baseline because they believe it more fully captures the costs. Some commenters thought it reasonable that the agencies consider both baselines given the uncertainty in this area. No commenters opposed the consideration of both baselines, although some argued that assuming a dynamic baseline is unrealistic or should be limited to a sensitivity analysis.

Although commenters were more supportive of using a flat baseline, the agencies have continued to analyze two different baselines for the final rules because we recognize that there are a number of factors that create uncertainty in projecting a baseline against which to compare the future effects of this action and the remaining alternatives. The composition of the future fleet—such as the relative position of individual manufacturers and the mix of products they each offer—cannot be predicted with certainty at this time. Having parallel baselines from which to analyze is one reasonable way to account for this unavoidable uncertainty.

Significantly, we note that the both reference cases lead us to the same conclusions, although using a dynamic reference cases results in somewhat lower values for both cost and benefits. This is because costs, benefits, and cost-effectiveness were not significantly limiting factors in determining the stringency of the standards for this rulemaking. Rather, we found that actual technological feasibility and lead time to be the more limiting factors.

While we understand the Center for Biological Diversity comment regarding comparison with emission levels in 1990, we do not believe that is the appropriate baseline for this rulemaking context.

## **8.4 Comments on Alternative 2 1421**

**Organization:** Association for the Work Truck Industry (NTEA)

### **Fuel Efficiency Payback**

The NTEA requests that standards similar to those described as “Alternative 2” be considered for the vocational truck segment. [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

With regard to Alternative 3, in 2027 when the standard is fully phased in, heavy-duty vehicles across all classes would achieve up to the following CO2 emissions and fuel use reductions.

- 24 percent for combination tractors designed to pull trailers and move freight when compared to Phase 1 standards
- 8 percent for trailers when compared to an average model year 2017 trailers
- 16 percent for pick-up trucks and light vans when compared to Phase 1 standards [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

Further, the proposal calculates figures for expected payback periods based on the additional costs associated with the proposed standards and the economic savings based on the increased fuel efficiency

expected with Alternative 3. The proposal estimates “Reasonable Payback Periods for the Trucking Industry In model year 2027,” for the buyer of a new vehicle. The notice states that the buyer would recoup the extra cost of technology used to achieve the standard (Alternative 3) within:

- 2 years for a tractor/trailer combo
- 3 years for pick-ups and vans

The expected payback periods for tractor/trailer combinations and pick-ups/vans seems reasonable. Most companies would look towards a 2-3 year payback period for moderate fuel efficiency gains. [EPA-HQ-OAR-2014-0827-1187-A1 p.4]

### Regulatory Burden Equity

According to the proposal, the overall transportation sector is responsible for 70% of oil consumption and 28% of GHG emissions. By 2010 all medium and heavy duty vehicles were responsible for 23% of the total transportation sector fuel consumption and GHG emissions. [EPA-HQ-OAR-2014-0827-1187-A1 p.4]

Of these transportation sector totals, combination tractors were responsible for two-thirds of the overall MDV and HDV fuel consumption and GHG emissions. Vocational trucks were responsible for only 20%. Yet, the proposed rules would set standards such that combination tractor owners would see a payback on the additional regulatory costs of 2-3 years. Owners of vocational trucks would be burdened with a 6 year payback. [EPA-HQ-OAR-2014-0827-1187-A1 p.4]

The NTEA respectfully suggests that the agencies consider standards more in line with Alternative 2 for the vocational truck segment. The proposed standards (Alternative 3) place an unfair burden on this segment of the vehicle population in relation to the other regulated segments (tractor/trailer combinations and pickups and vans). [EPA-HQ-OAR-2014-0827-1187-A1 p.4]

Per the notice, Alternative 2 represents a stringency level which is approximately half as stringent overall as the “preferred” alternative (3). The agencies developed Alternative 2 to reflect a continuation of the Phase 1 approach of applying off-the-shelf technologies rather than requiring the development of new technologies or fundamental improvements to existing technologies. [EPA-HQ-OAR-2014-0827-1187-A1 p.4-5]

The agencies project that the Alternative 2 vocational vehicle standard could be met with lower adoption rates of the other technologies that could be used to meet Alternative 3. [EPA-HQ-OAR-2014-0827-1187-A1 p.5]

**Organization:** Daimler Trucks North America LLC

Regarding Alternative 2, while the agencies immediately dismiss it as being faulty as both a matter of policy and of law, given the number of factors currently in the preferred approach that actually make the rule nearly twice as stringent as designed, Alternative 2 should be reconsidered if these other technical issues are not corrected. For example, it is estimated that due to baseline errors, elimination of compliance margins, and regulatory trailer specifications, that the reduction required from linehaul approaches 50% - in which case Alternative 2 would actually provide the agencies with the reductions claimed by the rule for linehaul. In addition, Alternative 2 should be adopted in part for vocational

vehicles as the current program for vocational vehicles under the preferred approach is not tenable. As the agencies mention – Alternative 2 could be met without the use of strong hybrids, a technology that is extremely expensive and highly likely to create market disruptions. A more realistic approach is to adopt Alternative 2, in particular for vocational vehicles and include an ‘advanced credit’ similar to that under Phase 1 to encourage the hybrid market to recover as currently there is no hybrid market (see our discussion of hybrids in the “Vocational Vehicle Stringency” section of this document). [EPA-HQ-OAR-2014-0827-1164-A1 p.73]

Further, we do not understand why it is estimated that technology effectiveness would be lower under Alternative 2 than Alternative 3. We request that the agencies provide an explanation. It is not readily apparent why technologies in use today and under develop would erode in efficiency gains due to adoption of Alternative 2 as opposed to the preferred approach. In addition, the agencies have assumed that Alternative 2 would involve less integrated optimization for linehaul vehicles and engines. There has been a fundamental shift by truck manufacturers to optimize fuel efficiency to focus not on discreet components but instead look at the complete vehicle and operations, as this is where remaining gains are available. Based on what data and information is this assumption made? Please provide details. [EPA-HQ-OAR-2014-0827-1164-A1 p.74]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

OOIDA recommends that the agencies do not so easily disregard Alternative 2. According to the NPRM, Alternative 2 represents a stringency level which is approximately half as stringent overall as the preferred alternative. The agencies developed Alternative 2 to consider a continuation of the Phase 1 approach of applying off-the-shelf technologies rather than requiring the development of new technologies or fundamental improvements to existing technologies. For tractors and vocational vehicles, this also involved less integrated optimization of the vehicles and engines. Put another way, Alternative 2 is not technology-forcing. The agencies’ decisions regarding which technologies could be applied to comply with Alternative 2 considered not only the use of off-the shelf technologies, but also considered other factors as well, such as how broadly certain technologies fit in-use applications and regulatory structure. The resulting Alternative 2 could be met with most of the same technologies the agencies project could be used to meet the proposed standards, although at lower application rates. Alternative 2 is estimated to be achievable without the application of some technologies, at any level. [EPA-HQ-OAR-2014-0827-1244-A1 p.37]

Nevertheless, the agencies stated that they are not proposing Alternative 2 because they do not believe that it represents the “maximum feasible improvement” within the meaning of 49 U.S.C. 32902(k)(2). However, OOIDA would argue that Alternative 2 is the “maximum feasible improvement” because it does not force technologies that could be harmful to consumers or to the market. In addition, while the some of the adoption rates for the various technologies are still too high, such as for the APU estimate, overall this Alternative is far more realistic. [EPA-HQ-OAR-2014-0827-1244-A1 p.38]

**Response:**

As noted in Section X of the FRM Preamble, the agencies are not adopting standards reflecting Alternative 2 for reasons of both policy and law. Technically feasible alternate standards are available that provide for greater emission reductions and reduced fuel consumption than provided under Alternative 2. These more stringent standards, which are being adopted, are feasible at reasonable cost, considering both per-vehicle and per-engine cost, cost-effectiveness, direct benefits to consumers in the form of fuel savings, and lead time. Consequently, the agencies do not believe that the modest

improvements in Alternative 2 would be appropriate or otherwise reasonable under section 202 (a) (1) and (2) of the Clean Air Act, or represent the “maximum feasible improvement” within the meaning of 49 U.S.C. 32902(k)(2).

Central to this conclusion is the conclusion that the final standards are feasible and appropriate. Comments related to this conclusion are addressed in Sections 3 through 7 of this RTC and Chapter 2 of the RIA.

## **8.5 Comments on Alternative 5 1424**

**Organization:** Daimler Trucks North America LLC

Regarding Alternative 5, DTNA agrees that this is too stringent to be feasible. [EPA-HQ-OAR-2014-0827-1164-A1 p.74]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

OOIDA proposes that agencies’ preferred alternative, Alternative 3, as well as Alternatives 4 and 5, are unrealistic and if adopted as part of this rulemaking process, will severely compromise the agencies’ praiseworthy objectives to increase the fuel efficiency of medium-and heavy-duty trucks and reduce GHG emissions. Truck drivers certainly desire fuel efficient trucks and appreciate cleaner air to breathe. While various governmental agencies and environmental groups tend to paint owner-operators as individuals who do not care about the environment, nothing could be further from the truth. It is crucial to understand that owner-operators are not only hardworking Americans who help to move our economy, but that they also spend a majority of their life around tractor-trailers. Therefore, it is in their best interest, as well as in the interest of the public, to operate clean and efficient trucks. [EPA-HQ-OAR-2014-0827-1244-A1 p.36-37]

### **Response:**

We agree that Alternative 5 is not feasible. We are not adopting Alternative 5 because we cannot project that manufacturers can develop and introduce in sufficient quantities the technologies that could be used to meet Alternative 5 standards. Some examples of technology adoption rates that were used in Alternative 5 for MY 2024 that the agencies do not believe are feasible include the following:

- Up to 66% adoption rate of strong hybrids for gasoline HD pickups
- 40% adoption rate of strong hybrids in tractors
- Up to 3% electric vehicles plus 36% adoption rate of strong hybrids in some vocational vehicle subcategories

## 9 Aggregate GHG, Fuel Consumption, and Climate Impacts

### 9.1 General Comments

#### 9.1.1 1425MOVES Model 1425

**Organization:** Recreational Vehicle Industry Association (RVIA)

##### c. Motorhome VMT

In assessing the impact of this rule, RVIA commissioned Statistical Surveys, Inc. to collect vehicle miles travelled (VMT) data for motorhomes. In carrying out this analysis, Statistical Surveys, Inc. used data from IHS Inc., a well-known source of information on the automotive industry, to review odometer readings of three year old motorhomes sold in calendar years, 2012-2014. Using readings from 987 motorhomes, Statistical Surveys found that the average VMT for motorhomes was 4,290 and that the median VMT was 3,042.<sup>5</sup> Thus, for the current analysis, EPA should use the more accurate figure of an annual 4,290 VMT for motorhomes, but, given the lower median, even that number is likely conservative. For additional details on the motorhome VMT work carried out by Statistical Surveys, Inc. see Appendix A. [EPA-HQ-OAR-2014-0827-1261-A1 p.8][This comment can also be found in section 6.3 of this comment summary]

Because motorhomes are used primarily for camping and recreation purposes, they are relatively under-driven compared to other vehicles. They are typically driven from Point A to Point B (*e.g.*, a family residence to a campground or event) via interstate highways and other rural roads. Average motorhome use is 27.5 days per year.<sup>8</sup> Many use days are spent in the stationary mode at a campground. [EPA-HQ-OAR-2014-0827-1261-A1 p.9]

EPA should use a more accurate though still very conservative VMT figure of 4,290 miles in its calculations and determine more accurate and specific payback periods for motorhomes under the Proposed Rules, using more accurate ICMs and scenarios (*i.e.*, Scenario 4 as set forth VI.b). Doing so will demonstrate the payback periods are significantly longer than for other vocational and regulated vehicles under the Proposed Rules -- even longer than average years of ownership in nearly all circumstances -- and thereby do not provide consumers with a significant benefit. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

EPA should also recognize that the more realistic low-level production and low VMT, as well as episodic use of motorhomes, would result in fewer emission reductions relative to other vocational and other regulated vehicles. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

#### **Response:**

The commenter suggested using an average annual VMT of 4,920 for motorhomes. Also, the analysis by the commenter based on the IHS data suggested that the actual VMT might even be lower. The modified version of MOVES2014a used in the final rulemaking projects that the annual mileage traveled by new motorhomes is less than 2,200 miles in calendar year 2011. The annual mileage tends to decrease for all motor homes in future years, especially for older motorhomes. Therefore, we believe the assumptions of annual motorhome VMT in MOVES is consistent with the finding by Statistical Surveys, Inc.

The decision-making regarding the final standards for each vehicle category were based on the need to decrease GHG emissions and fuel consumption, along with the projected maximum feasible technology – considering technology costs and requisite lead time consistent with the requirements of the CAA and EISA. Metrics related to cost effectiveness were not limiting the agencies from determining the standards. We note that this rule is not being finalized with the motivation to provide operators with a specific payback period. We present paybacks estimates in order to provide information regarding one aspect of the potential effect of the standards on the user community.

**Organization:** Vehicle Industry Association (RVIA)

### **EPA's motorhome MOVES model forecast for motorhomes in unrealistic**

In the Proposed Rule, it is stated that, according to the MOVES model forecast, there will be approximately 90,000 recreational vehicles manufactured for MY 2018. For motorhome sales to reach 90,000 by MY2018, shipments would need to increase 20% per year. Although sales have increased significantly over the past five years, this was largely a function of post-recession recovery. The annual growth rates since the recession have not been representative of historic shipment trends. When examining historic sales trends for the 20 years preceding the recession, shipments averaged slightly under 60,000 units per year. From 1991 to 1999, a period of steady growth, shipments went from 41,948 to 71,514, an annual average increase of 6.9%. A second growth period occurred from 2001 to 2004 when shipments went from 49,207 to 71,633, an average growth rate of 13.3%. Based on this history, the idea that the industry will go from 44,000 shipments in 2014 to 90,000 shipments in 2018 is unsupported and unlikely. EPA's conclusion is further unrealistic in view of the projected decrease in production we estimate arising from the Proposed Rules. [EPA-HQ-OAR-2014-0827-1261-A1 p.25]

Even if a rather optimistic annual 10% motorhome shipment growth rate for the next four years were to be presumed, shipments would not exceed 65,000 units. Though also optimistic, this is a far more realistic estimate than the 90,000 figure used in the Proposed Rules. It is also conservative since it would still not account for production lowered by application of the Proposed Rules. In modeling motorhome emissions, EPA should at maximum project motorhome shipments to not exceed 65,000 for MY2018. [EPA-HQ-OAR-2014-0827-1261-A1 p.25]

We note that by using the more appropriate shipment estimates discussed above, GHG emissions projected by EPA for motorhomes will be only 2/3 of that projected by EPA, and therefore, the corresponding emission decreases from the Proposed Rule will be significantly less than predicted by EPA, further showing that the Proposed Rules are not reasonable for the motorhome sector. [EPA-HQ-OAR-2014-0827-1261-A1 p.25-26]

[Chart, 'motorhome shipments by year', can be found on p.26 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

EPA should use a more accurate estimate of annual production volume of motorhomes for use in its MOVES model forecast. The 90,000 figure used is overly optimistic and is not consistent with recent data. 65,000 vehicles is a more accurate though still optimistic estimate. [EPA-HQ-OAR-2014-0827-1261-A1 p.28]

### **Response:**

In the version of MOVES used for the notice of proposed rulemaking analysis, MOVES2014, the vehicle population in 2011 is considered a base year population. MOVES2014 estimates motorhome



population of slightly less than 1.5 million in 2011.<sup>199</sup> A study by the Survey Research Center estimated that there were over 2.1 million motorhomes in 2011.<sup>200</sup> The National Household Transportation Survey in 2009 estimated that there were just under 1.1 million motorhomes in 2009.<sup>201</sup> Therefore, we believe the base year population of motorhomes in MOVES falls within the range of estimates obtained from third-party data. MOVES then forecasts the sales and future year populations by applying the year-to-year growth rates of VMT from U.S. Energy Information Administration's Annual Energy Outlook (AEO) to the base year population – AEO2014 was used for the NPRM and AEO2015 was used for the FRM.

We agree that the MOVES estimates for population growth and sales of motorhomes may be considered aggressive compared to the motorhome sales data provided by RVIA. However, given the lack of available data to update MOVES, we believe relying on AEO projections for assumptions of sales and growth projections for motorhomes is justified. Furthermore, we believe the impacts of different sales projections on GHG reductions from the rule are minimal since it is estimated that the difference in model year lifetime GHG reductions of Phase 2 projected by MOVES and the one projected by using the motorhome shipment estimates suggested by RVIA above is less than 1 million metric tons of CO<sub>2</sub>eq, 0.1% of the reductions from the heavy-duty sector.

## 9.2 Projected Reductions in Fuel Consumption and GHG Emissions<sup>1427</sup>

**Organization:** California Air Resources Board (CARB)

Alternative 4 vs. Alternative 3 Emission Benefits

This comment provides an overview of the emissions benefits from the proposed regulation in California. Trucking operations in California differ substantially from the national average. Trucks that are operated primarily in California are retained by fleets longer than the national average.<sup>8</sup> In addition, the California trucking market is segmented, with national, regional and local fleets all competing in different segments of the goods movement economy; and hence it has a lower fraction of long-haul freight truck traffic as compared to national truck activity.<sup>9</sup> This leads to a different vehicle fleet mix, vehicle age, and vehicle miles traveled (VMT) profiles than the national average. California's emissions model, EMFAC2014 (v1.0.7), reflects these California-specific factors, and is used to estimate the GHG emissions impact of the proposed rule as applied to medium and heavy-duty vehicles operating in California. [EPA-HQ-OAR-2014-0827-1265-A1 p.21-22]

[Figure 1, 'Statewide On-Road GHG Emissions (Normalized to 2020 as a Baseline year) from Phase 2 Regulated Vehicles: without Regulation (Baseline including CARB Tractor-Trailer Regulation), with the Phase 1 Regulation, and with the Alternative 3 of Phase 2 Regulation', can be found on p.22 of EPA-HQ-OAR-2014-0827-1265-A1]

Using the model year (MY) specific percent reductions in CO<sub>2</sub> emission rates, staff assessed the emissions impact of the proposed regulation under both alternative 3 and 4 scenarios. Figure 1 shows

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<sup>199</sup> US EPA, *Population and Activity of On-road Vehicles in MOVES2014*, EPA-420-R-16-003a, Ann Arbor, MI: March 2016, <https://www3.epa.gov/otaq/models/moves/documents/420r16003a.pdf>.

<sup>200</sup> Curtin, R. T. *The RV Consumer in 2011*. Survey Research Center. University of Michigan Ann Arbor, MI. <https://data.sca.isr.umich.edu/fetchdoc.php?docid=49063>.

<sup>201</sup> U.S. Department of Transportation, Federal Highway Administration, 2009 National Household Travel Survey. URL: <http://nhts.omni.gov>.

the impact of the Phase 1 and Phase 2 (Alternative 3) regulations on GHG emissions from affected vehicles.<sup>10</sup> Results show a combined reduction of ~31percent in GHG emissions by 2050. Furthermore, staff analysis shows that as compared to alternative 3, alternative 4 would achieve an additional 4 MMT cumulative benefit in CO2 emissions by 2030 (Figure 2). If Alternative 4 is adopted, Phase 1 and 2 together would achieve approximately a 22 percent reduction in petroleum use from the medium- and heavy-duty sector in 2030. This reduction would be a first step towards reaching the California Governor's goal of up to a 50 percent reduction in petroleum use by 2030. As shown in Figure 1, due to the relatively fast growth of freight activity in California and at California ports (which handle roughly 40 percent of the nation's freight flow), GHG emissions from the regulated trucks will start increasing in 2035. Therefore, achieving California's mid- and long-term climate change targets will require additional steps such as broader use of renewable fuels, increasing use of zero-emission technologies, and increasing operational efficiencies. [EPA-HQ-OAR-2014-0827-1265-A1 p.22-23]

[Figure 2, 'Statewide Cumulative On-Road CO2 Emissions Benefit from the Alternative 3 and Alternative 4 of Phase 2 Regulation', can be found on p.23 of EPA-HQ-OAR-2014-0827-1265-A1]

**Response:**

Thank you for the comment. As shown in RIA Chapter 5, in terms of year-by-year GHG reductions, the final program is expected to reduce more GHGs over the long run than both the proposed program and Alternative 4. In general, the greater reductions can be attributed to increased market penetration and effectiveness of key technologies, based on new data and comments, leading to increases in stringency such as with the diesel engine standards.

**Organization:** California Air Resources Board (CARB)

**Neutral Comment to Provide Additional Information**

**Comment – GHG emissions reductions**

According to Table VII-13 of the NPRM, the annual downstream GHG emissions impact of the proposed regulation (preferred Alternative 3 vs. Alternative 1a baseline using Analysis Method A) in year 2050 is reported as ~134.9 MMT CO<sub>2</sub>eq (at the national level). In order to compare these federal emissions reductions estimates to a California-specific analysis, it is necessary to have estimates of the baseline emissions (baseline Alternatives 1a and 1b). However, the NPRM does not provide baseline information. [EPA-HQ-OAR-2014-0827-1265-A1 p.173]

Therefore, CARB staff encourages U.S. EPA and NHTSA to either provide estimates of GHG emissions (in MMT CO<sub>2</sub>eq) for baseline scenarios (Alternatives 1a and 1b), or report the benefits as a percent reduction from the baseline emissions similar to those provided in Section VIII of the NPRM for non-GHG emissions (e.g. Table VIII-7). [EPA-HQ-OAR-2014-0827-1265-A1 p.173]

**Response:**

Thank you for the comment. In the FRM, the annual greenhouse gas reductions from downstream and upstream are presented both in absolute tons and in percent reductions relative to the baselines.

6 Assembly Bill 32: Reduce GHG emissions to 1990 levels by 2020.; Executive order B-32-15: Reduce GHG Emissions to 40 percent below 1990 levels by 2030; Executive order S-21-09: Reduce GHG emissions to 80 percent below 1990 levels by 2050; Governor Brown’s inaugural address: Reduce petroleum use in cars and trucks in California by up to 50 percent by 2030

7 Assuming tractor meets baseline emission level of 88 g CO<sub>2</sub>/ton-mile; payload of 38,000 lbs; travels 120,000 miles/year over 6 year period (2024 to 2030).

<sup>8</sup> United States Census Bureau, “Vehicle Inventory and Use Survey (2002),” available at: <http://www.census.gov/svsd/www/vius/products.html>.

<sup>9</sup> Id.

<sup>10</sup> The affected EMFAC vehicle categories by Phase 1 and 2 regulations are heavy-duty trucks and buses exceeding 8,500 pounds GVWR.

**Organization:** California Air Resources Board (CARB)

### **Calculation of HFC emissions**

U.S. EPA and NHTSA are proposing to estimate refrigerant emissions from heavy-duty vehicles using the same emission rates for light-duty vehicles assumed in the Vintaging Model, consistent with the methodology in U.S. EPA and NHTSA’s heavy-duty Phase 1 GHG regulation. [EPA-HQ-OAR-2014-0827-1265-A1 p.146]

Heavy-duty vehicles are primarily used for commercial or industrial purposes, as opposed to light-duty vehicles, typically used for commuting or pleasure. For this reason, heavy-duty vehicles, and hence, their AC systems, operate much longer than light-duty vehicles. Longer operation of the AC systems leads to higher annual refrigerant leakage and may accelerate aging-related deterioration of refrigerant containment. Therefore, CARB staff encourages U.S. EPA and NHTSA to continue to evaluate refrigerant emission rates for heavy-duty vehicles, in order to improve the understanding of refrigerant emissions for this sector. CARB staff is willing to provide assistance in this regard. [EPA-HQ-OAR-2014-0827-1265-A1 p.146]

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<sup>53</sup> (Clodic, 2006) Clodic, D., Refrigerant MAC leakage, new evidences from the Armines / ACEA study. IEA Workshop, Cooling Car with Less Fuel. Paris, France, October 23 – 23, 2006. (Prölss et al., 2006) Prölss, K., Schmitz, G., Limperich, D., Braun, M., Influence of refrigerant charge variation on the performance of an automotive refrigeration system. Proceedings of the 2006 International Refrigeration and Air Conditioning Conference at Purdue. West Lafayette, Indiana, USA, July 17 - 20, 2006. (Huyghe, 2011) Huyghe, E. P., Impact of low refrigerant charge on energy consumption of the MAC system. SAE Automotive Refrigerant System Efficiency Symposium. Scottsdale, Arizona, USA, September 27 – 29, 2011.

### **Response:**

Thank you for your comment. As suggested, we plan to continue to evaluate the HFC emission inventories from heavy-duty vehicles and look forward to coordinating with CARB on these efforts.

**Organization:** Honeywell Fluorine Products

Studies have shown that leakage rates as expressed as a percentage of the initial charges show a range of 7.3 to 11.5 % (8.9 average) annually for heavy duty vehicles vs. generally 1.5 – 3% range for light duty vehicles.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1191-A1 p.3]

To properly account for leakage from AC units in HD vehicles, the scoring system must consider the significantly higher miles and heavier pounding these vehicles endure each year and over the life of the vehicle, as well as variation.<sup>5</sup> HD vehicles often have much higher annual mileage usage, in many cases over 100,000 miles per year and 1- 2 million miles over the lifetime of the vehicle. In addition, HD vehicles have different loads (engine torque on A/C compressor and engine/road vibration loads on A/C lines, fittings, and components) on its A/C components, which likely results in higher leakage rates than light duty vehicles. Finally since many HD trucks have sleeper cabs, the air conditioning systems are often run even when the vehicle is not moving, adding further to the wear and tear of the A/C system. [EPA-HQ-OAR-2014-0827-1191-A1 p.3-4]

We request EPA to consider more fully these real world realities of harder pounding over many more miles in assigning leakage rates over time for HD A/C systems. While a design based approach in estimating leakage may have applicability to new HD vehicles, we believe that real world performance based testing would reveal shortcomings in the application of SAE J2727 to HD, MD, and VV over the life of the vehicle. We suggest EPA gather leak rate data on older heavily used vehicles to determine if the leak rates predicted by SAE J2727 are accurate over the life of the vehicles. [EPA-HQ-OAR-2014-0827-1191-A1 p.4]

**Response:**

Please see RTC Section 6.6.3 for responses to the use of SAE J2727 as a certification procedure. We will continue to evaluate direct leakage emission inventories of HFC from A/C systems on HD vehicles in the future.

### **9.3 Climate Impacts and Indicators 1430**

**Organization:** American Automotive Policy Council

**Global Warming Potential (GWP) change for non-CO2 GHGs** - EPA should refrain from having different GWP based on vehicle classifications. If EPA chooses to lower the N2O GWP from 298 to 268 and increase CH4 from 25 to 36 based on latest IPCC report, the cost-benefit analysis needs to be clearly outlined in the final RIA inclusive of the impact on flex fuel vehicle and CNG products. In addition, the effective impact on greenhouse gas stringency associated with offsetting exceedances of the N2O and CH4 cap standards must be evaluated. Furthermore, the draft RIA should also include a detailed analysis of the merits of using Global Temperature Potential (GTP) values in lieu of GWP for both N2O and CH4. As stated above, this change should be consistent across all vehicle classes, as well as, all regulations under EPA and NHTSA authority. [EPA-HQ-OAR-2014-0827-1238-A1 p.11]

**Response:**

As noted in the Preamble of the final rule, the GWPs being used in this action are consistent with the IPCC 4<sup>th</sup> Assessment Report unless stated otherwise. One key exception is that the CO<sub>2</sub> Credit trading program will use GWPs from the Fifth Assessment Report (see 40 CFR 1036.705). The reasoning and details are discussed in Section VII.D.2.a of the Preamble of the final rule. See also Response to Comment Section 12.1.1.

The cost-benefit analysis itself is done using the Social Cost of CO<sub>2</sub>, the Social Cost of CH<sub>4</sub>, and the Social Cost of N<sub>2</sub>O. These are the appropriate metrics to use in order to determine the monetized impacts of a marginal change in greenhouse gas emissions.

EPA recognizes that there are potential merits of using the Global Temperature Potential in some applications: some research suggests that this metric is well adapted for use with non-well-mixed substances. However, for a rule that is targeted towards long-lived greenhouse gases, the most appropriate metrics are the GWP-100 and the Social Cost metrics and EPA does not consider an analysis of the GTP in this rule to be necessary.

**Organization:** American Lung Association

The American Lung Association shares the Administration's view that climate change first and foremost represents a public health crisis and a public health opportunity. In recognition of that, the American Lung Association has enlisted health and medical organizations in support of the Obama Administration's Clean Power Plan and other measures to fight climate change. Earlier this year, the American Lung Association in California launched a public awareness campaign, Doctors for Climate Health, to bring this point home. Throughout the United States, medical voices are speaking up – including Surgeon General Vivek Murthy – that climate change is the public health challenge of our time. [NHTSA-2014-0132-0087-A1 p.1][[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.142.]]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards protecting public health.

**Organization:** Center for Biological Diversity

A group of leading climate scientists has calculated that developed countries like the United States must reduce their greenhouse gas emissions by 35-65 percent below 1990 levels by 2030 in order to preserve a likely chance of limiting global temperature rise to 2°C this century.<sup>4</sup> On an economy-wide basis, moreover, current United States climate policy, which includes heavy-duty vehicle standards, will result in emissions 5 percent above 1990 levels by 2030.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.2]

The urgency of addressing greenhouse gas pollution is becoming more evident every day. The National Climate Assessment released in May 2014 by the U.S. Global Change Research Program states that “reduc[ing] the risks of some of the worst impacts of climate change” will require “aggressive and sustained greenhouse gas emission reductions” over the course of this century.<sup>6</sup> Humanity is rapidly consuming the remaining “carbon budget” necessary to preserve a likely chance of holding the average global temperature increase to only 2°C above pre-industrial levels. According to the IPCC, if non-CO<sub>2</sub> forcings are taken into account, total cumulative future anthropogenic emissions of CO<sub>2</sub> must remain below about 1,000 gigatonnes (Gt) to achieve this goal.<sup>7</sup> Another recent scientific report found that “[i]n all of the studies consistent with limiting warming below 2°C the energy sector needs to decarbonise rapidly and reduce to zero emissions as early as 2040 but no later than 2070.”<sup>8</sup> Even more recently, the International Energy Agency projected that in its central scenario, the entire remaining 1,000 GtCO<sub>2</sub> carbon budget will be consumed by 2040.<sup>9</sup> Some leading scientists – characterizing the effects of even a 2°C increase in average global temperature as “disastrous” – have prescribed a far more stringent carbon

budget for coming decades.<sup>10</sup> The agencies must consider the present rulemaking within the context of the global carbon budget, especially through the lens of achieving accelerated and deep cuts to U.S. fossil fuel usage. [EPA-HQ-OAR-2014-0827-1460-A1 p.2-3]

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<sup>4</sup> Bill Hare et al., *Below 2°C or 1.5°C Depends on Rapid Action from Both Annex I and Non-Annex I Countries*, Climate Action Tracker Policy Brief at 12 (June 4, 2014) (“Hare et al. 2014”) (calculating “from the IPCC AR5 scenarios that reductions for the Annex I countries in 2025 and 2030 are 25-55% and 35-65% below 1990 levels respectively for an equity scenario based on relative capability to mitigate”).

<sup>5</sup> Hare et al. 2014, *supra* note 4 at 12. The Proposed Rule also is insufficient to achieve either the United States’ international pledge to reduce emissions 17% below 2005 levels by 2020 or its longer-term stated goal of reducing emissions 83% below 2005 levels by 2050. *Id.*

<sup>6</sup> Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, *Climate Change Impacts in the United States: The Third National Climate Assessment* at 14-15 (2014) (“National Climate Assessment”), available at <http://nca2014.globalchange.gov/downloads>.

<sup>7</sup> Intergovernmental Panel on Climate Change, *Climate Change 2013 Synthesis Report: Approved Summary for Policymakers* at SPM-8 (Nov. 1, 2014) (“IPCC AR5 SYR SPM”) (“Multi-model results show that limiting total human-induced warming to less than 2°C relative to the period 1861-1880 with a probability of >66% would require cumulative CO<sub>2</sub> emissions from all anthropogenic sources since 1870 to remain below about 2900 GtCO<sub>2</sub> (with a range of 2550-3150 GtCO<sub>2</sub> depending on non-CO<sub>2</sub> drivers). About 1900 GtCO<sub>2</sub> had already been emitted by 2011.”); see also Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Summary for Policymakers* at 14 (2013) (“IPCC AR5 WGI SPM”) at 25-26 (“Limiting the warming caused by anthropogenic CO<sub>2</sub> emissions alone with a probability of >33%, >50%, and >66% to less than 2°C since the period 1861–1880, will require cumulative CO<sub>2</sub> emissions from all anthropogenic sources to stay between 0 and about 1570 GtC (5760 GtCO<sub>2</sub>), 0 and about 1210 GtC (4440 GtCO<sub>2</sub>), and 0 and about 1000 GtC (3670 GtCO<sub>2</sub>) since that period, respectively. These upper amounts are reduced to about 900 GtC (3300 GtCO<sub>2</sub>), 820 GtC (3010 GtCO<sub>2</sub>), and 790 GtC (2900 GtCO<sub>2</sub>), respectively, when accounting for non-CO<sub>2</sub> forcings as in RCP2.6. An amount of 515 [445 to 585] GtC (1890 [1630 to 2150] GtCO<sub>2</sub>), was already emitted by 2011.”). United Nations Environment Programme, *The Emissions Gap Report* at 13-22 (2013) (describing emissions “pathways” consistent with meeting 2°C and 1.5°C targets).

<sup>8</sup> Hare et al. 2014, *supra* note 4 at 2.

<sup>9</sup> International Energy Agency, *World Energy Outlook 2014: Executive Summary* at 2 (Nov. 12, 2014).

<sup>10</sup> James Hansen, et al., *Assessing “Dangerous Climate Change”: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, 8 PLoS ONE e81648 at 15 (2013), available at <http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0081648&representation=PDF>

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Climate 911

According to the most recent Fifth Assessment Report of the IPCC, global greenhouse gas emissions must peak by 2020 and decline rapidly thereafter to avoid irreversible catastrophic climate change. At this time we are facing a very large gap between the emissions reductions required to accomplish this and the sum of the commitments offered by the international community. 2020 is only five years away. As the largest historical contributor to the atmospheric GHGs and world's current second largest emitter, the US must cut our GHG emissions as steeply and deeply as possible if we want other countries to do the same. [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Competitive Enterprise Institute et al.

Although the ostensible purpose of the rule is to reduce greenhouse gas (GHG) emissions and oil imports, the climate and energy-security benefits of the rule are entirely speculative and vanishingly small at best. [EPA-HQ-OAR-2014-0827-1251-A2 p.2][This comment can also be found in section 11.10 of this comment summary]

**II. The rule's climate and energy security benefits are vanishingly small at best and completely unverifiable.**

The proposed standards, which phase in during model-years 2021–2027, apply to four types of HDVs: (1) combination tractors (semi-trucks), (2) trailers pulled by combination tractors, (2) heavy-duty pickups and vans, and (4) vocational trucks (a wide-ranging assortment of trucks and buses). The agencies estimate that the technologies needed to comply with the proposed standards will cost \$25 billion but that the rule will generate \$230 billion in net benefits over the lifetime of vehicles sold in the regulatory timeframe, including \$170 billion in fuel savings.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.5-6][This comment can also be found in section 11.10 of this comment summary]

Although the ostensible objectives of the rule are to reduce GHG emissions and oil consumption, the climate and energy-security benefits, if any, are speculative and no one will actually experience them. [EPA-HQ-OAR-2014-0827-1251-A2 p.6][This comment can also be found in section 11.10 of this comment summary]

Climate Change Impact

Based on the unverifiable assumption<sup>9</sup> that each ton of carbon dioxide-equivalent (CO<sub>2</sub>e) GHGs emitted imposes a “social cost” of \$37-\$77 during 2012-2050 (assuming a 3% discount rate),<sup>10</sup> the agencies

project \$34 billion in cumulative climate benefits from emission reductions over the lifetimes of the covered vehicles.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.6]

[Table IX-15 can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Yet the agencies also estimate that by 2100, the rule will decrease atmospheric CO<sub>2</sub> concentration “approximately 1.1 to 1.2 parts per million by volume (ppmv).” That miniscule change would, in turn, reduce global mean temperature by “approximately 0.0026 to 0.0065°C” and global mean sea level rise by “approximately 0.023 to 0.057 cm” (depending on whether climate sensitivity is as low as 1.5°C or as high as 6°C). It would also reduce ocean acidification by 0.0006 pH.<sup>12</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.7]

[Table VII-37 can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Such tiny decreases in global warming and sea-level rise cannot be distinguished from the noise of interannual variability.<sup>13</sup> Similarly, the tiny projected decrease in ocean acidification is orders of magnitude smaller than natural inter-seasonal and inter-regional variations.<sup>14</sup> Such changes would have no detectable effect on heat-related mortality, weather patterns, coral calcification rates, or any other climate-related indicator people care about. Hypothetical climate benefits during the lifetimes of vehicles subject to the rule would be even more microscopic. In short, the rule’s multi-billion-dollar climate benefits exist only in the virtual world of integrated assessment models (IAMs) – computer models that combine speculative climatology with speculative economics.<sup>15</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.7]

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8 EPA, NHTSA, Overview Fact Sheet: Cutting Carbon Pollution, Improving Fuel Efficiency, Saving Money, and Supporting Innovation for Trucks, EPA-420-F-15-900, June 2015, p. 2, <http://www.epa.gov/oms/climate/documents/420f15900.pdf>

9 By fiddling with non-validated climate parameters, made-up damage functions, and below-market discount rates, SCC analysts can get almost any result they desire. See Robert S. Pindyck, Climate Change Policy: What Do the Models Tell Us? NBER Working Paper No. 19244, July 2013, <http://www.nber.org/papers/w19244>; Marlo Lewis, Competitive Enterprise Institute, et al., Comment on Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, February 26, 2014, <http://www.globalwarming.org/wpcontent/uploads/2014/02/Competitive-Enterprise-Institute-and-Cooler-Heads-Comment-Letter-to-Office-of-Management-and-Budget-Technical-Support-Documents-on-Social-Cost-of-Carbon-February-26-2014-Spelling-Corrected.pdf>; Written Statement of Patrick J. Michaels, Director, Center for the Study of Science, Cato Institute, Hearing on An Analysis of the Obama Administration’s Social Cost of Carbon, House Committee on Natural Resources, July 22, 2015, <http://naturalresources.house.gov/uploadedfiles/michaelstestimony.pdf>; and Written Statement of Kevin D. Dayaratna, Senior Statistician and Research Programmer, Heritage Foundation, Hearing on An Analysis of the Obama Administration’s Social Cost of Carbon, House Committee on Natural Resources, July 22, 2015, <http://naturalresources.house.gov/uploadedfiles/dayaratnatestimony.pdf>

10 EPA, NHTSA, Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2, Draft Regulatory Impact Assessment, EPA-420-D-15-900, June 2015, 8-37, <http://www.epa.gov/oms/climate/documents/420d15900.pdf> (hereafter Draft RIA)



11 80 FR 40458

12 Draft RIA, 6-44

13 According to the Climatic Research Unit of the UK Met Office, the margin of error in estimating global surface temperature is 0.1°C – 15 to 38 times larger than the projected decrease in global mean temperature. UK Met Office, “2014 one of the warmest years on record globally,” January 26, 2015, <http://www.metoffice.gov.uk/news/release/archive/2015/2014-global-temperature>

14 In coastal waters, month-long ocean pH varies from 0.024 to 1.430 pH units. Even “Open water areas [in the Southern Ocean] experience a strong seasonal shift in seawater pH (~0.3-0.5 units) between austral summer and winter.” Hofmann et al. 2011. High-Frequency Dynamics of Ocean pH: A Multi-Ecosystem Comparison. PLOS/one, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0028983>

15 Anne E. Smith, Testimony, Hearing on Impacts of U.S. Environmental Protection Agency Rulemakings, Committee on Oversight and Government Reform, February 26, 2015, [http://www.nera.com/content/dam/nera/publications/2015/PUB\\_Smith\\_EPA\\_Testimony\\_0215.pdf](http://www.nera.com/content/dam/nera/publications/2015/PUB_Smith_EPA_Testimony_0215.pdf)

### **Response:**

See Response to Comments Section 11.8 for responses to critiques of the Social Cost of Carbon methodology.

The commenter’s claims that the benefits are unverifiable and speculative are incorrect. The science behind the impact of greenhouse gas emissions on global temperatures and subsequent impacts is extensive, well-documented, and robust, as can be verified in the assessments of the IPCC, the NRC, and the USGCRP.<sup>202</sup>

The commenter has highlighted what they see as a disconnect between billions of dollars of cumulative carbon benefits as calculated by the Social Cost methodology, and the changes of fractions of a degree and millimeters of sea level rise. However, this apparent disconnect is resolved by understanding the spatial and temporal scales of climate change. The key insight is to recognize that any benefit, even a marginal one, to any individual or in any one location aggregated over billions of individuals, hundreds of thousands of miles of coastline, and so forth can yield sizeable numbers, and that the Social Cost methodology is the right tool to do this kind of aggregation. That is, it appropriately monetizes impacts by aggregating over space and time and types of impacts. Aggregation is not only important for a single impact (such as sea level rise and damage to coastal properties), but because there are such a wide range of impacts from heat waves to allergens to flooding to droughts. Furthermore, because of the lifetime of greenhouse gases, these impacts can occur over decades and centuries. Additionally, global average temperature changes also need to be understood in the context of history, where a few degrees of global temperature change was enough to go from ice sheets covering much of high latitude land areas to today’s climate.

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<sup>202</sup> For a complete list of core references from IPCC, USGCRP/CCSP, NRC and others relied upon for development of the TSD for EPA’s Endangerment and Cause or Contribute Findings see Section 1(b), specifically, Table 1.1 of the TSD. (Docket EPA-HQ-OAR-2010-0799).

Climate change will not be halted by any individual action. It is a global, long-term issue and solving the problem will require many actions in aggregate. Reducing global greenhouse gas emissions, including those from the U.S., will reduce impacts in the U.S. and around the globe.

**Organization:** Dignity Health

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 204.]

Strong phase 2 standards offer a rare opportunity to address serious health concerns associated with climate change and cut freight costs.

Freight trucks currently account for about half a billion tons of climate-forcing GHG emissions per year and are the fastest growing single source of GHG emissions in the United States.

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards protecting public health.

**Organization:** Environmental Defense Fund (EDF)

### **Harms Associated with Climate Change**

As EPA has properly concluded, the scientific record demonstrating that “elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future U.S. generations is robust, voluminous, and compelling.”<sup>6</sup> The transportation sector is the second largest source of domestic greenhouse gas emissions and heavy-duty trucks and buses are responsible for nearly a quarter of the sector’s GHG emissions. Significantly reducing these emissions from new heavy-duty vehicles is necessary to mitigate the serious harms associated with climate change in the United States. [EPA-HQ-OAR-2014-0827-1312-A1 p.6]

The proposal’s Regulatory Impact Analysis (“RIA”) provides an overview of the pressing threats posed by greenhouse gas emissions and a summary of EPA’s 2009 Endangerment Finding. It also incorporates major assessments by the U.S. Global Change Research Program (USGCRP), the Intergovernmental Panel on Climate Change (“IPCC”), the National Academies’ National Research Council (NRC), and more recent assessments that support the endangerment finding. Climate research and assessment reports published since 2009 (and cited in the heavy-duty RIA) further emphasize the urgency of climate change and the need to mitigate greenhouse gas emissions.<sup>8</sup> The climate science that forms the basis of the Endangerment Finding provides a legally sufficient and scientifically compelling justification for curbing greenhouse gas emissions from heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.6]

### **A. Direct threats to public health and welfare from climate change**

Climate change is threatening, and will continue to threaten, public health in many regards. It is expected to increase the incidence and severity of heat waves, for instance, which are particularly dangerous to the elderly, the very young, and the infirm.<sup>9</sup> Warmer days lead to enhanced ozone (or

smog) formation, which can exacerbate respiratory illnesses, contribute to asthma attacks and hospitalizations, and heighten the risk of premature death among affected populations.<sup>10</sup> Because a warmer atmosphere retains more moisture, climate change will produce heavier precipitation events, stronger tropical cyclones, and associated flooding, spreading toxins and diseases and causing severe infrastructure damage, social upheaval, and widespread injury and death.<sup>11</sup> Pathogens and pests are expected to disseminate among susceptible populations due to changes in those species' survival, persistence, habitat range, and transmission under changing climate conditions, further endangering the public.<sup>12</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.6-7]

As EPA has attested at length, climate change also threatens public welfare. Sea level rise is well documented and is very likely to accelerate over the coming decades.<sup>13</sup> Rising seas, amplified by storm surges and stronger tropical cyclones, will threaten our coastal homes, cities, and infrastructure, forcing expensive efforts to protect or relocate critical resources.<sup>14</sup> Millions of U.S. citizens will be affected and many will be displaced. Further inland, shrinking snowpack and early spring melts will increase flood risks early in the melt season and will cause water shortages throughout much of the western United States, which now depends on snowpack as a reliable water source.<sup>15</sup> Droughts, especially in the western and southern United States, are expected to occur more frequently, and the extent of drought-limited ecosystems is projected to grow by 11 percent for every degree Celsius of warming.<sup>16</sup> This phenomenon will exacerbate the water scarcity already affecting numerous regions of the country.<sup>17</sup> Furthermore, the combination of changing atmospheric chemistry and shifting, more violent weather patterns will likely cause crop damage and crop failure, with corresponding increases in food prices and declines in availability.<sup>18</sup> On forested lands, the same changes will instigate more severe fires, as seen in California this summer, pest outbreaks, and higher tree mortality, which will likely disrupt timber production.<sup>19</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.7]

## **B. Climate change threatens the ecosystems upon which society depends**

Natural environments and biodiversity provide humans with a wide range of benefits, or “ecosystem services,” including fresh water supplies, fertile soil for agriculture, fisheries, climate regulation, and aesthetic, cultural, and recreational benefits.<sup>20</sup> However, climate change will have major implications for wildlife, biodiversity, and the fundamental ecosystem services upon which we depend. Observed changes in our climate are already shifting habitat ranges, altering migration patterns, and affecting reproductive timing and behavior.<sup>21</sup> At anticipated levels of increased global temperature, many terrestrial, freshwater, and marine species are at far greater risk of extinction than in the past.<sup>22</sup> The situation is particularly dire for Arctic wildlife, as climate change causes significant loss of sea ice and a dramatic reduction in marine habitat for polar bears, ice-inhabiting seals, and other animals.<sup>23</sup> And the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, fragmentation of natural systems, overexploitation of resources).<sup>24</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.7-8]

The footprint of humans on the planet is now straining ecosystems more than at any time in history. Terrestrial, freshwater, and marine environments have already undergone extensive transformation and deterioration.<sup>25</sup> More than 75 percent of Earth's ice-free land has been altered by human activity.<sup>26</sup> Nine of the world's fourteen biomes (each of which designates a broad ecological land category) have been converted into cropland at factors ranging from 20 to 50 percent.<sup>27</sup> Over 40 percent of the world's oceans, including two-thirds of the ocean waters within the United States Exclusive Economic Zone, are designated as having an anthropogenic impact rating of at least “medium high.”<sup>28</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.8]

Together with these stressors, climate change is having a major effect on ecosystems. For example, research indicates that climate change and other anthropogenic factors are causing the sixth mass extinction of global biodiversity in the last 600 million years of life on Earth, with current extinction rates 100 to 1,000 times greater than historical rates.<sup>29</sup> In 2007, the IPCC concluded that by the mid-21st century, 15 to 37 percent of plant and animal species worldwide would be committed to extinction if temperatures increase 1.6 to 1.8° C above late 20th century levels.<sup>30</sup> “Specialist” species—those with a narrow tolerance for changes in habitat, diet, or other environmental conditions—are particularly vulnerable to the threat of extinction due to climate change.<sup>31</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.8-9]

Even species that do not go extinct will have to contend with ecological conditions they have not previously faced. Many terrestrial species are shifting their geographical ranges in response to a changing climate. Plants and animals have moved to higher elevations at a median rate of 0.011 kilometers per decade and to higher latitudes at a median rate of 16.9 kilometers per decade, two to three times faster than previously reported.<sup>32</sup> For example, of the 305 bird species tracked in annual Christmas bird counts during the last four decades, 177 species (58 percent) had significant northward range shifts, with more than 60 species moving 100 miles or farther.<sup>33</sup> These range shifts are likely to cause unprecedented interactions among species. [EPA-HQ-OAR-2014-0827-1312-A1 p.9]

Shifts in seasons, especially in the duration and intensity of winter, are also having significant impacts on ecosystems. One consequence of shifting seasons is the increased likelihood of mismatches between interdependent species (e.g., predator and prey, insects and flowers).<sup>34</sup> A striking example is found in western forests, where warmer winters and longer growing seasons have triggered more intense and extensive forest fires, promoting mountain pine beetle outbreaks that kill millions of trees across millions of hectares of forest.<sup>35</sup> In turn, the decreased availability of whitebark pine nuts as a food source for grizzly bears has been tied to lower cub birth rates, lower over-winter survival rates, and increased conflicts between bears and humans.<sup>36</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.9]

In the coming decades, climate-related disturbances (such as altered precipitation regimes and extremes in weather and temperature) will continue to have marked impacts on ecosystems. In some cases, these phenomena will cause ecosystems to transition to significantly different community types.<sup>37</sup> For example, more arid ecosystems and river habitat areas will likely be particularly sensitive to changes in precipitation and water supply caused by climate change.<sup>38</sup> Reduced river flow and longer droughts in these regions are projected to diminish native cottonwood and willow populations and render them more susceptible to livestock grazing and encroachment from upland species and invasive weeds.<sup>39</sup> Such changes in ecosystem composition and function will pose critical adaptation challenges for affected human communities. [EPA-HQ-OAR-2014-0827-1312-A1 p.9-10]

In short, greenhouse gas emissions are fundamentally destabilizing global ecosystems. Because human society depends upon the goods and services these ecosystems provide, this ecological crisis is a pressing threat to public welfare. [EPA-HQ-OAR-2014-0827-1312-A1 p.10]

### **C. Harm associated with ocean acidification**

Some of the carbon dioxide emitted by fossil fuel combustion is subsequently absorbed by the world’s oceans. Because carbonic acid forms when carbon dioxide dissolves in water, rising CO<sub>2</sub> emissions are causing the seas to become more acidic. Independent of climate change, ocean acidification alone demonstrates that greenhouse gases endanger public welfare. The National Research Council has reported that ocean acidity has increased approximately 30 percent since pre-industrial times, and could intensify by three to four times this amount by the end of the century if carbon emissions remain

uncurbed.<sup>40</sup> Furthermore, increasing rates of ocean acidification may hamper the oceans' ability to absorb more CO<sub>2</sub>, resulting in more atmospheric carbon and, in turn, intensified climate change.<sup>41</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.10]

Increased acidification poses a significant threat to the ocean's critical food webs. For instance, it will sharply reduce the underwater area suitable for coral reefs, which function as fish nurseries.<sup>42</sup> Similarly, planktonic animals, which are an important food supply for many underwater species, may be unable to tolerate more acidic waters.<sup>43</sup> By disrupting the delicate balance of oceanic ecosystems, acidification could have devastating impacts on coastal communities that rely heavily on the sustained health of their fisheries. [EPA-HQ-OAR-2014-0827-1312-A1 p.10]

Ocean acidification is taking place with extraordinary rapidity. According to a 2012 study that surveyed hundreds of millions of years of ocean chemistry, the current rate of CO<sub>2</sub> release into the oceans (and hence the rate of acidification) "stands out as capable of driving a combination and magnitude of ocean geochemical changes potentially unparalleled in at least the last ~300 [million years] of Earth history."<sup>44</sup> Based on future projections of atmospheric carbon concentration, ocean acidity can be expected to increase by 100 to 150 percent by the end of this century.<sup>45</sup> Troublingly, this upward shift in acidity will be accompanied by increasing surface stratification of the ocean on account of warmer surface waters. As a result, phytoplankton will experience both heightened acidity and more intense exposure to light. Together, these two phenomena have been shown to dramatically reduce the photosynthesis and growth of diatoms, currently responsible for approximately 40 percent of total primary production in the oceans.<sup>46</sup> Accordingly, the combination of heightened acidification and ocean stratification may result in a "widespread decline in marine primary production," doing great damage to the base of the oceanic food chain with potentially devastating effects on the food supply for many regions around the globe.<sup>47</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.11]

#### **D. New research, reports, and assessments show increasing severity of harm**

Greenhouse gas emissions and atmospheric carbon concentrations have continued to rise in the years since EPA made its Endangerment Finding. As EPA moves forward with the truck standards, the evidence of an intensifying threat reflects the importance of selecting the most protective standards possible in this rule, as well as the need for continued efforts to control emissions from other sectors. [EPA-HQ-OAR-2014-0827-1312-A1 p.11]

Global greenhouse gas emissions are now rising faster than the IPCC's highest emissions scenario from 2007, as illustrated in the figure below, compiled by the European Environment Agency.<sup>48</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.11]

[Figure can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1312-A1]

The graph shows six IPCC emissions scenarios (labeled A1B to B2), compared with actual atmospheric carbon measurements from two sources. The highest scenario, A1F1, which assumes a "world of very rapid economic growth" with "fossil-intensive" energy systems,<sup>49</sup> is the most aggressive scenario generally modeled. The graph demonstrates that, in the last decade, global emissions have rapidly increased to match, or even slightly outpace, the A1F1 scenario. Hence, in the absence of swift emissions reductions, we can expect harms even greater than those projected under the IPCC's highest emissions scenarios in the Fourth Assessment Report (AR4). [EPA-HQ-OAR-2014-0827-1312-A1 p.12]

Recent modeling results project that by mid-century, warming may be significantly greater than scientists had previously forecast. According to this research, by 2050, average global temperatures could warm by 1.4 to 3°C relative to the 1961-1990 period, even under mid-range emissions scenarios (which current emissions figures significantly exceed).<sup>50</sup> Numerous large-scale reports and assessments further attest that threats to public health and welfare from carbon emissions are even more pressing than anticipated just a few years ago. For instance, it is now clear that the IPCC's sea level rise projections in AR4 were overly conservative. A recent IPCC report notes that "satellite-measured sea levels continue to rise at a rate closer to that of the upper range of [earlier] projections" and that "the contribution to sea level due to [ice] mass loss from Greenland and Antarctica is accelerating."<sup>51</sup> Similarly, in the Fifth Assessment Report (AR5), the IPCC's Working Group 1 predicts that sea levels could increase by as much as 0.82 meters by the late 21st century and 0.98 meters by 2100.<sup>52</sup> By contrast, the AR4's upper bound estimate for sea level rise was just 0.59 meters by the late 21st century.<sup>53</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.12-13]

More broadly, Working Group 1 emphasizes that "[s]ubstantial advancements in the availability, acquisition, quality and analysis of observational data sets in atmosphere, land surface, ocean, and cryosphere have occurred since the AR4."<sup>54</sup> These advancements point primarily toward increased estimates of the severity of the harm that will result from climate change. The report for AR5, for instance, asserts that "[m]easurements of glacier change have increased substantially in number since AR4," and that, with regard to the Greenland Ice Sheet, "large rates of mass loss have spread to wider regions than reported in AR4."<sup>55</sup> The report also increases AR4's estimates of the radiative forcing (or heat-trapping) potential of current and predicted atmospheric greenhouse gas concentrations,<sup>56</sup> and expresses increased confidence since AR4 in its determinations regarding upper-ocean warming,<sup>57</sup> the link between climate change and precipitation patterns,<sup>58</sup> and the human influence on global surface temperature increases,<sup>59</sup> water cycle variations,<sup>60</sup> daily temperature maxima,<sup>61</sup> extreme precipitation events,<sup>62</sup> and droughts,<sup>63</sup> to name just a few examples. [EPA-HQ-OAR-2014-0827-1312-A1 p.13]

The USGCRP's Third Climate Assessment reflects a similar pattern. Describing changes from the Second Climate Assessment, the authors explain that "[c]ontinued warming and an increased understanding of the U.S. temperature record, as well as multiple other sources of evidence, have strengthened our confidence in the conclusions that the warming trend is clear and primarily the result of human activities."<sup>64</sup> For example, the authors emphasize that "[h]eavy precipitation and extreme heat events are increasing in a manner consistent with model projections; the risks of such extreme events will rise in the future," and that "[a] longer and better-quality history of sea level rise has increased confidence that recent trends are unusual and human-induced. Limited knowledge of ice sheet dynamics leads to a broad range of potential increases over this century."<sup>65</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.13-14]

Finally, in May 2013, the Interagency Working Group on the Social Cost of Carbon (IWG) published an updated assessment that increases the predicted threat that climate change poses and will continue to pose into the future. The IWG's original estimate in 2010 provided four potential values to represent the cost that each metric ton of CO<sub>2</sub> emissions will impose on society for the year 2020: \$7, \$26, \$42, and \$81.<sup>66</sup> The 2013 estimate increases those values to \$12, \$43, \$65, and \$129, respectively.<sup>67</sup> While the Joint Environmental Commenters believe that these updated figures fundamentally underestimate the true cost of carbon emissions, they nonetheless reflect the same trend as seen in the scientific literature: not only does the potential harm from carbon emissions increase with each additional ton released into the atmosphere, but the severity of the predicted harm increases as our understanding of climate change grows. [EPA-HQ-OAR-2014-0827-1312-A1 p.14][This section can also be found in section 11.8 of this comment summary]

These new studies, reports, and assessments indicate that the urgency of acting to curb greenhouse gas emissions has, if anything, grown since the 2009 Endangerment Finding. Emission trajectories are already at or beyond what was anticipated in the 2007 IPCC reports, and are causing severe effects on an accelerated timeline. In the absence of substantial emissions reductions, the harms to public health and welfare from climate change may well prove catastrophic. While robust actions are needed in every sector of our economy to mitigate the greenhouse gas emissions that contribute to public health and environmental harms, improving the efficiency of the heavy-duty fleet is one of the most impactful things we can do to stem climate pollution in the United States. [EPA-HQ-OAR-2014-0827-1312-A1 p.14]

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6 75 Fed. Reg. 49,556, 49,557 (Aug. 13, 2010) (Endangerment Reconsideration Denial); see also 74 Fed. Reg. 66,496, 66,523 (Dec. 15, 2009) (Endangerment Finding); Coalition for Responsible Regulation, Inc. v. EPA, 684 F.3d 102, 122—28 (D.C. Cir. 2012) (upholding Endangerment Finding in its entirety).

8 See HD RIA at 6-41.

9 EGU RIA at 3-1—3-2.

10 Id. at 3-2—3-3, 5-39—5-40; G. G. Pfister et al., Projections of Future Summertime Ozone Over the U.S. (2014), (higher temperatures increase smog formation in already polluted areas).

11 Id. at 3-3.

12 Id.

13 Id. at 3-6.

14 Id. at 3-3, 3-6—3-7.

15 Id. at 3-5.

16 Id. at 3-5, 3-8; USGCRP at 33, 44.

17 RIA at 3-5.

18 Id. at 3-4.

19 Id. at 3-4—3-5.

20 US Climate Change Science Program, Abrupt Climate Change, at 291 (2008).

21 EGU RIA at 3-7.

22 Id. at 3-7.

23 Id. at 3-7.

24 Climate Change 2007: Synthesis Report (2007) by the IPCC at 48.

25 See generally *id.* at 291-313; Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Biodiversity Synthesis* (2005), Chapters 4 and 28; Brook, et al., Synergies among extinction drivers under global change, 23 *Trends in Ecology and Evolution* 453 (2008); Butchart, et al., Global Biodiversity: Indicators of Recent Declines, 328 *Science* 1164 (2010).

26 Ellis and Ramankutty, Putting people in the map: anthropogenic biomes of the world, 6 *Frontiers in Ecology and the Environment* 439, 439 (2008).

27 Millennium Ecosystem Assessment at 79.

28 Halpern, et al., A Global Map of Human Impact on Marine Ecosystems, 319 *Science* 948, 949 (2008); Kappel, et al., In the Zone: Comprehensive Ocean Protection, 25 *Issues in Science and Technology* 33, 38 (2009).

29 Pimm, et al., The Future of Biodiversity, 269 *Science* 347, 347 (1995); Dirzo and Raven, Global State of Biodiversity and Loss, 28 *Annual Review of Environment and Resources* 137, 137 (2003); Barnosky, et al., Has the Earth's sixth mass extinction already arrived?, 471 *Nature* 51 (2011); Pereira, et al., Scenarios for Global Biodiversity in the 21st Century, 330 *Science* 1496, 1497 (2010); see also Pimm, Biodiversity: Climate Change or Habitat Loss—Which Will Kill More Species?, 18 *Current Biology* R117 (2008).

30 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Impacts, Adaptation, and Vulnerability* (2007) at 243, available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter4.pdf>.

31 See generally Clavel, et al., Worldwide decline of specialist species: toward a global functional homogenization?, 9 *Frontiers in Ecology and the Environment* 222 (2011).

32 Chen, et al., Rapid Range Shifts of Species Associated with High Levels of Climate Warming, 333 *Science* 1024 (2011).

33 National Audubon Society, *Birds and Climate Change: Ecological Disruption in Motion* at 3 (2009).

34 See generally, e.g., Miller-Rushing, et al., The effects of phenological mismatches on demography, 365 *Philosophical Transactions of the Royal Society B: Biological Sciences* 3177 (2010); Thackeray, et al., Trophic level asynchrony in rates of phenological change for marine, freshwater and terrestrial environments, 16 *Global Change Biology* 3304 (2010); Yang, et al., Phenology, ontogeny and the effects of climate change on the timing of species interactions, 13 *Ecology Letters* 1 (2010).

35 Westerling, et al., Continued warming could transform Greater Yellowstone fire regimes by mid-21st century, 108 *Proceedings of the National Academies of Science, U.S.A.* 13165 (2011); Westerling, et al., Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity, 313 *Science* 940 (2006); U.S. Forest Service, Climate Change Resource Center, Western U.S. Bark Beetles and Climate Change (2008), available at <http://www.fs.fed.us/ccrc/topics/insect-disturbance/bark-beetles.shtml>.

36 Gunther, et al., Grizzly bear–human conflicts in the Greater Yellowstone ecosystem, 1992—2000, 15 *Ursus* 10 (2004); USGCRP, *Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem*



Services: Technical Input to the 2013 National Climate Assessment (2012) at 3-13—3-14, available at <http://downloads.usgcrp.gov/NCA/Activities/Biodiversity-Ecosystems-and-Ecosystem-Services-Technical-Input.pdf>.

37 See generally Peters, et al., Directional climate change and potential reversal of desertification in arid and semiarid ecosystems, 18 *Global Change Biology* 151 (2012); Rood, et al., Declining summer flows of Rocky Mountain rivers: Changing seasonal hydrology and probable impacts on floodplain forests, 439 *Journal of Hydrology* 397 (2008).

38 Rood at 405.

39 *Id.* at 409; see also Stromberg, et al., Effects of Stream Flow Patterns on Riparian Vegetation of a Semiarid River: Implications for a Changing Climate, 26 *River Research and Applications* 712 (2010).

40 National Research Council (NRC), *Advancing the Science of Climate Change* (2010) at 55.

41 *Id.*

42 *Id.* at 55-56, 59-60; NRC, *Abrupt Climate Change, Inevitable Surprises*, (2002) at 209-210.

43 NRC, *Advancing the Science of Climate Change* (2010) at 55-56, 59-60; NRC, *Abrupt Climate Change, Inevitable Surprises* (2002) at 209-210.

44 Barbel Hönsich, et al., The Geological Record of Ocean Acidification, 335 *Science* 1058, 1058 (2012).

45 Gao, et al., Rising CO<sub>2</sub> and Increased Light Exposure Synergistically Reduce Marine Primary Productivity, 2 *Nature Climate Change* 519, 519 (2012).

46 *Id.* at 519-522.

47 *Id.* at 519.

48 “Observed global fossil fuel CO<sub>2</sub> emissions compared with six scenarios from IPCC,” European Environment Agency (September 30, 2015), available at [http://www.eea.europa.eu/data-and-maps/figures/observed-global-fossil-fuel-co2/ccs102\\_fig2-3.eps](http://www.eea.europa.eu/data-and-maps/figures/observed-global-fossil-fuel-co2/ccs102_fig2-3.eps).

49 IPCC, *Climate Change 2007: Synthesis Report* (2007), at 44.

50 See abstract for Rowlands, et al., Broad range of 2050 warming from an observationally constrained large climate model ensemble, 5 *Nature Geoscience* 256 (2012).

51 IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (2012), at 178-79.

52 IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary* (United Kingdom: Cambridge University Press and USA: New York, 2013).

53 IPCC, *Climate Change 2007: Synthesis Report (2007)*, at 47.

54 IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary (2013)*, at TS-37.

55 *Id.* at TS-41.

56 *Id.* at TS-51.

57 *Id.* at TS-68.

58 *Id.* at TS-72.

59 *Id.* at TS-73.

60 *Id.* at TS-72.

61 *Id.* at TS-73.

62 *Id.*

63 *Id.*

64 US Global Change Research Program (USGCRP), *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment (2014)*, at 27.

65 *Id.*

66 Interagency Working Group on the Social Cost of Carbon (IWG), *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (2013)*, at 2.

67 *Id.*

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards protecting public health.

**Organization:** Fuller, Tony

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 149-150.]

The U.S. EPA and the DOT also have a moral obligation to future generations to adopt strong standards. We are in a race to prevent a global temperature rise of two degrees above pre-industrial times, to limit

the impacts that climate change would have on this planet. Unfortunately, current plans don't go far enough. According to Climate Action Tracker, a group of research organizations dedicated to analyzing the world's progress, U.S. action plans are short of what's needed.

By increasing these second phase standards to a 40 percent reduction, we could take one step towards limiting the impacts of climate change.

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Gilroy, JD

A second thing I like very much about the proposed standards is that all the information I've seen about them indicate that their impact on the environment will be enormous in a favorable direction. A Union of Concerned Scientists (UCS) website stated that their impact could be as great as a reduction of a million barrels of oil per day by 2035, or more than the Keystone XL pipeline could ever provide. Another source indicated that the standards could ultimately cut global warming emissions by 1 billion metric tons or be the equivalent of eliminating all greenhouse gas emissions from electricity and power usage by all US residents for a year. If these estimates are anywhere near correct, the standards will play a major role in diminishing our greatest global danger. [EPA-HQ-OAR-2014-0827-0751 p.2]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Investor Network on Climate Risk

In addition, climate change presents significant long-term risks to the global economy, and to investors across all asset classes. Strong standards will serve to mitigate that risk by providing significant GHG reductions; the standards we propose have the potential to save 270 million metric tons of GHG emissions annually by 2030.<sup>4</sup> [NHTSA-2014-0132-0113-A1 p.2][This comment can also be found in section 11.10 of this comment summary]

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4 American Council for an Energy-Efficient Economy (ACEEE), Environmental Defense Fund (EDF), Natural Resources Defense Council (NRDC), Sierra Club, and Union of Concerned Scientists (UCS). 2014. Big fuel savings available in new trucks. Web. <http://aceee.org/files/pdf/fact-sheet/truck-savings-0614.pdf>, Factsheet accessed June 29, 2015.

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Manufacturers of Emission Controls Association (MECA)

The Manufacturers of Emission Controls Association (MECA) is pleased to provide comments in support of the U.S. EPA's proposed rulemaking to establish medium- and heavy-duty greenhouse gas emission standards and corporate average fuel economy standards for model years 2018 and beyond. We believe an important opportunity exists to continue to reduce greenhouse gas emissions and improve fuel economy from medium- and heavy-duty engines and vehicles by applying the fundamental regulatory structure that has been effective under the first phase of the medium and heavy-duty standards. [EPA-HQ-OAR-2014-0827-1210-A3 p.1] [This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.95.] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.211.]]

Anthropogenic activities, particularly the burning of fossil fuels, have changed the composition of the atmosphere in ways that threaten dramatic changes to the global climate. Signs of climate change are evident worldwide and additional changes will have serious impacts on our nation's future. Although transportation is a vital part of the economy and is crucial for everyday activities, it is also a significant source of greenhouse gas (GHG) emissions. Some of the important greenhouse gas emissions from fossil fuel combustion from mobile sources include: carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), and black carbon. Climate change is also impacted negatively by higher ground-level ozone emissions. Ozone levels are in turn linked to hydrocarbon and NO<sub>x</sub> emissions from mobile and stationary sources. The adverse health effects of ozone is compounded by rising temperatures caused by climate change. These complex relationships support the need to continue to reduce emissions of criteria pollutants and climate forcing compounds and we commend the agency for making further progress in this effort. [EPA-HQ-OAR-2014-0827-1210-A3 p.1-2]

In conclusion, MECA commends EPA for taking important steps to continue to reduce greenhouse gas emissions and improve fuel economy from medium- and heavy-duty vehicles. MECA believes that a variety of advanced powertrain options are available for reducing carbon dioxide emissions from these vehicles and engines. MECA believes that the proposed reductions for greenhouse gas emissions from heavy-duty vehicles proposed by EPA are technically and economically feasible under a 2024 implementation timeframe. Our industry is prepared to do its part and deliver cost-effective advanced emission control and efficiency technologies to the heavy-duty sector to assist in achieving lower greenhouse gas emissions, while also meeting future reductions in NO<sub>x</sub> and other criteria pollutants. [EPA-HQ-OAR-2014-0827-1210-A3 p.15]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Mass Comment Campaign sponsored by anonymous 1 (email) - (23)

I am concerned about the impact of climate change and air pollution on the health of my family. Climate change threatens the health of our children through increased heat, air pollution, fires, storms, drought, airborne allergens, and other serious effects. That's why I strongly support improved fuel efficiency standards that would reduce dangerous climate pollution from medium and heavy duty trucks. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

The proposed standards will help protect our families from harmful climate change and from unhealthy air pollution. They will significantly reduce our national fuel consumption, and will save money for both truckers and consumers. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Michaels and Knappenberger

The Environmental Protection Agency's (EPA) proposed regulation Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 results in no demonstrable or verifiable mitigation of future climate change—the primary justification for the regulation. The reported reductions in the rate of rise of atmospheric carbon dioxide concentrations, average global temperature and global average sea level are so small as to be statistically indistinguishable from the evolution of these measures absent this regulation. As such, it is scientifically improper for the EPA to claim this regulation results in a “meaningful” impact on future climate change. Further, the EPA did not investigate any impact beyond the grossest of global-scale measures. [EPA-HQ-OAR-2014-0827-1206-A1 p.1]

*Specific Comments on Climate Change*

We list below a few of the glaring faults, logical flaws, and inconsistencies, primarily found in Section D (“Climate Impact and Indicators”) of these proposed regulations. This is by no means an exhaustive list. [EPA-HQ-OAR-2014-0827-1206-A1 p.2]

*Federal Register*, Vol. 80, No. 133, pg 40148:

“Finally, it should be noted that the concentration of carbon dioxide in the atmosphere continues to rise dramatically. In 2009, the year of the Endangerment Finding, the average concentration of carbon dioxide as measured on top of Mauna Loa was 387 parts per million. The average concentration in 2013 was 396 parts per million. And the monthly concentration in April of 2014 was 401 parts per million, the first time a monthly average has exceeded 400 parts per million since record keeping began at Mauna Loa in 1958, and for at least the past 800,000 years according to ice core records.” [EPA-HQ-OAR-2014-0827-1206-A1 p.2]

According to the Draft Environmental Impact Statement EIS accompanying this NOPR, this regulation is determined to reduce the atmospheric burden of CO<sub>2</sub> by the year 2100 by approximately 1ppm (e.g., Page S-21 of the draft EIS). This means that the CO<sub>2</sub> reduction achieved by this proposed regulation 85 years hence is 14 times less than the atmospheric increase (as described in the quote above) that took place during in the 5 years following 2009—the year of the Endangerment Finding. This fact alone

should make obvious the overall ineffectiveness of this regulation in mitigating future climate change—the intended outcome of the rule. [EPA-HQ-OAR-2014-0827-1206-A1 p.2]

*Federal Register*, Vol. 80, No. 133, pg 40407:

“Once emitted, GHGs that are the subject of this proposed regulation can remain in the atmosphere for decades to millennia” [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

Similar text is repeated on page 40408.

This is completely wrong. The turnover time for atmospheric carbon dioxide is about 3-5 years. So the actual CO<sub>2</sub> molecules that are emitted and the “subject of this proposed regulation” do not remain in the atmosphere for decades to millennia, but instead, remain less than a decade. Your simplified explanation of the concept you are attempting to explain does an injustice to the underlying science and casts doubt as to the rigor of the scientific explanations throughout the body of the report. [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

See the Intergovernmental Panel on Climate Change’s Fourth Assessment Report, Glossary (term: “Turnover”) for a more accurate and complete scientific description. [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

*Federal Register*, Vol. 80, No. 133, pg 40408:

“Based on modeling analysis performed by the agencies, reductions in CO<sub>2</sub> and other GHG emissions associated with these proposed rules will affect future climate change.” [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

This is a statement completely devoid of meaning as it now stands. Please include a defensible definition of the term “will affect.” Just because a climate model can produce an output to four significant digits (in this case, thousandths of degrees) does not mean that it is precise at that level. The measurement error for global temperature as well as the accruing round-off errors in the model clearly render such specifications useless, which means the term “will effect” is devoid of meaning. [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

Is “affect” measurable? Detectable? Significant (in any sense of the word)? [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

The draft EIS noted that (page 5-75, footnote 37): [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

“[T]he projected reductions in global climate effects for each of the alternatives are too small to incorporate into a regional/local-scale analysis, which would likely introduce uncertainties at the same magnitude or more than the projected change itself (i.e., the projected change would be within the noise of the model).” [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

In other words, EPAs own analysis concedes that the model noise is greater than the model signal. This is indisputable proof that the impacts are statistically insignificant. Further, if the model noise represents real world noise, then this is also indisputable proof that the “affect” will be undetectable and thus unverifiable. And further still, no one could argue that averting 0.003°C of a projected 3.48°C of global

warming (as described in the draft EIS, e.g., pg. S-21) would have any ecologically significant impacts in the real world. [EPA-HQ-OAR-2014-0827-1206-A1 p.3]

We also note that a formal estimate of the full range of uncertainties around the estimated impacts (e.g., global average temperature, sea level rise) from these regulations was not performed. While sensitivity to a range of climate sensitivity values was examined, the draft Regulatory Impact Analysis (RIA) (pg.6-44) notes: “Other uncertainties, such as uncertainties regarding the carbon cycle, ocean heat uptake, or aerosol forcing, were not addressed.” [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

These types of uncertainties can be addressed had the EPA used the newest version of Model for the Assessment of Greenhouse Gas-Induced Climate Change, or MAGICC (v6, <http://live.magicc.org/>) which now can be run in a probabilistic mode incorporating a range of carbon cycles estimates and other model parameter estimates. Had this been done, the overlap between the baseline runs and the perturbed runs (to reflect this regulation) would have been so great that no statistical difference could ever exist between them. [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

In summation, in no way will the carbon dioxide reductions compelled by this regulation “affect” future climate change in a scientifically meaningful fashion. As it stands, EPA’s statement is incorrect, misleading and should be removed. [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

*Federal Register*, Vol. 80, No. 133, pg 40408:

“EPA determines that the projected reductions in atmospheric CO<sub>2</sub>, global mean temperature, sea level rise, and ocean pH are meaningful in the context of this action.” [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

This is gross a mischaracterization and an affront to sound science. The EPA did not “determine” *anything* scientifically. It simply stipulates that the “projected reductions” are “meaningful.” In fact, EPA’s own analysis shows that they are not. [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

As mentioned previously, the draft EIS (footnote 37) finds that the noise in the model output is greater than the signal—*prima facie* evidence that the impacts of this regulation are undetectable. An undetectable impact cannot be a “meaningful” one. [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

Further, the “global mean temperature” although a metric of climate change, is not a measure of specific impacts of the local climate that may occur in association with a change in the global temperature. An analysis of the resulting changes to the local/regional weather/climate that may result from these regulations (i.e., those changes which may result in “meaningful” impacts) was not conducted for this regulation. It is specifically stated in the draft EIS (pg. 5-75) that: [EPA-HQ-OAR-2014-0827-1206-A1 p.4]

NHTSA’s [and EPA’s] assumption is that reductions in climate effects relating to temperature, precipitation, and sea level rise would reduce impacts on affected resources. However, the magnitude of the changes in climate effects that the alternatives would produce (see Section 5.4) are too small to address quantitatively in terms of their impacts on the specific resources discussed below. Consequently, the discussion of resource impacts in this section does not distinguish among the alternatives; rather it provides a qualitative review of projected impacts (where the potential benefits of reducing GHG emissions would result in reducing these potential impacts) and the magnitude of the risks involved in climate change. [EPA-HQ-OAR-2014-0827-1206-A1 p.4-5]

Clearly the EPA (and the NHTSA) are merely *assuming* that the admittedly meager reductions resulting from this regulation will reduce the potential environmental impacts in a “meaningful” way. No quantitative analysis or proof of such an outcome is demonstrated. [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

In fact, the only example offered by the EPA is risible (*Federal Register*, Vol. 80, No. 133, pg 40409): [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

“These effects are occurring everywhere around the globe, so benefits that appear to be marginal for any one location, such as a reduction in seal level [sic] rise of half a millimeter, can be sizable when the effects are summed along thousands of miles of coastline.” [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

Summing an inconsequential rise (half a millimeter) over large area does NOT result in large impacts. This is a ludicrous assertion and one without any backing. What editor or GS-15 in charge of this proposal could be so simple? [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

We ask EPA to consider a simple question: Does it have a threshold below which the impacts of CO<sub>2</sub> reductions from a proposed action would be too small to be of any consequence and therefore the regulation would not stand as an action producing “meaningful” impacts on future climate change? [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

If so, what is it?

To us, and we would presume many others, a climate change regulation that shows (*Federal Register*, Vol. 80, No. 133, pg 40409): [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

“that relative to the reference case, by 2100 projected atmospheric CO<sub>2</sub> concentrations are estimated to be reduced by 1.1 to 1.2 part per million by volume (ppmv), global mean temperature is estimated to be reduced by 0.0026 to 0.0065 °C, and sea-level rise is projected to be reduced by approximately 0.023 to 0.057 cm” would fall far beneath such a threshold. [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

If such a threshold does not exist, then the EPA has not only thrown science out of the window but has also helped itself to limitless executive power. Such a situation cannot stand, but it is a sad hallmark of the Obama Administrations manifold activities on climate change. [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

*Federal Register*, Vol. 80, No. 133, pg 40409: [EPA-HQ-OAR-2014-0827-1206-A1 p.5]

“Though the magnitude of the avoided climate change projected here in isolation is small in comparison to the total projected changes, these reductions represent a reduction in the adverse risks associated with climate change (though these risks were not formally estimated for this action) across a range of equilibrium climate sensitivities.” [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

We applaud the EPA for this time doing what it is typically not wont to do—that is, make a direct determination of the impact that this proposed regulation will have on the course of future climate change. The EPA’s findings that the resulting impacts on future climate change are so small comports with our own findings using a similar set of tools—that the impact of the these and other federal actions on the future evolution of the earth’s climate at global, regional, or local scales, is, by any normative scientific evaluation measure, inconsequential and undetectable. [EPA-HQ-OAR-2014-0827-1206-A1 p.6]



Yet, somehow the EPA considers that these demonstrably undetectable changes (by the EPA's own reckoning (see footnote 37 of the draft EIS)) will "contribute to reducing the risks associated with climate change." Perhaps more remarkably, this finding was made despite the fact that "these risks were not formally estimated for this action." [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

### *Sea Level Rise*

The sea level rise module in the DICE model used by the IWG2013/2015 produces future sea level rise values that far exceed mainstream projections and are unsupported by the best available science. The sea level rise projections from more than half of the scenarios (IMAGE, MERGE, MiniCAM) exceed even the highest end of the projected sea level rise by the year 2300 as reported in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (see figure). [EPA-HQ-OAR-2014-0827-1206-A1 p.23][This comment can also be found in section 11.8 of this comment summary]

[Figure, 'Sea Level Rise (DICE)', can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

How the sea level rise module in DICE was constructed is inaccurately characterized by the IWG2013 (and misleads the reader). The IWG2013 report describes the development of the DICE sea level rise scenario as: [EPA-HQ-OAR-2014-0827-1206-A1 p.23][This comment can also be found in section 11.8 of this comment summary]

"The parameters of the four components of the SLR module are calibrated to match consensus results from the IPCC's Fourth Assessment Report (AR4).6" [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

However, in IWG2013 footnote "6" the methodology is described this way (Nordhaus, 2010): [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

"The methodology of the modeling is to use the estimates in the IPCC Fourth Assessment Report (AR4)." [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

"Using estimates" and "calibrating" are two completely different things. Calibration implies that the sea level rise estimates produced by the DICE sea level module behave similarly to the IPCC sea level rise projections and instills a sense of confidence in the casual reader that the DICE projections are in accordance with IPCC projections. However this is not the case. Consequently, the reader is misled. [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

In fact, the DICE estimates are much higher than the IPCC estimates. This is even recognized by the DICE developers. From the same reference as above: [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

"The RICE [DICE] model projection is in the middle of the pack of alternative specifications of the different Rahmstorf specifications. Table 1 shows the RICE, base Rahmstorf, and average Rahmstorf. *Note that in all cases, these are significantly above the IPCC projections in AR4.*" [emphasis added][EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

That the DICE sea level rise projections are far above the mainstream estimated can be further evidenced by comparing them with the results produced by the IWG-accepted MAGICC modelling tool (in part developed by the EPA and available from <http://www.cgd.ucar.edu/cas/wigley/magicc/>). [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

Using the MESSAGE scenario as an example, the sea level rise estimate produced by MAGICC for the year 2300 is 1.28 meters—a value that is less than 40% of the average value of 3.32 meters produced by the DICE model when running the same scenario (see figure below). [EPA-HQ-OAR-2014-0827-1206-A1 p.24][This comment can also be found in section 11.8 of this comment summary]

[Figure, 'Projected Sea Level Rise (MESSAGE)', can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

The justification given for the high sea level rise projections in the DICE model (Nordhaus, 2010) is that they well-match the results of a “semi-empirical” methodology employed by Rahmstorf (2007) and Vermeer and Rahmstorf (2009). [EPA-HQ-OAR-2014-0827-1206-A1 p.25][This comment can also be found in section 11.8 of this comment summary]

However, subsequent science has proven the “semi-empirical” approach to projecting future sea level rise unreliable. For example, Gregory et al. (2012) examined the assumption used in the “semi-empirical” methods and found them to be unsubstantiated. Gregory et al (2012) specifically refer to the results of Rahmstorf (2007) and Vermeer and Rahmstorf (2009): [EPA-HQ-OAR-2014-0827-1206-A1 p.25][This comment can also be found in section 11.8 of this comment summary]

The implication of our closure of the [global mean sea level rise, GMSLR] budget is that a relationship between global climate change and the rate of GMSLR is weak or absent in the past. The lack of a strong relationship is consistent with the evidence from the tide-gauge datasets, whose authors find acceleration of GMSLR during the 20th century to be either insignificant or small. It also calls into question the basis of the semi-empirical methods for projecting GMSLR, which depend on calibrating a relationship between global climate change or radiative forcing and the rate of GMSLR from observational data (Rahmstorf, 2007; Vermeer and Rahmstorf, 2009; Jevrejeva et al., 2010). [EPA-HQ-OAR-2014-0827-1206-A1 p.25][This comment can also be found in section 11.8 of this comment summary]

In light of these findings, the justification for the very high sea level rise projections (generally exceeding those of the IPCC AR5 and far greater than the IWG-accepted MAGICC results) produced by the DICE model is called into question and can no longer be substantiated. [EPA-HQ-OAR-2014-0827-1206-A1 p.25][This comment can also be found in section 11.8 of this comment summary]

Given the strong relationship between sea level rise and future damage built into the DICE model, there can be no doubt that the SCC estimates from the DICE model are higher than the best science would allow and consequently, should not be accepted by the IWG as a reliable estimate of the social cost of carbon. [EPA-HQ-OAR-2014-0827-1206-A1 p.25-26][This comment can also be found in section 11.8 of this comment summary]

And here again, the IWG (2015) admits that these sea level rise estimates are an outlier on the high end, yet retains them in their analysis by claiming that they were interested in representing a “range” of possible outcomes. But, even the IWG (2015) admits that the IPCC AR5 assigned “a low confidence in projections based on such [semi-empirical] methods.” It is internally inconsistent to claim the IPCC as

an authority for limiting the range of possibilities explored by the IAMs (which it did in the case of equilibrium climate sensitivity) and then go outside the IPCC to justify including a wildly high estimate of sea level rise. Such inconsistencies characterize the IWG response to comments and weaken confidence in them. We thereby suggest that our comments should be considered independently from the IWG (2015) response. [EPA-HQ-OAR-2014-0827-1206-A1 p.26][This comment can also be found in section 11.8 of this comment summary]

We did not investigate the sea level rise projections from the FUND or the PAGE model, but suggest that such an analysis must be carried out prior to extending any confidence in the values of the SCC resulting from those models—confidence that we demonstrate cannot be assigned to the DICE SCC determinations. [EPA-HQ-OAR-2014-0827-1206-A1 p.26][This comment can also be found in section 11.8 of this comment summary]

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Gregory, J., et al., 2012. Twentieth-century global-mean sea-level rise: is the whole greater than the sum of the parts? *Journal of Climate*, doi:10.1175/JCLI-D-12-00319.1, in press.

Intergovernmental Panel on Climate Change, 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Solomon, S., et al. (eds). Cambridge University Press, Cambridge, 996pp.

Intergovernmental Panel on Climate Change, 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Final Draft Accepted in the 12th Session of Working Group I and the 36th Session of the IPCC on 26 September 2013 in Stockholm, Sweden*.

Nordhaus, W., 2010. *Projections of Sea Level Rise (SLR)*, [http://www.econ.yale.edu/~nordhaus/homepage/documents/SLR\\_021910.pdf](http://www.econ.yale.edu/~nordhaus/homepage/documents/SLR_021910.pdf)

Rahmstorf, S., 2007. A semi-empirical approach to projecting future sea-level rise. *Science*, 315, 368–370, doi:10.1126/science.1135456.

Vermeer, M. and S. Rahmstorf, 2009. Global sea level linked to global temperature. *Proceedings of the National Academy of Sciences*, 106, 51, 21527–21532, doi:10.1073/pnas.0907765106.

Wigley, T.M.L., et al. *MAGICC/SCENGEN v5.3. Model for the Assessment of Greenhouse-gas Induced Climate Change/A Regional Climate Scenario Generator*. <http://www.cgd.ucar.edu/cas/wigley/magicc/>

**Response:**

EPA has reviewed this comment and has determined that the Preamble and RIA have appropriately characterized climate impacts despite the commenter’s critiques. EPA responds to the various points that the commenter makes as follows.

The commenter compares the benefits of the rule (a reduction of 1.2-1.3 ppm of CO<sub>2</sub> in 2100) to the historical change in CO<sub>2</sub> concentrations since 2009 (12 ppm, based on an annual average of 387 ppm in 2009, compared to an annual average 399 ppm in 2014). While the commenter appears to think that this

comparison (e.g., that the carbon dioxide concentration reductions resulting from the rule are about 1/10<sup>th</sup> of the increase in concentrations observed over a 5 year period) shows that the rule has little effect, the EPA considers that eliminating 6 months of concentration increase based on a single rule addressing a single sector in a single country is a meaningful reduction in the rate of rise of concentrations. This is especially true due to the lifetime of carbon dioxide perturbations.

The commenter also objects to the sentence stating that GHGs can remain in the atmosphere for decades to millennia, noting that the turnover time for carbon dioxide molecules is about 3-5 years. However, the perturbation lifetime of carbon dioxide is indeed on the order of thousands of years. In Chapter 6 of the IPCC Fifth Assessment Report, the persistence of carbon dioxide is characterized in the following fashion:

“The removal of human-emitted CO<sub>2</sub> from the atmosphere by natural processes will take a few hundred thousand years (high confidence). Depending on the RCP scenario considered, about 15 to 40% of emitted CO<sub>2</sub> will remain in the atmosphere longer than 1,000 years. This very long time required by sinks to remove anthropogenic CO<sub>2</sub> makes climate change caused by elevated CO<sub>2</sub> irreversible on human time scale”

EPA understands that any individual molecule of carbon dioxide emitted by the combustion of fossil fuels will likely be absorbed by the ocean or the biosphere on a timescale of years. However, it is well understood that this timescale is not the relevant one for understanding the climate impacts of carbon dioxide, and for the impact, it is the increase in concentrations resulting from emissions of carbon dioxide and the perturbation of the carbon cycle that matters, and this increase in concentration lasts for thousands of years, as the IPCC quote makes clear.

The commenter then makes a series of critiques about the significance of the action in terms of avoided warming, comparing the projected reduction to the total projected warming. The range of projected temperature reductions is 0.0027 to 0.0065 degrees, compared to total projected warming of 1.8 to 4.8 degrees. This is a reduction of more than 0.1%. Because this reduction is due to one action, for one sector, for one nation, it *is* a meaningful percentage. Climate change is not expected to be solved by any single action, but rather a large number of them. As discussed in the response to EPA-HQ-OAR-2014-0827-1251-A2 above, the challenge of understanding a problem of the geographic, temporal and encompassing nature of climate change can be best addressed using the Social Cost methodology for cost-benefit analysis, as it appropriately integrates over time and space and across numerous impacts.

The commenter also makes an error regarding the interpretation of the probabilistic mode of MAGICC 6.0. Comparison of any given perturbation run to the baseline should use the same set of uncertain parameters. If the appropriate procedure is followed, then in every case, there will be a reduction in warming and other impacts when comparing the future with emissions reductions to a future without. Whether the uncertainty span of the baseline runs and the perturbed runs might overlap has no relevance: in fact, the uncertainty spans do overlap in the analysis presented in the RIA, based on the uncertainty range of climate sensitivity, but noting that a perturbation run done with a climate sensitivity of 4.5 might be warmer than a baseline run with a sensitivity of 1.5 is not a useful comparison.

The commenter also critiques the discussion of considering the impacts of half a millimeter of sea level rise over thousands of miles of coastline as “ludicrous.” However, there are already existing damages from storm surges, nuisance flooding, and other events. Every additional millimeter of sea level rise will make these damages worse. This incremental damage over a single mile of coastline will be small, but there is a non-zero chance that this additional millimeter will be the last straw needed to flood a basement or subway system, overtop a levee, or short out a power line. Sea-level rise damages are non-

linear which makes the following comparison limited, but as a first order approximation, a millimeter of sea level rise that impacts 40,000 miles of coastline (e.g., the shoreline mileage of the continental US) will cause damage of the same order of magnitude as a rise in local sea level of 10 cm across 400 miles of coastline (e.g., the coast of Delaware). Such an analysis could also be done for global coastlines. Add to this the marginal increase in risk of more intense heatwaves due to a fraction of a degree of warming aggregated across the population of the U.S. or the world, and the increase in risk due to drought and floods and ocean acidification and the other myriad impacts of climate change, and there are billions of dollars of impact – exactly as calculated by the Social Cost methodology.

For the response to critiques of the sea level rise approach used in the Social Cost of Carbon, see Response to Comments Section 11.8.

**Organization:** Moving Forward Network

Importantly, Network members include individuals who live in and work directly with environmental justice communities. Moreover, many of these communities will be the hardest hit by climate change. Consequently, the Network has a personal stake in how EPA and NHSTA address harmful climate pollution from large equipment. [EPA-HQ-OAR-2014-0827-1130-A2 p.1]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change.

**Organization:** Operation Free

Additionally, the use of fossil fuels increases the likelihood of more troops sent into harm's way. As the Department of Defense's recent Report on National Security Implications of Climate-Related Risks and a Changing Climate affirms, climate change is widely recognized as a 'threat-multiplier.' Frequent and severe weather events destabilize some of the world's most dangerous regions. This exacerbates existing national security threats by pushing already unstable states to near constant crisis. The United States is requested to respond to disasters every two weeks a number likely to increase as the impacts of climate change become more acute. [EPA-HQ-OAR-2014-0827-1175 p.2] [[These comments can also be found in EPA-HQ-OAR-2014-0827-1372, pp.194-195.]]

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change as well as reducing the use of fossil fuels.

**Organization:** Respiratory Health Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p.129-131.]

It's become increasingly clear that global warming is a health threat, particularly to people living with lung disease.

Increasing heat waves put people with limited lung capacity at higher risk of hospitalization and death. Longer, hotter summers extend the ozone smog season, and increases the likelihood of unhealthy air days, cutting the gains we have made in reducing ozone precursors. More flooding means more displacement of medically vulnerable people and hinders access to medical care, and more allergenic pollen means greater risks for those with allergy-triggered asthma and misery for those who have allergies like hay fever.

Higher temps and greater droughts also increase the prevalence of wildfires, creating smoke plumes that travel hundreds of miles polluting the air where millions of people live.

The increasing effects of global warming are already having a direct impact on people's ability to breathe. It's putting vulnerable groups at risk, including babies, children, senior citizens, and those that live with chronic lung and heart conditions.

**Response:**

EPA has determined that elevated concentrations of greenhouse gases and climate change are reasonably anticipated to endanger public health and welfare, and that mitigation actions such as this rule are important steps towards reducing the rate of climate change and protecting public health.

## 10 Non-GHG Emissions Impacts and Their Associated Effects

### 10.1 Emissions Inventory Impacts

**Organization:** California Air Resources Board (CARB)

#### Neutral Comment to Provide Additional Information

##### **Comment – NOx benefits from the extended use of APUs appear overestimated**

According to page 40219 of the NPRM, to date, manufacturers are meeting the 2014 MY GHG standards without the use of automatic engine shutdown (AES) systems or APUs. U.S. EPA and NHTSA assume an APU/AES technology adoption rate of 90 percent for 2024+ MY class 7 and 8 tractors (page 40393 – 40394 of the NPRM). Given that manufacturers complied with Phase 1 without using APUs, CARB staff believes a 90 percent adoption rate may be too high. [EPA-HQ-OAR-2014-0827-1265-A1 P.172]

Additionally, CARB's engine certification database shows that almost all of the 2014 MY engines which are sold in California (especially in class 8) are certified (as 50-State families) to the California clean idle engine requirements of 30 grams/hour NOx at idle. Following U.S. EPA and NHTSA's projection of increased use of APUs during extended idling in combination tractors, the NPRM claims 34 percent NOx emissions reduction in year 2050 (page 40412 of the NPRM). Considering that APUs emit only a slightly lower NOx emissions than CA clean idle certified engines (because they are certified to CA clean idle requirements), such a high reduction in tailpipe NOx emissions (i.e., 34 percent) is not expected. [EPA-HQ-OAR-2014-0827-1265-A1 P.172]

Therefore, CARB staff encourages U.S. EPA and NHTSA to: [EPA-HQ-OAR-2014-0827-1265-A1 p.172]

1. Re-evaluate the projected level of AES/APU systems that will be used by manufacturers to comply with the requirements of the proposed regulation and;
2. Provide more information on the methodology and assumptions used to estimate the NOx emission benefits associated with this regulation.
3. Update the NOx emission benefit estimates to account for the current prevalence of clean idle certified engines.

#### **Response:**

In response to the comments from the proposal, the agencies have modified the projected adoption rates of idle reduction technologies. Additional details are provided in Chapter 2.4 and 2.8 of the RIA. Furthermore, the MOVES emission rates for extended idle and APUs were updated based on the analyses of the latest test programs that reflect the current prevalence of clean idle certified engines. This change resulted in smaller differences between emission rates for extended idle of the main engine and APUs for all criteria pollutants. Therefore, the emissions benefits of using APUs during extended idle, instead of the main engine, are much lower for non-GHGs in the final rulemaking than the proposal

(see Section VIII of the Preamble). Additional details on the revised emission rates are provided in the memorandum to the docket.<sup>203</sup>

**Organization:** California Air Resources Board (CARB)

**Comment – Need to control PM emissions from APUs to prevent Phase 2 causing PM increases**

The NPRM requests comment on the need and appropriateness to further reduce PM emissions from APUs. The Phase 1 regulations included provisions to use extended idle reduction technologies as a compliance path to meet the GHG standards for sleeper cab tractors. In developing the Phase 1 GHG standards, U.S. EPA and NHTSA assumed that manufacturers would install diesel-fueled APUs on all of the sleeper cab tractors to meet the Phase 1 GHG standards. Because the federal emission standards for APUs are less stringent than those for on-road heavy-duty engines, it was estimated that compliance with the Phase 1 standards using APUs as a compliance option would increase PM emissions by approximately 8 percent in 2030. Concerned about this potential increase in PM emissions, CARB and other stakeholders recommended that U.S. EPA and NHTSA regulate PM emissions from diesel-fueled APUs in the Phase 1 rulemaking.<sup>75</sup> However, U.S. EPA and NHTSA chose not to take action on APUs because such action was outside the scope of the Phase 1 rulemaking. [EPA-HQ-OAR-2014-0827-1265-A1 p.178-179]

To date, CARB staff is not aware of any tractor manufacturers using APUs as a technology option to meet the Phase 1 GHG standards. Nonetheless, U.S. EPA and NHTSA are proposing the use of extended idle reduction technologies as a compliance option to meet the proposed Phase 2 standards. Moreover, like in Phase 1, the proposed rule does not require PM control from APUs. Thus, U.S. EPA and NHTSA's inventory estimates project that compliance with the Phase 2 standards would increase federal PM emissions from heavy-duty trucks by approximately 10 percent in 2050 mainly due to PM increases from APUs. The NPRM requests comments on the need and appropriateness to further control PM emissions from APUs, taking into account cost, safety, noise, and energy factors. Although, as noted above, CARB staff believes the projection of APU use in the NPRM may be too high and hence the actual PM increases may be lower than projected, CARB staff is concerned about any such PM increases and believes they should be eliminated. [EPA-HQ-OAR-2014-0827-1265-A1 p.179]

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75 See <http://www.regulations.gov#!documentDetail;D=EPA-HQ-OAR-2010-0162-2354> for Phase 1 Comment submitted CARB and for comments by others "EPA Response to Comments, EPA-420-R-11004, August 2011, Pages 136-140 <http://www.epa.gov/otaq/climate/regs-heavy-duty.htm>.

**Response:**

In addition to the CO<sub>2</sub> emission standards for tractors, EPA is adopting Phase 1 and Phase 2 requirements to control particulate matter (PM) emissions from diesel-fueled auxiliary power units (APU) installed in new tractors. Additional details are discussed in Section III.C.3 of the FRM Preamble.

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<sup>203</sup> U.S. EPA. Updates to MOVES for Emissions Analysis of Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 FRM. Docket No. EPA-HQ-OAR-2016. July, 2016.



## 10.2 Health Effects, Environmental Effects, and Air Quality Impacts of Non-GHG Pollutants

**Organization:** American Lung Association

This past April, the American Lung Association's 16th annual State of the Air report once again found that cities in California ranked among the most polluted in the nation for both ozone and particle pollution. Transportation is leading source of pollution here, threatening the health of all residents of this region, but especially children, seniors, people living with asthma, COPD and other respiratory conditions. Pollution from the transportation sector is an added burden for those communities most disadvantaged by multiple pollution sources, including refineries, ports, rail yards and the freeways that carry the nation's goods through these communities first and most. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.142-143.]]

The residents of Southern California and the San Joaquin Valley have perhaps the most to gain from a strong rule of any area in the nation. In the past months, Californians have experienced record temperatures, raging wildfires, torrential flooding and a persistent drought that has grown over the past four years into a major threat to air quality, water supplies, and the way of life that makes California unique. [NHTSA-2014-0132-0087-A1 p.2 [These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.143.]]

**Organization:** Bay Area Air Quality Management District (BAAQMD)

The San Francisco Bay Area (Bay Area) is home to more than 7 million people, and has one of the densest populations located adjacent to highways in the United States. The BAAQMD Community Air Risk Evaluation (CARE) program and California Air Resources Board (ARB) studies have shown that 85% of the risk from toxic air contaminants in the Bay Area comes from diesel Particulate Matter (PM). This is a significant air quality problem especially in the West Oakland area where an ARB health-risk assessment showed that up to 70% of the cancer risk is coming from on-road sources of air pollution. [EPA-HQ-OAR-2014-0827-1136-A1 p.1]

**Organization:** California Air Resources Board (CARB)

In 1998, CARB identified diesel PM as a toxic air contaminant. In 2012, the International Agency for Research on Cancer, which is part of the World Health Organization, also classified diesel engine exhaust as carcinogenic to humans.<sup>76</sup> Numerous studies have shown diesel PM's adverse effects on human respiratory and cardiovascular systems and its contribution to increased morbidity and mortality. Further details regarding diesel PM health effects is available on CARB's website at <http://www.arb.ca.gov/research/diesel/diesel-health.htm>. [EPA-HQ-OAR-2014-0827-1265-A1 p.180]

The health risk posed by diesel PM is one of the largest public health problems tackled by CARB in recent decades, and even after an extensive control program including a series of air toxic control measures in California (see for example the mobile source measures listed at <http://www.arb.ca.gov/toxics/atcm/atcm.htm>), diesel PM remains responsible for 60 percent of the known risk for air contaminants. Hence, controlling diesel PM remains a huge priority for CARB. Diesel PM also contains black carbon, which is a powerful short-lived climate pollutant, so even beyond the toxicity reasons for controlling diesel PM, there are climate reasons as well. The PM 2.5 increases projected for the Phase 2 regulation are very significant – an increase of 1,631 tons and 2,257 tons of nationwide PM 2.5 in 2035 and 2050,<sup>77</sup> respectively. To put those emission increases in perspective,

they are greater than the entire projected reductions of 1,058 tons statewide diesel PM in 2023 from CARB's Truck and Bus Regulation.<sup>76</sup> While this issue does not significantly affect California because CARB already requires DPFs on APUs, CARB staff supports adopting similar requirements at the federal level concurrent with the Phase 2 program. [EPA-HQ-OAR-2014-0827-1265-A1 p.180-181][This comment can also be found in section 4.6 of this comment summary]

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<sup>76</sup> IARC: Diesel Engine Exhaust Carcinogenic, <http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213E.pdf>

<sup>77</sup> Phase 2 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Notice of Proposed Rulemaking; 40 CFR 1036; 40 CFR 1037; 40 CFR 86; <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-0002>.

<sup>78</sup> (CARB, 2014d) California Air Resources Board, "Staff Report: Initial Statement of Reasons for Proposed Rulemaking – Proposed Amendments to the Truck and Bus Regulation," page 33, March 2014, <<http://www.arb.ca.gov/regact/2014/truckbus14/tb14isor.pdf>>.

**Organization:** California State Senator Ricardo Lara

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 57.]

In order to meet our reduction goals, we must invest in cleaner transportation technologies with a technology-neutral approach that incentivizes improvements in air quality along with reductions in greenhouse gases. We have made that commitment in California, investing millions of cap and trade dollars to the development of clean truck technology. However, we need an ambitious federal standard that complements and supports these efforts with stringent rules that will be implemented as soon as possible. [This comment can also be found in section 9.3 of this comment summary]

**Organization:** City of South Bend, Indiana

Locally, air quality affects our County, with ozone and particulates adversely impacting human health approximately eight days per year.<sup>2</sup> With a diverse community and a poverty rate of 27.8 percent,<sup>3</sup> we recognize that we must protect the health of vulnerable populations while being good stewards of limited taxpayer resources. Here in South Bend we are already replacing much of our fleet with cleaner-burning and lower-cost compressed natural gas vehicles. [EPA-HQ-OAR-2014-0827-1009-A1 p.1]

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<sup>2</sup> American Lung Association, 2015 State of the Air, St. Joseph County Indiana

<sup>3</sup> U.S. Census Bureau, American Community Survey, 5-Year Estimates

**Organization:** Climate 911

35 million Americans live or work within 300 meters of a major roadway and are exposed to diesel pollution. Health consequences include adverse birth outcomes, childhood asthma, impaired lung

development, cancer, heart disease, and premature death. (EPA 2002, 2014). This hazardous exposure should be decreased to the greatest extent technically and economically feasible in the shortest possible amount of time. [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

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U.S. EPA. Health Assessment Document for Diesel Engine Exhaust (Final 2002). U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC, EPA/600/8-90/057F, 2002.

US EPA Update on Diesel Health Issues and EPA Actions 2014  
<http://www.epa.gov/cleandiesel/documents/diesel-health-issues-5-21-14.pdf> Clean Air Task Force, An Analysis of Diesel Air Pollution and Public Health in America

**Organization:** Coalition on the Environment and Jewish Life

Finally, the proposed rule would reduce toxic air pollution from idling trucks and refineries that produce fuel, resulting in \$37 billion in health and welfare benefits, including reductions in mortality and hospitalizations. Many refineries and areas where trucks idle for long periods of time are in low-income areas, so this rule will have a particularly important impact on these affected communities. [EPA-HQ-OAR-2014-0827-1249-A2 p.1]

**Organization:** Dignity Health

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 204.]

Dignity Health's healing mission and values compel us to seek ways to further improve air quality and the health of communities throughout the Southwest.

Strict standards will provide incentives to increase investment in clean truck technology and to help the U.S. meet federal ozone standards, which Dignity Health activity supports.

Our nation's current heavy-duty truck fleet poses significant health risks to Americans across the country.

**Organization:** East Yard Communities for Environmental Justice (EYCEJ)

These standards have the ability to help protect our most vulnerable populations from air pollution and the impacts of climate change. These impacts are disproportionately felt in low income and communities of color. From the idling of trucks to the refineries located next to homes and other sensitive receptors, it is the duty of the EPA to ensure that best practices are implemented to protect public health. Our members live on the fence line of oil and gas production, live with trucks idling nearby and rumbling through their neighborhoods, and shoulder the undue costs of these impacts through medications, hospitalizations, physical ailments, and premature deaths. [EPA-HQ-OAR-2014-0827-0843 p.1-2]

**Organization:** Environmental Law and Policy Center

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 216-219.]

They would save over a thousand lives each year.

The proposed regulation should do more to protect children's health. Asthma hospitalization rates in Chicago are nearly double those of the national average, and that's why we're so concerned that the proposed rule would actually increase particulate pollution by encouraging the use of auxiliary power units on trucks. We urge you to amend this rule by requiring that these units be equipped with particulate filters. This would eliminate the long-term increase in particulate pollution which may occur as a result of these regulations. [This comment can also be found in section 4.6 of this comment summary]

**Organization:** Gilroy, JD

Since I work as a health care utilization analyst for a large insurance company, I am very well aware that massive reductions in pollution can also yield great reductions in morbidity and mortality for residents susceptible to asthma, heart attacks, and other cardiovascular conditions. To speak anecdotally, while I take great joy in the beauty of the city of Chicago, the air quality here is notoriously bad, even years after the state of Illinois outlawed public indoor smoking and the city closed two old coal-fired power plants known as Crawford and Fisk. I have simply lost count of all the friends and family members who suffer from asthma or other more exotic medical conditions that are very probably linked in part to environmental toxins and irritants. [EPA-HQ-OAR-2014-0827-0751 p.2]

**Organization:** Houston-Galveston Area Council (H-GAC)

This rule, as proposed, will have substantial regional air quality and public health benefits. Projected emission reductions of 2.4 million tons of NOx emissions over the lifetime of the program should result in significant improvements of ground level ozone levels in our region. [EPA-HQ-OAR-2014-0827-1142-A2 p.1]

**Organization:** Illinois Public Interest Research Group (PIRG)

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 255.]

The standards are also important for public health. The reduction of toxic air pollution by the proposal rule will result in \$37 billion in health and welfare benefits, including reductions in mortality and hospitalizations.

**Organization:** League of Women Voters of Los Angeles County

As we continue to learn that climate change is expected to increase to dangerous ozone levels in many areas and that the poorest people live within the areas closest to Los Angeles County's main port areas of Los Angeles and Long Beach and along the related freeway truck routes, it is abundantly clear that unless we adopt the proposed truck standards, air pollution will worsen asthma symptoms and trigger higher rates of asthma attacks among children and adults, along with other dire impacts on the health of citizens of Los Angeles County.

**Organization:** Manufacturers of Emission Controls Association (MECA)

Emission reductions aimed at lowering emissions of the primary precursors of ozone such as volatile organic compounds (VOCs) and NO<sub>x</sub>, will have a positive impact on lower ambient ozone levels, climate change, as well as human health. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

**Organization:** Mass Comment Campaign sponsored by anonymous 1 (email) - (23)

I am concerned about the impact of climate change and air pollution on the health of my family. Climate change threatens the health of our children through increased heat, air pollution, fires, storms, drought, airborne allergens, and other serious effects. That's why I strongly support improved fuel efficiency standards that would reduce dangerous climate pollution from medium and heavy duty trucks. [EPA-HQ-OAR-2014-0827-1341-A1 p.1]

The proposed standards will help protect our families from harmful climate change and from unhealthy air pollution. They will significantly reduce our national fuel consumption, and will save money for both truckers and consumers. [EPA-HQ-OAR-2014-0827-1341-A1 p.1][This comment can be found in 9.4 of this comment summary]

**Organization:** Mass Comment Campaign sponsored by the Pew Charitable Trusts (web) - (4,452)

Burning less fossil fuels also means less pollution and related illnesses such as asthma [EPA-HQ-OAR-2014-0827-1252-A1 p.1]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **The link between Ground Level Ozone and Climate Change**

There is a significant linkage between ground level ozone concentrations and climate change impacts. One example was detailed by a group of researchers from the United Kingdom in a 2007 Nature publication. In this work, ground-level ozone was shown to damage plant photosynthesis resulting in lower carbon dioxide uptake from plants that have been exposed to higher levels of ozone. Other studies have shown that increasing average annual temperatures, resulting from climate change, are likely to result in even higher levels of ozone in the environment. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

Emission reductions aimed at lowering emissions of the primary precursors of ozone such as volatile organic compounds (VOCs) and NO<sub>x</sub>, will have a positive impact on lower ambient ozone levels, climate change, as well as human health. [EPA-HQ-OAR-2014-0827-1210-A3 p.3]

Policies that aim to reduce ambient ozone levels may also become more necessary and important to either mitigate the climate change impacts of ground level ozone or to mitigate higher ozone levels that result from climate change. [EPA-HQ-OAR-2014-0827-1210-A3 p.3-4]

The health-based National Ambient Air Quality Standards require that states focus on reducing their ambient levels of criteria pollutants. California and the Northeast states are struggling to achieve existing federal ozone ambient standards, and are already preparing to meet tighter ozone NAAQS limits in the future. These states are concerned about GHG emissions as well as NO<sub>x</sub> from mobile sources such as heavy-duty engines since the mobile sector represent 50-80% of their NO<sub>x</sub> inventory.

Implicit in federal and state greenhouse gas emission analyses is the ability of these advanced powertrain options to meet the applicable criteria pollutant emission standards, such as CO, NO<sub>x</sub>, and non-methane organic gases (NMOG). All of these advanced, heavy-duty powertrain options combined with the appropriately designed and optimized emission control and efficiency technologies can meet all current and future federal and state criteria emission requirements. In this manner, advanced emission controls for criteria pollutants enable advanced powertrains to also be viable options for reducing greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.4]

**Organization:** Moms Clean Air Force

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 64-65.]

While I, of course, am concerned about my child's health, I know that also frequently there are more freight depots and shipping companies in frontline neighborhoods where pollution is worse than in my neck of the woods. In Illinois, the rate of childhood asthma is at 13 percent, which is one percent higher than the national rate. The age adjusted asthma mortality rate here in Chicago is nearly five times higher in non-Hispanic blacks than in non-Hispanic whites. This rule will have a significantly positive impact on these affected communities.

**Organization:** Moving Forward Network

*Eliminate loophole for Auxiliary Power Units (APUs), which will increase harmful Particulate Matter Emissions* – As the California Air Resources Board has pointed out, a regulation that will increase the use of APUs more extensively throughout the nation will result in increased PM<sub>2.5</sub> emissions unless these APUs are equipped with diesel particulate filters. We cannot sacrifice public health protections as we seek to battle climate pollution. We represent groups on the front lines battling deadly pollution from the freight industry. This approach that increase PM<sub>2.5</sub> emissions is even more problematic given at least one state, California, has shown that diesel particulate filters can be required on APUs. The final rule should require the use of diesel particulate filters on APUs. [EPA-HQ-OAR-2014-0827-1130-A2 p.2][This comment can also be found in section 4.6 of this comment summary]

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

## **Ozone**

Ozone remains a persistent pollution problem in parts of the NESCAUM region during warm weather months. The evolution of severe ozone episodes often begins with the passage of a large high pressure area from the Midwest to the middle or southern Atlantic states. Three primary pollution transport pathways affect air quality in the region: long-range, mid-level, and near-surface. During severe ozone episodes associated with high-pressure systems, these pathways converge on the Mid-Atlantic area, where sea and bay breezes act as a barrier and funnel ozone and other air pollutants up the Northeast Corridor. [EPA-HQ-OAR-2014-0827-1221-A1 p.4-5]

Collectively, NO<sub>x</sub> emissions and ambient ozone concentrations in the region have dropped significantly since 1997, along with the frequency and magnitude of exceedances of the health-based ozone national ambient air quality standard (NAAQS).<sup>5</sup> Despite this demonstrated progress, some of the most populous areas of the region continue to violate the 2008 0.075 ppm ozone NAAQS. Attaining the standard in these areas will require significant additional NO<sub>x</sub> reductions within the Northeast and in upwind areas.

Looking toward the future, additional NO<sub>x</sub> reductions will be critical to ozone attainment in order to meet the recently revised 0.070 ppm ozone NAAQS, which EPA projects will continue to be exceeded in our region in 2025. [EPA-HQ-OAR-2014-0827-1221-A1 p.5][This comment can also be found in section 15.8.2 of this comment summary]

### **Particulate Matter**

Scientific evidence has established a solid link between cardiac and respiratory health risks and transient exposure to ambient fine particle pollution that is capable of penetrating deep into the lungs.<sup>6</sup> Exceedances of the fine particle NAAQS can occur at any time of the year, with some of the highest levels often reached in the winter. There are important differences in the chemical species responsible for high fine particle levels during summer and winter in the Northeast. Regional fine particle formation in the eastern United States is primarily due to SO<sub>2</sub>, but NO<sub>x</sub> is also important because of its influence on the chemical equilibrium between sulfate and nitrate particles during winter when nitrates can be a relatively greater contributor to urban PM<sub>2.5</sub> levels. [EPA-HQ-OAR-2014-0827-1221-A1 p.5][This comment can also be found in section 15.8.2 of this comment summary]

### **Acid Deposition**

Atmospheric sources of nitrogen are a primary contributor to acidification of forest soils and fresh water ecosystems in the Northeast. Nitrogen saturation results in a number of important changes in forest ecosystem functions, including: (1) increased acidification of soils and surface waters; (2) depletion of soil nutrients and the development of plant nutrient imbalances; and (3) forest decline and changes in species composition. More than 30 percent of the lakes in the Adirondacks and at least 10 percent of the lakes in New England are susceptible to the effects of acidic episodes that include long-term increases in mortality, emigration, and reproductive failure of fish, as well as short-term acute effects. Acidic episodes can occur at any time of the year but typically are most severe during spring snowmelt, when biological demand for nitrogen is low and saturated soils exhibit lower nitrogen retention.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1221-A1 p.5-6]

### **Marine Eutrophication**

Airborne nitrogen is an important contributor to eutrophication, the process by which a body of water acquires a high concentration of nutrients that promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Atmospheric nitrogen is a major contributor to eutrophication of key coastal resources in the Northeast, including Barnegat Bay in New Jersey and Long Island Sound.<sup>8</sup> The Chesapeake Bay is the largest estuary in the U.S. and its watershed stretches across more than 64,000 square miles, encompassing parts of six states, including New York. Since the 1950s, the bay has experienced a decline in water quality due to over-enrichment of unwanted nutrients such as phosphorus and nitrogen. The major contributors to nutrient discharge in the bay are wastewater effluent, urban and agricultural runoff, and air deposition.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1221-A1 p.6]

### **Visibility Impairment**

Regional haze is a form of air pollution that obscures the views of city skylines as well as “pristine” scenic vistas. It is caused by fine particle air pollution and can cover hundreds of square miles in the East. Natural visibility conditions in the East are estimated at 60 to 80 miles in most locations. Under current polluted conditions, average visibility ranges from 20 to 40 miles. On the worst days, regional haze can reduce visibility to just a few miles. Outdoor recreation is a multi-billion dollar industry in the

U.S. and is of particular economic importance to communities near protected federal lands. Surveys indicate visitors have rated “clean, clear air” as among the most important features of national parks and have overwhelmingly ranked scenic views and clean air as “extremely” or “very” important. Studies have yielded estimates in the billions of dollars for the visibility benefits associated with substantial national pollution reductions.<sup>10</sup> While sulfate, formed from SO<sub>2</sub> emissions, is currently the most important particle constituent of regional haze in the East, reductions in other local and distant pollutant emissions, including NO<sub>x</sub>, will be necessary to achieve the nation’s long-term goal of restoring pristine visibility conditions year-round in national parks and wilderness areas.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1221-A1 p.6-7]

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5 NESCAUM. 2010. The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description, prepared for the Ozone Transport Commission by NESCAUM, Boston, MA (August 2010). Available at:  
[http://www.nescaum.org/documents/2010\\_o3\\_conceptual\\_model\\_final\\_revised\\_20100810.pdf](http://www.nescaum.org/documents/2010_o3_conceptual_model_final_revised_20100810.pdf).

6 U.S. EPA. 2005. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, USEPA OAQPS Staff Paper, EPA-452/R-05-005a (December 2005).

7 Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, K.F. Lambert, G.E. Likens, J.L. Stoddard, and K.C. Weathers. 2001. Acidic deposition in the northeastern United States: Sources and inputs, ecosystem effects, and management strategies, *BioScience* 51, 180–198.

8 Bricker, S.B., C.G. Clement, D.E. Pirhalla, S.P. Orlando, and D.R.G. Farrow. 1999. National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation’s Estuaries, NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, MD: 71 pp.

9 Maryland Department of the Environment, Chesapeake Bay Restoration,  
<http://www.mde.state.md.us/programs/Water/Pages/water/bayrestoration.aspx> (accessed September 1, 2011).

10 NESCAUM. 2001. Regional Haze and Visibility in the Northeast and Mid-Atlantic States, NESCAUM, Boston, MA (January 31, 2001). Available at:  
<http://www.nescaum.org/documents/regional-haze-and-visibility-in-the-northeast-and-mid-atlantic-states/>.

11 In 1999, EPA promulgated the Regional Haze Rule in pursuit of the national visibility goal created by Congress in the Clean Air Act to ultimately restore natural visibility conditions in 156 national parks and wilderness areas across the country (called “Class I” areas).

**Organization:** Respiratory Health Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p.129.]



Tailpipe derived particulate matter triggers asthma attacks and heart attacks, and drives increases in emergency room visits, and hospitalizations, and premature deaths. Eliminating those emissions as well as slashing ozone forming and toxic air pollution has reduced health risks and, in fact, has saved lives.

**Response:**

EPA agrees that emissions of non-GHG pollutants from heavy-duty vehicles contribute to ambient air pollution that poses significant health and environmental concerns. Along with reducing GHGs, the Phase 2 standards also have an impact on non-GHG, criteria and air toxic pollutant, emissions. As discussed in Section VIII.C of the Preamble, the standards will impact exhaust emissions of these pollutants from vehicles and will also impact emissions that occur during the refining and distribution of fuel (upstream sources). Reductions in emissions of NO<sub>x</sub>, VOC, PM<sub>2.5</sub> and air toxics expected as a result of the Phase 2 standards will lead to improvements in air quality, specifically decreases in ambient concentrations of PM<sub>2.5</sub>, ozone, NO<sub>2</sub> and air toxics, as well as better visibility and reduced deposition. Section VIII of the Preamble for this final rule details the health and environmental impacts associated with non-GHG air pollutants. In addition, Section VIII.A.6 focuses on diesel exhaust and Section VIII.A.8 focuses on exposures and health effects associated with traffic. EPA also agrees that Environmental Justice (EJ) is an important principle and a more detailed discussion on EJ is included in Section VIII.A.9.

Several commenters noted concern about the fact that the proposal increased PM<sub>2.5</sub> emissions due to increased usage of auxiliary power units (APUs). EPA is adopting Phase 1 and Phase 2 requirements to control PM<sub>2.5</sub> emissions from APUs installed in new tractors, so we do not expect increases in downstream PM<sub>2.5</sub> emissions from the Phase 2 program. Additional discussion of the APU requirements can be found in Section 4.6 of this Response to Comments document.

## **11 Economic and Other Impacts**

### **11.1 General Comments**

#### **Organizations Included in this Section:**

Burger, Mark  
Business for Innovative Climate & Energy Policy  
Ceres  
City of South Bend, Indiana  
Clean Fuels Ohio (CFO)  
Coalition on the Environment and Jewish Life  
Consumer Federation of America (CFA)  
Earth Day Coalition (EDC)  
Edison Solar Inc.  
Energy Ohio Network  
Environment America and other local citizens across America  
Fuller, Tony  
Greenways to Go  
Houston-Galveston Area Council (H-GAC)  
Illinois Public Interest Research Group (PIRG)  
Investor Network on Climate Risk  
Los Angeles Cleantech Incubator (LACI)  
Lubrizol Corporation  
Mazza & Sons, Inc.  
Momentum Wireless Power  
MPI Solar  
Nelson, Dennis  
Ohio Sustainable Business Council (SBC)  
PepsiCo  
Pew Charitable Trusts  
Quasar Energy Group  
Sanborn Head  
Solar Provider Group  
Truck & Engine Manufacturers Association (EMA)  
Utility Trailer Manufacturing Company  
Werner Enterprises

#### **11.1.1 Positive Comments on Economic Impact, Cost and Benefit Analysis**

**Organization:** Burger, Mark

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 132.]

I want to emphasize the economic benefits that improved truck fuel efficiency standards will bring. Improved fuel efficiency standards resulting in demand destruction are one of the best tools to reduce pollution and keep fuel prices affordable. The fuel efficiency standards of cars and light trucks has resulted in the present savings of about three to four million barrels a day in the U.S.

**Organization:** Business for Innovative Climate & Energy Policy

Stronger standards would be important drivers of economic growth, benefiting both businesses and consumers. A joint analysis by Ceres and the Environmental Defense Fund found that stronger standards would reduce freight costs by 6.8% in 2040, an annual savings potential of approximately \$34 billion.<sup>2</sup> [NHTSA-2014-0132-0095-A1 p.1]

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<sup>2</sup> M. J. Bradley and Associates LLC, “EPA/NHTSA Phase 2 Fuel Efficiency & GHG Standards for Freight Trucks: Projected Effect on Freight Costs.” May 2015. Web. <http://www.ceres.org/trucksavings>

**Organization:** Ceres

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 200-201.]

Strict standards will catalyze investment in high efficiency truck technologies, thereby serving to retain the U.S. leadership position in this sector, save businesses money, promote energy security, and reduce climate risk. Such standards would be important drivers of economic growth, benefitting businesses, the trucking industry, and American consumers.

**Organization:** City of South Bend, Indiana

With medium-and heavy-duty vehicles accounting for twenty percent of US oil consumption but only five percent of vehicles,<sup>1</sup> the opportunity for improvement is significant. Requiring increased efficiency in a flexible, cost-effective way helps make U.S. businesses located in South Bend more competitive globally — especially beneficial to the rapidly-growing distribution and logistics companies that operate in our region. [EPA-HQ-OAR-2014-0827-1009-A1 p.1]

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<sup>1</sup> EPA and DOT propose greenhouse gas and fuel efficiency standards for heavy-duty trucks. NHTSA.

**Organization:** Clean Fuels Ohio (CFO)

Opportunities improving truck fuel efficiency are also great (and growing) based on already-existing technologies and others in the R&D pipeline that show future promise: [EPA-HQ-OAR-2014-0827-1192-A1 p.1]

The EPA has suggested that phase two would result in \$230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others. [EPA-HQ-OAR-2014-0827-1192-A1 p.2]

Clean Fuels Ohio encourages all parties to continue to work together as these rules are implemented to ensure maximum gains for efficiency that will produce longer-term cost savings, health and environmental benefits, overall economic benefits and gains in U.S. energy security while minimizing the disruptive impacts of higher up-front costs to commercial vehicle users. [EPA-HQ-OAR-2014-0827-1192-A1 p.2]

**Organization:** Coalition on the Environment and Jewish Life

In addition to the environmental benefits of reducing emissions, strong standards would create jobs, save households money, and protect public health. These standards will drive investments in fuel

efficient technology innovation and deployment, which will create new markets and tens of thousands of new jobs. [EPA-HQ-OAR-2014-0827-1249-A2 p.1]

**Organization:** Consumer Federation of America (CFA)

We next examine other, indirect benefits and costs. These are generally externalities that we would not expect producers and consumers to take into account in their decision making, but as important social costs and benefits, they should be taken into account in policymaking. Here we include macroeconomic considerations, including the rebound effect and public health effects. These benefits and costs increase the total value of the proposed rule significantly. [EPA-HQ-OAR-2014-0827-1336-A1 p.45]

The other two effectiveness tests involve environmental benefits. The economic benefits of fuel savings mean the environmental benefits are “free.”

With respect to the second measure, which is useful for comparisons to other GHG rules, the proposed standards would have overall \$/ton costs similar to the HD Phase 1 rule.... less than \$50 per metric ton of GHG (CO<sub>2</sub> eq) for the entire HD Phase 2 program. This compares well to... the agencies’ estimates of the social cost of carbon. Thus, even without accounting for fuel savings, the proposed standards would be cost effective. The third measure deducts fuel savings from technology costs, which also is useful for comparisons to other GHG rules. On this basis, net costs per ton of GHG emissions reduced would be negative under the proposed standards. [EPA-HQ-OAR-2014-0827-1336-A1 p.47-48]

This means that the value of the fuel savings would be greater than the technology costs, and there would be a net cost saving for vehicle owners. In other words, the technologies would pay for themselves (indeed, more than pay for themselves) in fuel savings. [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

In addition, while the net economic benefits (*i.e.*, total benefits minus total costs) of the proposed standards is not a traditional measure of their cost effectiveness, the agencies have concluded that the total costs of the proposed standards are justified in part by their significant economic benefits. [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

[T]his rule would provide benefits beyond the fuel conserved and GHG emissions avoided. The rule’s net benefits is a measure that quantifies each of its various benefits in economic terms, including the economic value of the fuel it saves and the climate-related damages it avoids, and compares their sum to the rule’s estimated costs. The agencies estimate that the proposed standards would result in net economic benefits exceeding \$100 billion, making this a highly beneficial rule.<sup>34</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

The second largest source of benefit is the environmental and public health benefits, accounting for a little over a quarter of the total benefits.<sup>35</sup> The value of the reduction in greenhouse gas emissions alone equals the total cost of the proposed rule. Other public health benefits are of similar magnitude to the value of greenhouse gas reductions. Environmental benefits are almost twice as large as the costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

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<sup>34</sup> EPA/NHTSA, PHASE II NOPR, p. 40169. As noted above, all costs and benefits are taken from the analysis which uses a 3% discount rate. Given the flat line of fuel economy over decades, we also report the results for the less dynamic base case. Other cases and discount rates support the same conclusions.

<sup>35</sup> EPA/NHTSA, PHASE II NOPR, Table I-8.

**Organization:** Consumer Federation of America (CFA)

Combining all of the costs and benefits, the benefit to cost ratio is over 8-to-1. For tractor trailers, which account for two-thirds of the fuel consumption of medium and heavy duty trucks, the benefit cost ratio is 10-to-1. This is a very high benefit cost ratio that highlights the question of why EPA/NHTSA did not push the standard to a higher level. [EPA-HQ-OAR-2014-0827-1336-A1 p.49]

**Organization:** Earth Day Coalition (EDC)

New fuel economy standards proposed by EPA and the Department of Transportation represent an opportunity to deliver significant cost savings, reduce fuel consumption and reduce emissions. Some context: [EPA-HQ-OAR-2014-0827-1169-A1 p.1]

- Medium- and heavy-duty trucks only make up 7 percent of all vehicles on the road but consume 25 percent of the fuel used by all vehicles. [EPA-HQ-OAR-2014-0827-1169-A1 p.1]
- The heavy-duty vehicle sector is second largest and fastest growing segment of the U.S. transportation sector in terms of emissions and energy use. [EPA-HQ-OAR-2014-0827-1169-A1 p.1]

According to the American Trucking Association, fuel is the single largest expense for motor carriers — accounting for nearly 40 percent of operating costs. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

- Travel among heavy-duty vehicles is expected to increase by nearly 50 percent over the next 25 years according to the Energy Information Administration. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]
- The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

- Finalizing a strong second phase rule is expected to save vehicle owners \$170 billion in fuel costs while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons over the lifetime of vehicles sold under the program. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]
- In total, the program would result in \$230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]
- Fuel savings will help bring down the costs of transporting goods, with the average household saving \$150 a year by 2030, assuming the savings and costs are passed through to consumers. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

As you can see, these new standards are a win for shippers, a win for businesses that rely on trucks to transport goods and materials, and a win for consumers who purchase products carried by trucks. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

Finally, we know that improving truck fuel efficiency is achievable and can be done affordably: [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

- Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]
- In model year 2027, a new tractor-trailer owner would recoup the extra cost of technology used to achieve the standards within 2 years. [EPA-HQ-OAR-2014-0827-1169-A1 p.2]

According to the American Trucking Association, fuel is the single largest expense for motor carriers — accounting for nearly 40 percent of operating costs.

- Travel among heavy-duty vehicles is expected to increase by nearly 50 percent over the next 25 years according to the Energy Information Administration.
- The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010.

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing):

- Finalizing a strong second phase rule is expected to save vehicle owners \$170 billion in fuel costs while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons over the lifetime of vehicles sold under the program.
- In total, the program would result in \$230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others.
- Fuel savings will help bring down the costs of transporting goods, with the average household saving \$150 a year by 2030, assuming the savings and costs are passed through to consumers.

As you can see, these new standards are a win for shippers, a win for businesses that rely on trucks to transport goods and materials, and a win for consumers who purchase products carried by trucks.

Finally, we know that improving truck fuel efficiency is achievable and can be done affordably:

- Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.
- In model year 2027, a new tractor-trailer owner would recoup the extra cost of technology used to achieve the standards within 2 years.

**Organization:** Edison Solar Inc.

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

• In total, the program would result in \$230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others. [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

As you can see, these new standards are a win for shippers, a win for businesses that rely on trucks to transport goods and materials, and a win for consumers who purchase products carried by trucks. [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

**Organization:** Energy Ohio Network

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>7</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1331-A1 p.2]

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<sup>7</sup> <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

<sup>8</sup> <http://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf>

**Organization:** Environment America and other local citizens across America

Setting a strong second-phase standard will help fleets save more money on fuel. For example, manufacturers could improve the efficiency of transit buses, school buses, utility trucks and other “vocational” vehicles by almost a third by 2025, with technology that would pay for itself in fuel savings in less than 4 years (compared to an average life of 15 years for an average transit bus, for example).[5] Payback times for heavy-duty pickups and vans would be less than three years. And for tractor-trailers, efficient technology could pay for itself completely in only 13 months.[6]

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<sup>[5]</sup> [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Fuel-Savings-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Fuel-Savings-Factsheet.pdf); [http://www.fta.dot.gov/documents/Useful\\_Life\\_of\\_Buses\\_Final\\_Report\\_4-26-07\\_rv1.pdf](http://www.fta.dot.gov/documents/Useful_Life_of_Buses_Final_Report_4-26-07_rv1.pdf)

<sup>[6]</sup> [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Fuel-Savings-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Fuel-Savings-Factsheet.pdf);

**Organization:** Fuller, Tony

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 149.]

Increased standards would yield additional health, economic, and environmental benefits with minimal costs, especially when you factor in the long-term threats posed by climate change and the health and economic benefits.

**Organization:** Greenways to Go

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 280-281.]

The proposed standards would establish a level playing field to finding areas where American innovation can provide solutions that benefit society as a whole by continuing to lead the U.S. and the world on a path of responsibly managing man's impacts on the earth's ecosystems while reducing the need for the U.S. to import oil. This leads to economic stimuli, jobs, reduced risks, and reduced costs required to globally protect oil, and reduce trade deficits in a more competitive U.S. global economic profile. [EPA-HQ-OAR-2014-0827-1372 p.280-281]

These technical advances will soon come from somewhere in the world, and having the U.S. leading these improvements will result in exporting of U.S. technologies, meaning even more American jobs and cash flow. Initiatives like the fuel efficiency standards help educate all of us on why we should be mindful of proper stewardship of the finite air, water, and land resources we share. [EPA-HQ-OAR-2014-0827-1372 p.281]

**Organization:** Houston-Galveston Area Council (H-GAC)

The rule, as proposed, will result in economic benefits for the region, with national estimates showing that the average household will save \$150 per year. Additionally, regional heavy-duty fleets serving our region are projected to see substantial savings over the lifetime of the proposed rule as well. [EPA-HQ-OAR-2014-0827-1142-A2 p.1]

**Organization:** Illinois Public Interest Research Group (PIRG)

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 255.]

Further, consumers support decreasing emissions. A Consumer Federation of America poll released in May 2015 found that a majority of Americans favor requiring manufacturers to increase the fuel efficiency of heavy duty trucks while less than one-quarter opposed this requirement. Consumers' voices should be considered with these standards.

**Organization:** Investor Network on Climate Risk

Strong standards would be important drivers of economic growth, benefiting businesses, truck manufacturers and suppliers, and consumers. A joint analysis by Ceres and the Environmental Defense Fund found that strong standards would save \$0.21 per mile by 2040. The same study indicated that strong standards would reduce freight costs by 3% in 2030 and 7% in 2040, an estimated \$34 billion annual saving potential.<sup>2</sup> [NHTSA-2014-0132-0113-A1 p.1-2]

Strict standards are also crucial for the United States to retain its leadership position in efficient truck manufacturing and expand job opportunities in that sector. We are currently the world leader in the development, production and use of energy-efficient and hybrid trucks. Without strong standards in place, companies and investors will lack the requisite certainty to invest in the development and production of new technologies that will allow us to retain our primary position and increase job growth. [NHTSA-2014-0132-0113-A1 p.2]



<sup>2</sup> M. J. Bradley and Associates LLC, “EPA/NHTSA Phase 2 Fuel Efficiency & GHG Standards for Freight Trucks: Projected Effect on Freight Costs.” May 2015. Web. <http://www.ceres.org/trucksavings>

**Organization:** Los Angeles Cleantech Incubator (LACI)

It’s an exciting time to be at the center of the City’s primary economic growth strategy: driving innovation in clean technologies. The Los Angeles region is already the largest green economy in the nation, and there is an unprecedented economic opportunity as our city, state, and country rebuilds its energy and transportation infrastructure, shifting energy dependence away from fossil fuels and toward sustainable energy sources. [EPA-HQ-OAR-2014-0827-1291-A1 p.1]

It is because of that economic opportunity that we applaud your efforts to implement strong, achievable fuel efficiency and emission standards for medium- and heavy-duty vehicles. The new standards will help save consumers and businesses money at the pump, lessen the economic and national security threats presented by oil dependence and price volatility, and – importantly from our perspective - encourage the development of new technologies to drive the transportation sector forward. [EPA-HQ-OAR-2014-0827-1291-A1 p.1]

Strong fuel efficiency standards will stimulate domestic innovation and manufacturing. Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks. It will also create opportunities for American companies and entrepreneurs to come up with breakthrough technologies to drive the transportation sector forward. [EPA-HQ-OAR-2014-0827-1291-A1 p.1-2]

**Organization:** Lubrizol Corporation

When finalized and implemented, the Phase 2 Rule will provide significant economic, health, environmental, and energy benefits from new trucks and buses built between 2018 and 2027. As EPA has estimated, the final Rule will cut CO<sub>2</sub> emissions by roughly 1 billion metric tons, save an estimated 1.8 billion barrels of oil, and deliver net benefits of \$230 billion to society in fuel savings, environmental improvements, and reduced health costs. [EPA-HQ-OAR-2014-0827-1325-A1 p.2]

**Organization:** Mazza & Sons, Inc.

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>7</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>8</sup>

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<sup>7</sup> <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

<sup>8</sup> <http://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf>

**Organization:** Momentum Wireless Power

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014. As travel among heavy-duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>4</sup> [EPA-HQ-OAR-2014-0827-0755-A1 p.1-2]

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>7</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>8</sup> [EPA-HQ-OAR-2014-0827-0755-A1 p.2]

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<sup>3</sup> <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>; <https://www.census.gov/prod/2011pubs/acs-15.pdf>;

<sup>4</sup> [http://www.eia.gov/forecasts/aeo/section del iveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section%20deliveredenergy.cfm)

<sup>7</sup> <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

<sup>8</sup> <http://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf>

**Organization:** MPI Solar

The new standards will help businesses, like ours, that depends upon trucks to receive and then deliver our products and service to our customers. More fuel efficient trucks will not only save money at the pump, lower our costs, but will lessen the economic and national security threats presented by oil dependence. [EPA-HQ-OAR-2014-0827-1473-A1 p.1]

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. [EPA-HQ-OAR-2014-0827-1473-A1 p.1]

**Organization:** Nelson, Dennis

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p.94.]

Another great thing about finalizing even tougher fuel economy standards for newer tractor trailers, vocational vehicles, and heavy duty pickup trucks and cargo vans is that they comprise a no regrets transportation energy efficiency strategy. Besides promoting climate protection, they will also have other positive benefits, like cutting our oil consumption by an additional 200,000 barrels each day in

2035; reducing hazardous air pollutants from idling trucks and operating oil refineries, saving the average tractor trailer driver roughly \$30,000 annually in fuel costs in 2025; reducing the expenses for the owners of truck fleets; and driving -- pun intended -- the green energy innovation for inherently cleaner heavy duty vehicles.

**Organization:** Ohio Sustainable Business Council (SBC)

The new standards will help save consumers and businesses money at the pump, lessen the economic and national security threats presented by oil dependence and price volatility, and encourage American manufacturers to develop new technologies that spur investment in research, development, and production of advanced vehicles. [EPA-HQ-OAR-2014-0827-1177-A1 p.1]

OSBC represents a broad base of sustainable-minded business leaders, who favor sensible regulations that create opportunity, protect the public, save money, and serve the common good. [EPA-HQ-OAR-2014-0827-1177-A1 p.2]

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>7</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1177-A1 p.2]

**Organization:** Pew Charitable Trusts

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>8</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1334-A1 p.2]

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<sup>8</sup> <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

<sup>9</sup> <http://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf>

**Organization:** Quasar Energy Group

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1335-A1 p.1]

In total, the program would result in \$230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

As you can see, these new standards are a win for shippers, a win for businesses that rely on trucks to transport goods and materials, and a win for consumers who purchase products carried by trucks. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

**Organization:** Sanborn Head

Strong fuel efficiency standards are good for American manufacturing because they stimulate innovation, making U.S. businesses more competitive globally. Through partnerships with the Department of Energy, major manufacturers have proven fuel economy ratings of over 12 mpg are achievable for combination tractors through advanced technologies.<sup>7</sup> Further investment in the research, production, and deployment of vehicle innovation will give the United States an opportunity to lead international markets as countries like China and Japan consider additional efficiency requirements for trucks.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1257-A1 p.2]

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<sup>7</sup> <http://energy.gov/eere/vehicles/articles/supertruck-team-achieves-115-freight-efficiency-improvement-class-8-long-haul>

<sup>8</sup> <http://www.fiafoundation.org/media/44209/gfei-annual-report-2014.pdf>

**Organization:** Solar Provider Group

Solar Provider Group committed to solar because it's a technology that's both good for the planet and delivers an increasingly beneficial return on investment, and we feel the same way about efficient trucking. We rely on medium- and heavy-duty trucks throughout our supply chain, and stand to benefit a great deal from more efficient vehicles that save us, our partners, and our clients money on transportation costs. The transportation sector also makes up 70 percent of all oil consumption in the United States and accounts for almost 30 percent of the nation's greenhouse gas emissions, presenting a significant opportunity for improvement. [EPA-HQ-OAR-2014-0827-1235-A1 p.1]

**Organization:** Werner Enterprises

EPA and NHTSA have been presented a unique opportunity to play a major role in setting fuel efficiency standards that align with the goals of the heavy-duty vehicle, engine, and operating industry and could provide fleets like Werner with real world fuel savings that translate into reduced GHGs and savings across the market. Given fuel is one of the top operating expenses for Werner, we support the aims of improving fuel efficiency and reducing our carbon footprint. Improving fuel efficiency has long been a key component of optimizing our operations and is an effort that naturally aligns with the Agencies' goal to reduce GHG emissions. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

**Response:**

We appreciate the commenters' reviews of the agencies' economic impact, cost and benefit analyses for this rulemaking and the citation of analyses from other organizations. These positive comments and citations of our economic impact analysis, cost and benefit estimates express support for the proposed HD Phase 2 program in general.

The Agencies agree with the commenters' assertions that building on the success of the Phase 1 standards, this new phase of the national program would significantly reduce carbon emissions and fuel

consumption from a wide range of on-road vehicles – from semi-trucks and their trailers to the largest pickup trucks and vans, and all types and sizes of work trucks and buses.

The Agencies estimate that Phase 2 program would cut GHG emissions by up to 1.1 billion metric tons, conserve up to 2.0 billion barrels of oil, and lower fuel costs by about \$170 billion over the lifetime of the vehicles sold under the program for the HD vehicles.

In total, the program would result in up to 230 billion total net benefits to society, including fuel savings, carbon reductions, health, energy security, and others, as shown in Table I-10, Preamble Section I. D. (2).

The agencies agree with the commenters' remarks that this national program would be an important driver of economic growth, benefitting businesses, the trucking industry, and American consumers. The agencies also agree with the commenters' observation that the Phase 2 program will promote energy security and give the United States an opportunity to lead international markets in this sector. The Phase 2 program represents a more technology-forcing<sup>204</sup> approach than the Phase 1 approach and will benefit consumers and businesses by reducing the costs for transporting goods while spurring investment and innovation in the clean energy technology sector.

### **11.1.2 Negative Comments on Economic Impact, Cost and Benefit Analysis**

**Organization:** Competitive Enterprise Institute et al.(CEI)

It may be unrealistic to expect an agency to take responsibility for the very problem it seeks more power over industry to solve. Nonetheless, given the administration's high-profile commitment to "transparency," EPA and NHTSA should have at least addressed the issue. They have not done so. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

**Response:**

In its comment, the Competitive Enterprise Institute (CEI) jointly with others makes several points in questioning the agencies' "transparency" in addressing issues such as the justification of the rules, energy security benefits, and small trucking firm impacts. The agencies disagree with commenter's points and its claims, and our responses to these issues can be found in Sections 11.2, 11.10, and 15.2 of this RTC, respectively. On the issue of "transparency," we refer to our response in Section 15.5 of this RTC, which illustrates how the agencies have gone beyond the procedural steps required by law to promote transparency and public participation for this Phase 2 rulemaking.

**Organization:** Utility Trailer Manufacturing Company

### **THE AGENCIES' COST-BENEFIT ANALYSIS IS FLAWED.**

Executive Order 12866, which applies to significant rules issued under the Clean Air Act, requires the Agency to assess systematically the regulation's costs and benefits. The Agency properly acknowledges

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<sup>204</sup> In this context, the term "technology-forcing" is used to distinguish standards that will effectively require manufacturers to develop new technologies (or to significantly improve technologies) from standards that can be met using off-the-shelf technology alone. Technology-forcing standards do not require manufacturers to use any specific technologies.

this obligation, and refers to its Regulatory Impact Analysis, in the Proposed Rulemaking. Although the Agency has set forth its conclusions in this regard, the analysis is flawed as it significantly overstates the benefits and understates the costs associated with the Proposed Rule. [EPA-HQ-OAR-2014-0827-1183-A1 p.15]

**Response:**

The agencies disagree with the commenter's assertion that the cost-benefit analysis is flawed. The agencies use standard economic parameters (including discount rates) to measure the monetary value of the rules' impacts. These parameters, methods and assumptions are based on the best available data at the time and are documented extensively in the Preamble and RIA that accompanies the rules.

The agencies acknowledge that a wide range of estimates is available for many of the primary inputs that are used in the HD GHG emissions models. The agencies recognize that each of these values has some degree of uncertainty. The agencies tested the sensitivity of their estimates of costs and benefits to a range of assumptions about each of these inputs, and found that the magnitude of these variations would not have changed the overall conclusions of the cost benefit-analysis; i.e., that the benefits of the program far outweigh the costs. The Agencies considered uncertainty in its analysis by utilizing a range of various estimates as well as other sensitivity analyses. These included:

- The benefits and costs of these rules, which are analyzed using 3 percent and 7 percent discount rates, consistent with current OMB guidance.
- The range of Social Cost of Carbon (SCC) values, by always considering all four SCC values developed by the interagency group (RIA Chapter 8.5.1)
- Fuel prices, by using the AEO reference fuel price case in all central analysis results but also calculating the net benefits using both the AEO High and Low fuel price cases (RIA Chapter 8.12)
- Engineering costs, by calculating vehicle technology costs and maintenance costs relative to two different baseline fleets.
- A range of PM2.5-related benefit per ton values, based on two different PM-related mortality studies and the two different discount rates
- A supplemental analysis of Calendar Year PM2.5- and ozone-related benefits derived from air quality modeling (see Appendix 8A in the RIA)

In total, the agencies' analysis found that the benefits of the final rulemaking, including fuel savings and many other benefit categories such as the Social Cost of Carbon, far outweigh the costs of the standards. See Table I-10 at Preamble Section I. D. (2).

### **11.1.3 Conceptual Framework**

**Organization:** California Air Resources Board (CARB)

#### **Comment on Topic Where NPRM Requests Comment**

**Comment – Energy efficiency gap**

The NPRM requests comment on the slow adoption of cost-effective technologies for reducing fuel consumption. CARB staff supports the hypothesis that the end-users are not adopting readily available, cost-effective energy efficiency technologies because they do not have full information regarding their costs and benefits (this economic situation is known as the “energy efficiency gap” or “energy paradox”). CARB staff also recognizes that in the highly diverse and specialized heavy-duty vehicle sector, no manufacturer wants to be the first to absorb high upfront research and development costs for new technologies that other manufacturers will subsequently utilize at lower costs (the “first-mover disadvantage”). Overall, CARB staff agrees these issues necessitate further research in order to better understand the heavy-duty vehicle sector and to identify potential strategies and mechanisms to speed the adoption of fuel efficient technologies. [EPA-HQ-OAR-2014-0827-1265-A1 p.182]

**Organization:** CALSTART

An additional consideration involves market barriers to change. Even technologies showing strong results and solid payback face resistance in a marketplace where risk avoidance remains high. As an example, there is now strong data showing that technologies such as post-transmission hybrids can achieve 15-35 percent fuel economy gains in the right vocational applications, and their costs are dropping below \$20,000 and approaching in some cases \$10,000. Yet overcoming market inertia likely requires early and innovative measures to encourage OEMs and fleets to take this step. [EPA-HQ-OAR-2014-0827-1190-A1 p.6]

**Organization:** Caterpillar Inc, et al.

### **Regulation must take into account total cost of ownership**

Given the many challenges faced by truck fleets over the last decade due to factors such as fuel cost volatility, slow economic growth, fleet consolidation, increasing regulation, and higher labor costs associated with driver shortages and increased turnover, any fleet successfully competing in today’s market considers a total cost of ownership view of vehicle life-cycles. Fleets capture this data down to tenths of a cent per mile and use this information to determine their purchase timing and truck selection. The Phase 2 stringencies are predicated on the penetration of specific technologies with consideration for the impacts of fuel, maintenance, and product costs on the vehicle owners; however, they should consider additional costs associated with this very basic economic principle. [EPA-HQ-OAR-2014-0827-1215-A1 p.7]

In their cost assessments, the Agencies should consider other key factors that impact total cost of ownership. [EPA-HQ-OAR-2014-0827-1215-A1 p.7]

**Organization:** Competitive Enterprise Institute et al.

Most of the projected benefits are fuel savings for heavy duty vehicle (HDV) owners and operators. However, EPA and NHTSA provide no solid evidence that the trucking industry’s alleged “under-investment” in fuel-saving technology is due to market failure. In fact, some of the agencies’ “hypotheses” suggest that truckers are simply behaving like prudent buyers. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

As in the Phase 1 rulemaking, EPA and NHTSA ignore a more credible and obvious explanation of the alleged “energy efficiency gap.” EPA’s diesel-engine emission standards, both by directly reducing the fuel efficiency of diesel engines, and by crowding out fuel economy-related R&D investment and

consumer spending, created the problem the agencies purport to solve via additional regulation. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

### **III. The rule implies that truckers, like children, are incapable of discerning and/or pursuing their own best interest.**

If the proposed rule will have no detectable effect on climate change or energy security, what is the point? The new standards will save truckers a bundle of money, EPA and NHTSA contend. According to their calculations, the rule will increase the cost of new trucks and trailers by \$20 billion to \$30 billion over the lifetimes of the vehicles, but it will also cut fuel consumption by more than 70 billion gallons, saving truckers approximately \$90 billion to \$170 billion in reduced fuel expenditures.<sup>35</sup> In other words, truckers will reap net benefits of approximately \$70 billion to \$140 billion. [EPA-HQ-OAR-2014-0827-1251-A2 p.10]

[Table I-8 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

This should immediately raise a red flag. Trucking companies are in business to make money. As the agencies acknowledge, “Unlike light-duty vehicles – which are purchased and used mainly by individuals and households – the vast majority of HDVs are purchased and operated by profit-seeking businesses for which fuel costs represent a substantial operating expense.”<sup>36</sup> Indeed, for many truckers, fuel is the single biggest operating expense, exceeding drivers’ wages and benefits combined.<sup>37</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.11]

[Figure 8-1 can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Clearly, nobody has a keener incentive to purchase cost-effective fuel-saving technology than people who haul freight for a living. Demand for fuel-efficient trucks should, in turn, spur manufacturers to develop, produce, and market such vehicles. [EPA-HQ-OAR-2014-0827-1251-A2 p.11]

If every dollar invested to improve fuel economy yields savings of \$4-\$6, why hasn’t the market already made those investments? If the agencies’ recommended package of fuel-saving technologies is such a great bargain, why do truckers need a regulation compelling them to buy it? [EPA-HQ-OAR-2014-0827-1251-A2 p.11]

The proposed rule implies that truckers, like children, are incapable of discerning and/or pursuing their own best interest. Or it implies that manufacturers are too dim or lazy to expand market share by developing vehicles that give their customers a competitive edge. [EPA-HQ-OAR-2014-0827-1251-A2 p.11]

EPA and NHTSA don’t put things that way, of course. As in the Phase 1 rulemaking, the agencies offer “hypotheses” drawn from economics literature to explain the “paradox” of under-investment in fuel economy.<sup>38</sup> None of the explanations provides solid evidence of market failure. In fact, some indicate truckers are just behaving like prudent buyers. Let’s look at each in turn. [EPA-HQ-OAR-2014-0827-1251-A2 p.12]

### **IV. The agencies’ “hypotheses” neither demonstrate market failure nor persuasively explain the “paradox” of “under-investment.”**

The agencies summarize five hypotheses. [EPA-HQ-OAR-2014-0827-1251-A2 p.12]



(1) Imperfect Information in the New Vehicle Market. One possible reason for the supposed under investment is that information “about the effectiveness of some fuel-saving technologies” is “inadequate or unreliable.” But if the relevant information is inadequate or unreliable, how do EPA and NHTSA know the rule will deliver billions in net benefits to truckers? [EPA-HQ-OAR-2014-0827-1251-A2 p.12]

The hypothesis implies that the agencies possess technical information unavailable to industry. That is implausible, because EPA has made considerable efforts since the early 2000s to share fuel-economy information with the trucking industry, its leading firms, and trade associations. Surely the agencies’ general position that fuel-saving technology more than pays for itself is now well known throughout the industry, which has been subject to fuel-economy regulation since 2011. [EPA-HQ-OAR-2014-0827-1251-A2 p.12]

Through its voluntary SmartWay Transportation Partnership Program, EPA “has worked closely with truck and trailer manufacturers and truck fleets over the last ten years to develop test procedures to evaluate vehicle and component performance in reducing fuel consumption and has conducted testing and has established test programs to verify technologies that can achieve these reductions.”<sup>39</sup> The program is a partnership between EPA and the freight goods industry, including the American Trucking Association and 2,380 truck carrier firms.<sup>40</sup> All of the top 25 U.S. long-haul trucking companies are SmartWay Partners.<sup>41</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.12]

With all the ‘verified’ fuel-saving information EPA has been providing, semi-truck owners should exhibit the smallest gap between actual investment in fuel economy and what the agencies consider optimal. Yet that’s where the alleged “energy efficiency gap” is largest. EPA and NHTSA estimate the rule will save semi-truck owners \$144.9 billion in fuel expenditures – seven times more than the rule will save vocational truck owners (\$20.4 billion) and eight times more than it will save HD van and pickup owners(\$17.5 billion).<sup>42</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.12]

[Table 7-11 can be found on p.13 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Note: The agencies also assume long-haul truckers will reap the biggest return on investment. Semitruck owners will have to spend more (\$12.7 billion) than vocational truck owners (\$7.8 billion) and HD pickup and van owners (\$4.9 billion) to comply with the rule.<sup>43</sup> However, the projected benefit-cost ratio for semi-truck owners (11.4:1) substantially exceeds those for vocational trucks (2.6:1) and HD vans and pickups (3.5:1). So the gap is largest for that segment of the HDV market that has the most agency provided information. In short, the hypothesis does not explain why truckers (supposedly) under-invest in fuel-saving technology. [EPA-HQ-OAR-2014-0827-1251-A2 p.13]

(2) Imperfect Information in the Resale Market. The agencies hypothesize that buyers in the new vehicle market may not be willing to pay more for fuel-efficient vehicles if buyers in the used market are unwilling “to pay adequate premiums” for improved fuel economy.<sup>44</sup> But why would buyers in the used market shun vehicles that (allegedly) repay the price premium many times over? [EPA-HQ-OAR-2014-0827-1251-A2 p.13]

To our knowledge, nobody claims the resale market fails to consider the value of technologies that enhance vehicle reliability, performance, comfort, and amenities. After all, people generally are willing to pay more for a better vehicle, whether it’s new or used. [EPA-HQ-OAR-2014-0827-1251-A2 p.13]

Why should fuel economy be the exception to the rule? Maybe fuel-saving technology doesn't add much to the price of used trucks because its money-saving potential is unproven or over-rated. [EPA-HQ-OAR-2014-0827-1251-A2 p.13]

(3) Principal-agent problems causing split Incentives. According to this hypothesis, those who own trucks are often different from those who operate the vehicles. The agencies' discussion here is terse. According to the Phase 1 rulemaking, operators may have "strong incentives to economize" on fuel consumption whereas owners may place a higher priority on capital investment that "improves vehicles' durability or reduces their maintenance costs."<sup>45</sup> Even if such split incentives exist, it would still not necessarily follow that owners under-invest in fuel economy. [EPA-HQ-OAR-2014-0827-1251-A2 p.14]

There are tradeoffs — opportunity costs — in every investment decision. Whether it is smart to invest more or less in fuel economy relative to vehicle durability or any other value depends on each firm's unique circumstances. As the Phase 2 rulemaking acknowledges, "In general, businesses that operate HDVs face a range of competing uses for available capital other than investing in fuel-saving technologies, and may assign higher priority to these other uses, even when investing in higher fuel efficiency HDVs appears to promise adequate financial returns."<sup>46</sup> Spot on. The agencies, however, do not seem to grasp what that observation implies. EPA and NHTSA are in no position to divine an appropriate tradeoff for the industry as a whole, because the right tradeoff varies from firm to firm, and within each firm at different times. [EPA-HQ-OAR-2014-0827-1251-A2 p.14]

Besides, just because truck operators make the actual fuel purchases does not necessarily mean owners ignore fuel costs. An owner may delegate many purchasing decisions for many things to other people. He is nonetheless responsible for the firm's bottom line. The tradeoffs the firm makes between fuel economy and other investments inevitably show up in the firm's balance sheets. [EPA-HQ-OAR-2014-0827-1251-A2 p.14]

Strangely, the Phase 2 rulemaking postulates a split incentive that works the other way – supposedly, owners care about fuel costs but drivers don't unless offered "financial incentives."<sup>47</sup> That the literature on split incentives is itself split on whether principal or agent undervalues fuel economy is reason enough to be skeptical of this alleged market failure. [EPA-HQ-OAR-2014-0827-1251-A2 p.14]

(4) Uncertainty about Future Cost Savings. Another possible reason companies don't adopt fuel-saving technology as fast as EPA and NHTSA deem appropriate is that "HDV buyers may be uncertain about future fuel prices, or about maintenance costs and reliability of some fuel efficiency technologies." Thus buyers may discount potential future savings at higher rates than those used in the agencies' analysis. "In contrast, the costs of fuel-saving or maintenance-reducing technologies are immediate and thus not subject to discounting."<sup>48</sup> Exactly! Whereas the costs of investment in fuel-saving technology are certain and immediate, the payoff depends on unknown quantities — the future price of fuel and, perhaps more importantly, the "lifetime, expected use, and reliability of the vehicle."<sup>49</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.14]

According to the previously cited report prepared for American Truck Dealers, owners of trucks and engines designed to meet EPA's model year (MY) 2004 and 2007 emission standards experienced "significant reliability, operating cost, and fuel economy concerns." [EPA-HQ-OAR-2014-0827-1251-A2 p.15]

For example, it has been reported that for the eighth largest carrier in the U.S., "maintenance costs for Schneider's 2007 model trucks were about 28.2% higher than vehicles manufactured before October

2002.” Reliability is critical for commercial fleets and owner-operators both because of the costs of keeping trucks in operation and the even greater potential costs associated with out-of-service equipment. In addition to higher truck prices and operating costs, anticipated reliability issues are often cited as contributing to the marketplace disruptions discussed herein.<sup>50</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.15]

Companies are just being prudent when they invest less in fuel-saving technology than they would if Congress required EPA and NHTSA to compensate truckers for every dollar of projected fuel savings that fails to occur. As the agencies acknowledge in the Phase 1 rulemaking, mandatory investment in fuel saving technology “requires purchasers to assume a greater level of risk than they would in its absence, even if the future fuel savings predicted by a risk-neutral calculation actually materialize.”<sup>51</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.15]

(5) Adjustment and Transactions Costs. According to this hypothesis, drivers may be slow or reluctant to make the operational adjustments required for effective use of new fuel-saving technologies, and owners may be reluctant to incur costs associated with driver training or faster fleet turnover.<sup>52</sup> This hypothesis is tantamount to saying there are costs of innovation. That is true in general, yet competition continually drives firms in most industries to innovate or get left behind. What makes fuel-saving technology the exception to the rule? [EPA-HQ-OAR-2014-0827-1251-A2 p.15]

The Phase 1 rulemaking offers this explanation: “Because of the diversity in the trucking industry, truck owners and fleets may like to see how a new technology works in the field, when applied to their specific operations, before they adopt it.”<sup>53</sup> Yes! Companies want real — road-tested — information about alternative investments. As Phase 2 similarly acknowledges, “businesses that operate HDVs may be concerned about how reliable new technologies will prove to be on the road, and whether significant additional maintenance costs or equipment malfunctions that result in costly downtime could occur.”<sup>54</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.15]

Truckers, apparently, take the agencies’ benefit-cost estimates with several grains of salt. That does not surprise us. After all, EPA and NHTSA are stakeholders – organizations with an interest in the rules they develop and administer. Regulators have an incentive to over-estimate the benefits and low-ball the costs of their rules, for at least three reasons. (1) New regulations typically increase agencies’ power, prestige, budgets, and/or staff. (2) When mandated technology malfunctions and vehicles are taken out of service, it’s the owners, not the agencies, who must pay for repairs and risk losing customers. (3) Ideological zeal for ‘greening’ the U.S. transport system is honored in both agencies. [EPA-HQ-OAR-2014-0827-1251-A2 p.15-16]

All of which is to say, the market is not failing when businesses choose to be guided by real-world results rather than agency forecasts. To their credit, the agencies’ Phase 1 rulemaking acknowledges that “there may be no market failure” in the risk-aversion induced by adjustment and transaction costs, which, unlike the promised payoffs from fuel-economy investments, “are typically immediate and undiscounted.”<sup>55</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.16]

## **V. Alternative hypothesis: EPA’s diesel-engine emission standards have hindered HDV fuel economy.**

Trucking industry profit-margins are thin and fuel is the single biggest operating expense. Consequently, truckers, especially those who haul freight long distances in “combination tractors” (semis), should have a strong incentive to purchase vehicles incorporating cost-effective improvements in fuel economy, and manufacturers, in turn, should have a strong incentive to compete for their

business. Yet the agencies claim to find a gap between current fuel efficiency and what is technically achievable at reasonable cost. How can that be? [EPA-HQ-OAR-2014-0827-1251-A2 p.16]

To some extent truckers may just be behaving like prudent buyers, as discussed above. Many reportedly feel they have been burned by previous technology mandates. Before incurring the certain and immediate costs of purchasing agency-approved fuel-efficiency technology, they want to see results – how much fuel is actually saved and what are the longer-term effects on truck reliability and maintenance costs. [EPA-HQ-OAR-2014-0827-1251-A2 p.16]

Considerable evidence suggests another, complementary explanation: EPA’s emission-control standards for diesel trucks caused or contributed to the very problem – stagnant fuel economy – the agencies now propose to solve with more rules. The Competitive Enterprise Institute (CEI) presented a case for a ‘government failure’ hypothesis in its comment on the Phase 1 rulemaking.<sup>56</sup> Because EPA’s Response to Comments either inadequately addressed or simply ignored some of CEI’s arguments, we will restate and update the alternative hypothesis here. [EPA-HQ-OAR-2014-0827-1251-A2 p.16]

#### Opportunity Costs: Manufacturers

Every dollar engine manufacturers spend on R&D to make vehicles compliant with EPA diesel emission standards is a dollar they cannot spend on R&D to increase HDV fuel efficiency. Such expenditures are substantial. [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

EPA’s Regulatory Impact Analysis (RIA), published in 2000, for its year 2007 diesel emission standards rule estimated that: [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

- Engine manufacturers would spend \$385 million over five years on HDV diesel-engine design R&D and \$220 million in catalyst systems R&D, yielding a “total R&D outlay for improved emission control of more than \$600 million.”<sup>57</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

- Each of 11 major engine manufacturers would spend \$7 million annually to deploy a “team of more than 21 engineers and 28 technicians to carry out advanced engine research.”<sup>58</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

In other words, over a five-year period, up to \$600 million that might have been invested in fuel economy R&D was instead invested in emission-control R&D. In addition, up to 540 engineers and technicians who might otherwise have spent all or much of their time developing fuel-saving technology instead likely spent all or much of their time developing emission-control technology. [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

EPA’s enforcement actions also diverted substantial resources that might otherwise have been available to enhance fuel-saving technology. During the 1990s, seven major truck manufacturers sold 1.3 million trucks equipped with “defeat devices” that bypass or disable on-board emission control systems. “These devices altered the engines’ fuel injection timing and, while this improved fuel economy, it also increased nitrogen oxide emissions by two to three times the existing regulatory limits,” GAO explained.<sup>59</sup> EPA launched what it described as the “largest Clean Air Act enforcement action” in its history. The case was settled via consent decrees under which the manufacturers agreed to pay \$83 million in civil penalties, invest almost \$110 million in NOX control R&D, and spend more than \$850 million to produce cleaner engines by October 1, 2002.<sup>60</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

The booming market in unlawful defeat devices was itself a reflection of the high value long-haul truckers place on cost-effective fuel-saving technology. How ironic that EPA punished manufacturers who promoted fuel savings by mandating \$1 billion in expenditures for technologies that did not enhance fuel efficiency or even (as discussed below) reduced it! [EPA-HQ-OAR-2014-0827-1251-A2 p.17]

#### Opportunity Costs: Buyers

Every dollar owners spend to buy and maintain trucks compliant with diesel emission standards is a dollar they cannot spend on improved fuel-saving technology. The RIA for the 2007-2010 emission standards estimated that the rule would increase vehicle cost by \$3,230 in the first year, declining to \$1,870 in later years, and increase operating costs by \$4,600.<sup>61</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.18]

In November 2008, NERA Economic Consulting published a report on customer responses to the 2007 rule. NERA found that the rule increased the unit cost of a Class 8 truck by \$7,000 between MYs 2006 and 2007 – more than twice what EPA estimated. In addition, NERA projected that EPA's 2010 NOX standard would increase the cost of a Class 8 truck by another \$7,000-\$10,000.<sup>62</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.18]

In March 2010, Kevin Jones, a reporter for The Trucker magazine, interviewed Daimler Trucks North America President and CEO Martin Daum at the Louisville, Ky. Mid-America Trucking Show.<sup>63</sup> Daum told Jones that EPA's emission standards added \$20,000 to the cost of an 18-wheeler over the previous six years. As noted above, the 2012 report for American Truck Dealers estimates that during 2004-2010, EPA emission standards cumulatively increased the cost of Class 8 trucks by more than \$21,000. [EPA-HQ-OAR-2014-0827-1251-A2 p.18]

Clearly, the standards took large bites out of customers' budgets – dollars truckers could not spend on fuel-saving technology. The regulation-induced increase in the cost of new trucks since 2004 is roughly twice the estimated cost of the technology upgrades semis will have install to comply with the Phase 2 GHG/fuel economy rule.<sup>64</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.18]

Truckers also incurred significant reliability and maintenance costs as a result of the penalties EPA imposed on the manufacturers who installed fuel-saving defeat devices. As part of the settlement agreement, manufacturers agreed to “accelerate by 15 months the schedule for meeting new, more stringent engine standards to October 2002 instead of the original mandatory date of 2004.”<sup>65</sup> According to GAO, “Trucking companies maintain they need 18 to 24 months to road test an engine's reliability in all weather and operating conditions and to develop their future purchasing plans.”<sup>66</sup> The consent decree did not allow time for adequate road-testing, and many truckers experienced costly engine problems. [EPA-HQ-OAR-2014-0827-1251-A2 p.18]

For example, one company reported that roughly one-half of its 140 new heavy-duty engines experienced an engine valve failure prior to 50,000 miles. In addition, these officials noted that roughly 20 percent of their heavy-duty vehicles with the new engines are out of service at any given time due to maintenance concerns, compared to 5 percent for the remainder of their fleet. Several of these officials expressed a concern that some companies may have difficulty absorbing increased costs from such maintenance problems.<sup>67</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.19]

#### Tradeoff: Emission Standards and Fuel Economy

In its Response to Comments (RTC) on the Phase 1 rulemaking, EPA acknowledged but summarily dismissed CEI's hypothesis that mandatory investment in pollution control "crowds out" investment in fuel economy: [EPA-HQ-OAR-2014-0827-1251-A2 p.19]

Only if access to capital is significantly constrained would the industry consider these as alternative investments. The same principles apply for access to expertise: truck companies could hire additional engineers and technicians to work on either fuel efficiency or emissions reduction. In the absence of evidence of "crowding out" of investments in fuel economy, we are left with the puzzle of what appears to be a great deal of lack of adoption of cost-effective fuel saving technology.<sup>68</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.19]

That response is unpersuasive. Regulatory mandates can have disruptive impacts on the market for new vehicles, leading to surges in buying pre-compliant vehicles ("pre-buying") followed by revenue losses and layoffs ("sales cliffs"). As the agencies acknowledge: [EPA-HQ-OAR-2014-0827-1251-A2 p.19]

Several of the heavy-duty vehicle manufacturers, fleets, and commercial truck dealerships informed the agencies that for fleet purchases that are planned more than a year in advance, expectations of reduced reliability, increased operating costs, reduced residual value, or of large increases in purchase prices [as a result of technology mandates] can lead the fleets to pull ahead by several months planned future vehicle purchases by pre-buying vehicles without the newer technology. In the context of the Class 8 tractor market, where a relatively small number of large fleets typically purchase very large volumes of tractors, such actions by a small number of firms can result in large swings in sales volumes. Such market impacts would be followed by some period of reduced purchases that can lead to temporary layoffs at the factories producing the engines and vehicles, as well as at supplier factories, and disruptions at dealerships.<sup>69</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.19]

The report prepared for American Truck Dealers contains a chart showing the regulation-induced surge in pre-buy orders before consent decree standards took effect in 2002, following by a slump, and another surge in pre-buy orders in 2006 before the MY 2007 standards took effect, again followed by a slump.<sup>70</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.19-20]

[Figure 1, 'Annual US Retail Sales for Class 4-8 Heavy-Duty Trucks', can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Manufacturers experienced non-trivial employment impacts as a consequence of the pre-buy/sales cliff swings: [EPA-HQ-OAR-2014-0827-1251-A2 p.20]

For example, when faced with declining sales following the pre-buy, Volvo laid off 300 workers in March of 2001 and another 300 workers in April of that year. In 2006, Volvo's Deputy Chief Executive Officer warned that the new environmental regulations would cause such a precipitous decline in sales that Volvo would have no choice but to lay off more people. Volvo ended up laying off nearly 600 workers in 2006; the direct result of the new emissions mandates. Also in 2006, Peterbilt cut their workforce by almost half. Freightliner laid off nearly 1,800 workers in 2007, followed by another layoff of 2,100 workers, and the complete shut down a manufacturing plant in 2009.<sup>71</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.20]

Clearly, EPA emission standards have the power to "significantly constrain" manufacturers' sales and work forces in particular years. Why should access to capital and expertise be immune to such effects? As a general matter, moreover, we find it hard to believe manufacturers would incur no opportunity

costs from continual increases in regulatory stringency and a \$1 billion enforcement action. [EPA-HQ-OAR-2014-0827-1251-A2 p.20]

The RTC simply ignores the other side of the equation – the opportunity cost imposed on truck buyers by emission standards that increase the cost of new vehicles. [EPA-HQ-OAR-2014-0827-1251-A2 p.20]

More importantly, the RTC also ignores the point, widely acknowledged in the literature, that it is difficult and/or costly to boost (or maintain) diesel fuel economy while reducing diesel emissions. Consider this excerpt from a paper by diesel emission-control expert W. Addy Majewski: [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

We should also mention that there is a certain cost for meeting these ambitious emission standards with future diesel engines. This cost consists of two components: (1) the cost of the emission control equipment and (2) a fuel economy penalty. The first component can vary greatly depending on the technology (some of which relies on expensive precious metal catalysts). The fuel economy penalty may be derived from a number of sources. First, traditionally there has been a correlation between engine-out NOX emissions and fuel consumption in the diesel engine, where higher engine efficiency and better fuel economy are associated with higher NOX. Second, exhaust after-treatment devices are associated with a varying additional fuel economy penalty caused by such factors as increased pressure drop and energy consumption for the regeneration of filters and/or NOX adsorbers. In the case of SCR catalysts, while there may be no direct fuel economy penalty, operating costs are increased by the cost of urea.<sup>72</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

Despite decades of technological advances, the Volkswagen scandal indicates that emission standards continue to impose a fuel-economy tradeoff on diesel-powered passenger vehicles. Why did VW take the insane risk of installing unlawful defeat devices in 11 million vehicles? Apparently, VW believed cheating on emissions tests was the only way to give consumers all the fuel-economy and performance they wanted at prices they could afford. As a recent article in Wired explains: [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

Once the sting of the lie fades, the US customers who bought 482,000 of those cars will feel the real pain. Because Volkswagen will be forced to recall those vehicles and somehow make them meet federal standards. There are two apparent ways to do that, and owners who value performance, fuel economy, and trunk space won't like either. [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

One is to “reflash” the engine control module, recalibrating the software so the car always runs the way it does during EPA testing, and always meets emission standards. [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

The downside here is that to achieve the drastic drop in NOX emissions, the cars in test mode sacrificed some fuel economy, or performance. Just how much is hard to say, but any drop in torque – one great thing about diesels is how they accelerate off the line – will not make drivers happy. And a drop in mileage would likely cost VW, since hundreds of thousands of drivers would have to spend more on fuel than VW promised at the time of sale. . . . [EPA-HQ-OAR-2014-0827-1251-A2 p.21]

The standard way of making a diesel run cleanly is to use selective catalytic reduction, a chemical process that breaks NOX down into nitrogen and water. Part of that process includes adding urea to the mix. The super effective system can eliminate 70 to 90 percent of NOX emissions, and is used by other diesel manufacturers like Mercedes and BMW. The downside is that it adds complication to the system,

and cost – \$5,000 to \$8,000 per car. And you need to periodically add the urea-based solution to your car to keep it working.<sup>73</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.21-22]

GAO's report on EPA's 1998 enforcement action against truck manufacturers who sold 1.3 million illegal defeat devices has already been noted. That this unlawful practice was the industry norm for years also attests to a non-trivial tradeoff between lower emissions and higher mileage. [EPA-HQ-OAR-2014-0827-1251-A2 p.22]

As mentioned, because the settlement agreement accelerated from January 2004 to October 2002 the schedule for producing less polluting vehicles, which did not allow truck owners adequate time to roadtest those vehicles, owners engaged pre-buying. In the months preceding the October 2002 deadline, demand for new vehicles with older technology surged. According to GAO, roughly 19,000 to 24,000 (20%-26%) of the 93,000 large semis (Class 8 trucks) produced during April to September 2002 were prebuys. Conversely, sales of compliant vehicles after the deadline were much lower than EPA had projected. Data for the first 13 of the 15 months “show that about 148,000 fully or partially compliant heavy-duty diesel engines are on the road, compared to EPA's estimate of 233,000 such compliant engines for the entire 15-month time frame.”<sup>74</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.22]

GAO found three main reasons for the pre-buy surge: (1) Trucks equipped with older emission-control technology costs several thousand dollars less than trucks with the new emission-control technologies; (2) the settlement agreement did not give the market time to sort out the effects of the new technologies on truck durability and maintenance; and (3) the technologies were expected to reduce fuel economy. GAO stated: [EPA-HQ-OAR-2014-0827-1251-A2 p.22]

The four companies that pre-bought large numbers of trucks before the October 2002 deadline did so primarily because they were concerned about the higher price and unproven reliability of the new engines, according to company officials. They said that the new engines would have added from \$1,500 to \$6,000 to the purchase price of a new heavy-duty truck—whose base cost is about \$96,000—and would have reduced fuel economy by 2 to 10 percent. For 2002, these additional costs could have ranged from about \$4 million to \$27 million per company in purchase price and about \$3 million to \$90 million per company in fuel costs. These trucking officials said that these additional costs would have been problematic for some companies because, according to one representative, the industry only returns 3 or 4 cents per dollar invested.<sup>75</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.22]

Industry expected further adverse impacts on fuel economy from EPA's 2007 diesel emission standards rule: [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

Because the technologies needed to meet the 2007 standards are much more advanced than those associated with prior upgrades, the trucking companies are concerned that the new engines will cost much more and decrease fuel efficiency much more than EPA predicted in 2000 when it was developing the standards. Consequently, according to representatives of 9 of the 10 trucking companies we contacted, companies most likely will once again decide to buy trucks before the deadline, but in larger numbers than they did in response to the consent decrees. This could again disrupt markets and postpone needed emissions reductions.<sup>76</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

Specifically, trucking industry representatives opined that the 2007 standards would reduce fuel efficiency by 3-5%. That's a big deal for an industry where fuel is the single biggest operating expense and profit margins can be as low as 2 cents per dollar earned: [EPA-HQ-OAR-2014-0827-1251-A2 p.23]



In addition, these officials are concerned that the 2007 trucks will experience another 3 to 5 percent loss in fuel economy – added to the 3 to 5 percent loss resulting from the consent decrees – that could increase their companies’ fuel costs by millions of dollars per year. Even minor increases in business costs can have adverse effects in the trucking industry, according to trucking industry officials we contacted, because these companies’ profit margins are very narrow – sometimes only 2 cents per dollar earned. The officials claim that the highly competitive nature of the trucking business precludes companies from passing such significant cost increases to their customers.<sup>77</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

In short, the industry representatives interviewed by GAO estimated the 2007 Rule combined with the consent decree could lower heavy-truck fuel economy by as much as 10%. [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

In April 2007, Robert Guy Matthews reported in the Wall Street Journal that new trucks compliant with EPA diesel emission standards “got worse mileage” than older trucks. The fuel-economy penalty was big enough to affect company bottom lines: [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

Previous-generation trucks average about nine or 10 miles to each gallon of diesel fuel. New engines designed to meet the more-stringent federal mandate on truck exhaust get about one mile less to the gallon. That may not seem like much, but it all adds up for large fleet owners that operate trucks crisscrossing the country. [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

“For every additional mile-per-gallon lost, it costs us about \$10 million in [total annual] fuel costs,” said YRC Worldwide Chief Executive Bill Zollars. YRC is one of the largest transportation providers in the country, operating a fleet of 20,000 trucks. . . . [EPA-HQ-OAR-2014-0827-1251-A2 p.23]

Freightliner LLC, the largest heavy-duty truck maker in North America, confirmed that some loss of fuel economy was inevitable for engines to comply with the new standards. Certain parts of the engine must run at a higher temperature to burn off pollutants, and that requires more fuel.<sup>78</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

To meet EPA’s MY 2004 NOX emission standards, new trucks required exhaust gas recirculation (EGR) technology. EPA predicted that fuel injection, variable geometry, and turbocharging would offset any EGR-associated fuel-economy penalty, and projected no drop in fuel economy from the MY 2007-2010 requirements. According to the report prepared for American Truck Dealers: [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

EGR systems may be effective at reducing NOX emissions, but they undeniably reduce the fuel economy performance that would otherwise have been achieved. For example, Judy McTigue, director of marketing and planning research for Kenworth Trucks, stated that “2007-compliant engines equipped with exhaust gas recirculation systems suffered a fuel economy penalty of 5% to 9%.” EGR systems also contributed to a loss of 50 to 100 horsepower from heavy-duty engines.<sup>79</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

If we also factor in the opportunity costs of EPA’s emission standards program — foregone investment in fuel-saving technology R&D, foregone purchases of more fuel-efficient trucks — it is possible that EPA’s regulatory and enforcement actions account for all of perceived problem of lagging fuel economy in the heavy truck sector. Were it not for truckers’ use of regulatory avoidance strategies – buying trucks equipped with defeat devices in the 1990s, pre-buying older engines, and low-buying compliant engines

in the 2000s — heavy-truck fuel economy might be even lower. [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

EPA and NHTSA acknowledge the reality of a “NOX- CO<sub>2</sub> tradeoff,” but only as a rationale for using the “same test procedures” for both NOX and CO<sub>2</sub> to discourage engine manufacturers from gaming emission tests.<sup>80</sup> They discuss several “hypotheses” to explain industry’s alleged “under-investment” in fuel-saving technology without ever wondering whether the regulatory environment in which truckers operate might have something to do with it. [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

Substantial evidence indicates that, during the 2000s, EPA’s diesel-truck emission standards held back HDV fuel efficiency and imposed significant opportunity costs on both manufacturers and truckers. Insofar as there is an “energy-efficiency gap,” it appears to be an example of regulation-induced government failure rather than of market failure. [EPA-HQ-OAR-2014-0827-1251-A2 p.25]

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35 80 FR 40165

36 80 FR 40435

37 Draft RIA, 8-12

38 80 FR 40436-40438

39 80 FR 40148

40 EPA, SmartWay, Partner and Affiliate Lists (accessed September 10, 2015),  
<http://www.epa.gov/smartway/about/partnerlists.htm><http://www.epa.gov/smartway/about/partnerlists.htm>

41 JOC.Com, “Top 25 Truckload Companies,” September 10, 2015,  
[http://www.joc.com/sites/default/files/u48801/46-specTop25Truck\\_bwcb%20copy.jpg](http://www.joc.com/sites/default/files/u48801/46-specTop25Truck_bwcb%20copy.jpg)

42 Draft RIA, 7-13, Table 7-11

43 Draft RIA, 7-11, Table 7-8

44 80 FR 40435

45 EPA, NHTSA, Greenhouse Gas Emissions Standards and Fuel Efficiency standards for Medium- and Heavy-Duty Engines and Vehicles, 75 FR 74306, November 30, 2010,  
<http://www.gpo.gov/fdsys/pkg/FR-2010-11-30/pdf/2010-28120.pdf>

46 80 FR 40437

47 80 FR 40437

48 80 FR 40436

49 75 FR 74306

50 Calpin and Plaza-Jennings, p. 13. “Marketplace disruptions” (about which, more below) refer to surges in buying pre-compliant vehicles (“pre-buying”) and the subsequent revenue losses and manufacturing layoffs (“sales cliffs”) after regulatory standards kick in.

51 75 FR 74306

52 80 FR 40436

53 75 FR 74306

54 80 FR 40437

55 75 FR 74306

56 Marlo Lewis, Competitive Enterprise Institute, comment letter on Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Docket ID No. NHTSA–2010–0079 and/or EPA–HQ–OAR–2010–0162, January 31, 2011, <https://cei.org/sites/default/files/Marlo%20Lewis%20Competitive%20Enterprise%20Comment%20on%20EPA%20NHTSA%20Proposed%20Fuel%20Economy%20Standards%20for%20HD%20Vehicles.pdf>

57 EPA, Regulatory Impact Analysis, Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, vi, December 2000 (hereafter EPA, 2000 RIA), <http://www3.epa.gov/otaq/regs/hdhw/2000frm/420r00026.pdf>

58 EPA, 2000 RIA, V-20

59 Government Accounting Office, Air Pollution: EPA Could Take Additional Steps to Help Maximize the Benefits of the 2007 Diesel Emission Standards, March 2004, p. 11 (hereafter GAO), <http://www.globalwarming.org/wpcontent/uploads/2010/12/gao-epa-diesel-truck-emission-standards-2004.pdf>

60 GAO, pp. 11-12

61 EPA, 2000 RIA, vi

62 David Harrison and Mark Lebel, Customer Behavior in Response to the 2007 Heavy-Duty Engine Standards: Implications for the 2010 NOX Standard, NERA Economic Consulting, pp. 3, 13, November 14, 2008 (hereafter NERA), [http://www.ooida.com/Documents/NERA\\_2010\\_NOx\\_Standard\\_Report.pdf](http://www.ooida.com/Documents/NERA_2010_NOx_Standard_Report.pdf)

63 Kevin Jones, “Daum: Double-digit mpg achievable, not affordable – yet,” TheTrucker.Com, March 26, 2010, <http://www.thetrucker.com/News/Stories/2010/3/26/DaumDoubledigitmpgachievable%20notaffordable%20yet.aspx>

64 Draft RIA, p. 7-4

65 GAO, p. 12

66 GAO, p. 6

67 GAO, p. 20

68 EPA, Response to Comments Document for Joint Rulemaking, Greenhouse Gas Emission Standards and Fuel Economy Standards for Medium- and Heavy-Duty Engines and Vehicles, August 2011, p. 14-19, <http://www3.epa.gov/otaq/climate/documents/420r11004.pdf>

69 80 FR 40155

70 Calpin and Plaza-Jennings, p. 3

71 Calpin and Plaza-Jennings, p. 5

72 W. Addy Majewski, Diesel Emission Control, DieselNet Technology Guide (accessed September 24, 2015), [https://www.dieselnet.com/tech/engine\\_control.php](https://www.dieselnet.com/tech/engine_control.php)

73 Alex Davies, “VW Owners Aren’t Going to Like the Fixes for their Diesels,” Wired, September 22, 2015, [http://www.wired.com/2015/09/vw-owners-arent-going-like-fixes-diesels/?mbid=social\\_fb](http://www.wired.com/2015/09/vw-owners-arent-going-like-fixes-diesels/?mbid=social_fb)

74 GAO, pp. 19, 23

75 GAO, pp. 17-18, emphasis added

76 GAO, p. 7, emphasis added

77 GAO, p. 43

78 Robert Guy Matthews, “Trucking Firms Bemoan Stricter Emission Rules,” Wall Street Journal, April 24, 2007, <http://www.wsj.com/articles/SB117737647290679826>

79 Calpin and Plaza-Jennings, p. 13

80 80 FR 40182, 40192

**Organization:** Consumer Federation of America (CFA)

In the these comments, the Consumer Federation of America (CFA) demonstrates the increasing the fuel economy of medium and heavy duty trucks (work trucks) is an important consumer issue and that the proposal by EPA/NHTSA will yield substantial benefits to consumers. CFA takes a uniquely consumer approach to the analysis of performance standards, that asks a basic set of questions, always starting with the consumer pocketbook question: [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

o Will increasing fuel economy save consumers money? Yes, and a well-designed performance standard will address the clear “efficiency gap in the work truck market. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

Our analysis of these questions in the work truck market shows that EPA/NHTSA has taken the correct approach and set a standard that is highly beneficial to consumers. While we fully support the standard, the fact that the cost per gallon of saved fuel is only \$0.47 and the benefits are six times larger than the costs, leads us to call on EPA/NHTSA to provide better documentation and support for the decision not to set the standards at a higher level. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

In Section II, we estimate the potential benefits of increasing fuel economy in work trucks based on several sources including the EIA Residential Consumption Survey, the Department of Transportation's, National Household Transportation Survey; the Energy Information Administration's Annual Energy Outlook; the Bureau of Labor Statistics' Consumer Expenditure Survey; and the U.S. Department of Transportation's, Bureau of Transportation statistics each of which estimates fuel usage by types of vehicles. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

o On a per household basis, we estimate that the cost of fuel consumed by work trucks is equal to almost half as much as households spend on gasoline and almost as much as they spend on electricity. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

Moreover, our analysis in Section III leads us to believe that these fuel costs are recovered from consumers in the cost of goods and services that rely on work trucks. The pass-through of costs is suggested and supported by analysis of macro-economic models and widely documented elasticities of demand. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

Respondents to national random sample surveys commissioned by CFA understand that they pay for big truck fuel in the cost of goods and services, and they support standards to improve truck fuel economy. The vast majority of the public (over 90%) understand that "some, most, or all" of the fuel costs of heavy-duty trucks, which transport virtually every consumer good, are passed on to consumers. In both of the CFA surveys, consumers clearly understood the possibility of these savings as nearly three quarters of the respondents favored requiring truck manufacturers to increase the fuel economy of large trucks. [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

As discussed in Section IV, studies by half a dozen research organizations, including industry groups, the National Research Council, EPA/NHTSA, indicate that a substantial reduction in work truck energy consumption could be achieved at relatively low cost by adopting technologies that are currently available. So we look to answer the next logical questions about closing the efficiency gap: [EPA-HQ-OAR-2014-0827-1336-A1 p.3]

. Why is there an efficiency gap that appears to impose unnecessary costs on consumers? Because the work truck market exhibits numerous important market imperfections. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

Studies of the trucking sector that are summarized in Section IV indicate that there are market barriers, imperfections and obstacles that prevent these beneficial technologies from penetrating the work truck market. Table ES-1, shows the barriers are numerous and substantial. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

[Table ES-1 can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

. Is a standard an appropriate policy and, if so, is the proposed standard well-designed to achieve the goal of lowering consumer cost? Yes, EPA/NHTSA have taken an approach that will deliver significant

consumer savings. The only question is whether they should have chosen higher levels of fuel efficiency to deliver larger economic and environmental benefits. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

Our research, summarized in Section V, shows that performance standards are an ideal approach to overcoming the barriers to efficiency investments when they exhibit six characteristics. They need to be: long-term, technology neutral, product neutral, responsive to industry needs, responsive to consumer needs, pro-competitive. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

Based on our evaluation of the Phase II standard, in Section VI and summarized in Table ES-2, we conclude that EPA/NHTSA have done an excellent job designing the standards. While large additional potential savings lead us to call on the agencies in Section VII to give a hard second look at the factors that led them to not push the industry harder, the huge efficiency gap underscores the importance of the major advances the agencies have made in the economic analysis, including: [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

[Table ES-2 can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

- o Discount rate: Recognizing real world consumer discount rate of 3% and market imperfections driving observed discount rate. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

- o Efficiency Gap/Market Imperfection Analysis: Recognizing 30 years of empirical evidence demonstrating validity of efficiency gap explanation and identifying specific barriers, imperfections and obstacles that afflict specific markets. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

- o Merging energy and environmental analysis: Recognizing major impact of fuel savings on assessment of rules. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

- o Macroeconomic analysis: Reconciling important benefit of expansion of macroeconomic activity resulting from greater fuel economy with realistic assessment of the rebound effect. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

- o National security: Looking carefully at the impact of imports on national security and consumption externalities created by large U.S. role in petroleum markets. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

- o Effective design of standards: Designing standards that “command but do not control,” thereby unleashing forces of competition to ensure least cost implementation. [EPA-HQ-OAR-2014-0827-1336-A1 p.4]

## **ACHIEVING FUEL COST SAVINGS WITH EFFICIENCY STANDARDS**

With such large potential economic gains available, this section offers answers to two important questions based on the reviews of freight truck sector by several major research institutions: [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

- . Why don't market forces drive these technologies into the vehicles? [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

- . What policies can be implemented to achieve the economic gains? [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

The evidence they provide is clear: [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

. The medium/heavy duty truck market exhibits significant market obstacles, barriers and imperfections that inhibit investment in energy saving technologies, and [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

. Performance standards are a very effective tool for overcoming these obstacles. [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

We examined these questions at length in our comments supporting the recently adopted light duty vehicles efficiency standard.<sup>23</sup> A recent paper on performance standards<sup>24</sup> identified over three dozen market barriers, imperfections and other causes of market failure in the residential appliances and buildings, light duty vehicles and industrial sectors. Here we add the important findings from the medium/heavy duty truck sector to our earlier analysis. [EPA-HQ-OAR-2014-0827-1336-A1 p.33]

### **EXTERNALITIES LEAD TO UNDERINVESTMENT IN FUEL SAVING TECHNOLOGIES**

Externalities as the source of market failure are well grounded in traditional economic analysis. These analyses of benefits and costs reviewed in the previous section recognize that externalities play a key part in driving policies to spur investment in energy saving technologies, but they focus on other obstacles to investment. Externalities are factors that are not directly included in typical cost-benefit analysis of business investment decisions. In the case of investing in fuel efficient technologies, the failure to consider externalities leads to the undervaluation of improving energy efficiency from the societal point of view and a resulting underinvestment in efficiency because these benefits do not factor into typical and immediate business decisions. Because these considerations never enter into business calculations, they are considered market failures. They are distinct from cases where businesses do make the calculations, but arrive at the results that fail to invest in cost beneficial technologies for any of a variety of reasons. Different authors apply different labels to the various types of obstacles that inhibit investment but the underlying obstacles are similar.<sup>25</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.33-34]

There are negative externalities that result from fuel consumption which do not enter into the typical business cost/benefit calculations, for example: tail pipe emissions create environmental and health problems. An externality that is unique to transportation fuel is the national security implications of dependence on oil imports. While externalities are generally not factored into business decision making, from a societal perspective they can, and should, be an important factor in standard development. [EPA-HQ-OAR-2014-0827-1336-A1 p.34]

While these negative externalities that are reduced by high fuel economy receive the most attention, our focus in the prior section was on positive economic externalities. Investment in energy efficiency creates benefits for the broad public for which the firm making the investment cannot charge. As a result, the indirect macroeconomic effects of energy efficiency do not enter into typical cost/benefit decisions about investing in energy efficient technologies. While transportation companies capture some of the benefits in increased demand for their services, each company captures, at best, only a small part of the broader economic stimulus that reducing fuel consumption would cause. Therefore, such a benefit would be absent in each company's typical internal cost benefit analysis of fuel saving technology. This category of externalities has expanded recently well beyond the public goods aspect that was identified in traditional economic analysis to include information and learning, network effects and innovation process. [EPA-HQ-OAR-2014-0827-1336-A1 p.34-35]

Similarly, U.S. consumption of transportation fuels is sufficiently large that a reduction in the quantity consumed has the effect of lowering the global (and therefore the national) price of crude oil. The public enjoys a large benefit, but the firms investing in efficiency receive only a small part of that total benefit because each individual firm receives a very small share of the total. This is called a consumption externality.<sup>26</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.36]

In the freight truck sector, the link between efficiency induced fuel cost savings and positive economic impacts is particularly strong. Transportation is an important intermediate service. When truckers drive more, they are very likely to be carrying more goods or delivering more services, which means that the economy is expanding. Where the increase in truck freight results from a shift between transportation modes, it likely reflects the selection of a more efficient mode, which again indicates an improvement in the economy. [EPA-HQ-OAR-2014-0827-1336-A1 p.36]

## **MARKET OBSTACLES, BARRIERS AND IMPERFECTIONS INHIBITING INVESTMENT**

In all of the economic analyses of efficiency discussed earlier, only direct economic costs and benefits were included. No value was placed on environmental or national security benefits; however these are significant additional benefits. Even though we did not include externalities in the cost benefit calculation, we found that the benefits far exceeded the costs. EPA reached exactly the same conclusion in the Phase I analysis. Since externalities cannot explain the failure of firms to invest in these attractive technologies, EPA shifts its attention to the other factors that inhibit investment. [EPA-HQ-OAR-2014-0827-1336-A1 p.36]

Not surprisingly, given the strong evidence of many factors that inhibit efficiency in the other sectors demonstrated in our earlier analysis,<sup>29</sup> we find strong support for similar factors in the medium and heavy duty truck sector. Table V-1 shows the results of the analysis of the obstacles to investment in efficiency in the medium/heavy duty truck sector prepared by three major independent institutions. It also identifies the major documents upon which they rely. We also include the EPA/NHTSA Phase I analysis of the truck market, which has been vetted through litigation. In constructing this table, we use the same criteria as we applied in the analysis of Performance Standards – including empirical studies or summaries of the empirical literature from the past ten years. These studies support our findings in several important ways. [EPA-HQ-OAR-2014-0827-1336-A1 p.36]

[Table V-1 can be found on p.37-38 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

While some argue that there are no market barriers and imperfections to inhibit investment in energy saving technologies in the medium and heavy duty truck sector,<sup>30</sup> the failure to make the previously cited investment in technologies, in spite of their clear benefits, indicates that there are significant inhibitors at work that have created an “efficiency gap.” [EPA-HQ-OAR-2014-0827-1336-A1 p.38]

In the Phase I analysis, EPA identified six broad categories of factors that have been offered as explanations for the failure of the truck market to pursue investment opportunities in fuel saving technologies that appear to be cost effective. The other major analyses identify these obstacles and several more, adding a great deal of detail. The findings from the medium and heavy duty truck sector reinforce several of the key aspects of our earlier analysis. [EPA-HQ-OAR-2014-0827-1336-A1 p.38-39]

o The analysis involves commercial enterprises, which affirms the fact that economic motivation alone does not ensure optimum investment in efficiency. [EPA-HQ-OAR-2014-0827-1336-A1 p.39]



o Many of the same factors are confirmed as important obstacles to energy saving investment on both the supply and the demand sides of the market. [EPA-HQ-OAR-2014-0827-1336-A1 p.39]

o The supply and the demand sides interact and reinforce each other in a vicious circle. Policies that can break the circle are extremely attractive. [EPA-HQ-OAR-2014-0827-1336-A1 p.39]

o The diffusion of innovation unfolds as a process in which the early challenge is to provide reliable, verifiable information to trigger the diffusion process. Experience allows the sharing of information later in the process, which creates different challenges. [EPA-HQ-OAR-2014-0827-1336-A1 p.39]

The Environmental Protection Agency and the National Highway Traffic Safety Administration (EPA/NHTSA) examined the evidence that these barriers affect the truck market and summarized their conclusion as follows: [EPA-HQ-OAR-2014-0827-1336-A1 p.39]

On the other hand, the short payback period required by buyers of new trucks is a symptom that suggests some combination of uncertainty about future cost savings, transaction costs, and imperfectly functioning market. In addition, widespread uses of tractor-trailer combinations introduces the possibility that owners of trailers have weaker incentives than truck owners to adopt fuel-saving technology for their trailers...[EPA-HQ-OAR-2014-0827-1336-A1 p.39]

[B]ecause individual results of new technologies vary, new truck purchasers may find it difficult to identify or verify the effects of fuel saving technologies. Those who are risk averse are likely to avoid new technologies out of a concern over the possibility of inadequate returns on the investment, or with other impacts...[EPA-HQ-OAR-2014-0827-1336-A1 p.39]

Both baselines used project substantially less adoption than the agencies consider to be cost-effective. The agencies will continue to explore reasons for this slow adoption of cost-effective technologies.<sup>31</sup>[EPA-HQ-OAR-2014-0827-1336-A1 p.39]

The report from the International Council on Clean Transportation summarized the supply-and demand side factors that inhibit innovation with a simple graph that depicts a recursive loop of factors that reinforce one another, as shown in Figure V-1. [EPA-HQ-OAR-2014-0827-1336-A1 p.39]

[Figure V-1 can be found on p.41 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Given the thorough review by EPA/NHTSA, the NRC, and the International Council for Clean Transportation, as well as our own, suffice it to say that there is a significant energy efficiency gap in the medium and heavy duty truck market and there is no reason to doubt the economic analysis of the potential benefits of closing that gap. In fact, the benefits have likely been underestimated, not only because the full value of externalities has not been included in the economic analyses, but also because the costs of implementing the standards have likely been overestimated, as discussed below. [EPA-HQ-OAR-2014-0827-1336-A1 p.41]

## **PERFORMANCE STANDARDS AS A POLICY TOOL TO OVERCOME OBSTACLES TO INVESTMENT**

These reviews of the literature on obstacles to investment in efficiency in the medium and heavy duty truck sector also identify and discuss the ways that performance standards can improve the market performance. The regulatory analyses are required to consider alternatives. They do not conclude that the alternatives (like simple information programs) will have no impact, but that the alternatives do not

address key obstacles effectively. As we showed in our Performance Standards paper, standards are attractive because they effectively address a wide range of obstacles. As shown in Table V-1, above, in the medium/heavy duty truck sector these beneficial effects include the following: [EPA-HQ-OAR-2014-0827-1336-A1 p.41-42]

- . Partially internalize the externalities
- . Provides experience with the new technologies, lowering hidden costs.
- . Creates the market by embedding the technology in products, thereby lowering marketplace risk and risk of being the first mover.
- . Triggers learning and economies of scale that lower cost
- . Generates and makes available reliable information in a standardized manner
- . Fosters cooperation, as the efficiency attribute is given higher visibility [EPA-HQ-OAR-2014-0827-1336-A1 p.42] [EPA-HQ-OAR-2014-0827-1336-A1 p.42]

We believe that one of the other major findings of our earlier analysis of fuel economy and performance standards applies in the medium/heavy duty truck sector as well. In order to effectively achieve the large net benefits, performance standards must be well-designed and carefully implemented. The following characteristics, which were critical for the success in the adoption of fuel economy standards for automobiles and light duty trucks, can successfully guide the development of performance standards for medium and heavy duty trucks: [EPA-HQ-OAR-2014-0827-1336-A1 p.42] [EPA-HQ-OAR-2014-0827-1336-A1 p.42]

**Long-Term:** Setting a progressively rising standard that targets a high long term goal over the course of a decade or more will foster and support a long-term perspective for the truck manufacturers, transportation companies and public, by reducing the marketplace risk of investing in new technologies. The long-term view gives the truck makers time to re-orient their thinking, retool their plants and help re-educate the transportation industry. It also gives the industry buying and using these trucks time to adjust. [EPA-HQ-OAR-2014-0827-1336-A1 p.42]

**Technology Neutral:** Taking a technology neutral approach to a long term standard unleashes competition around the standard that ensures that the industry will get a wide range of choices at that lowest cost possible. [EPA-HQ-OAR-2014-0827-1336-A1 p.42]

**Product Neutral:** The new attribute-based approach to standards accommodates buyer preferences; it does not try to supplant them. This levels the playing field between truck makers and removes any pressure to push inappropriate vehicles into the market. [EPA-HQ-OAR-2014-0827-1336-A1 p.43]

**Responsive to industry needs:** As was done in the light vehicle standards, establishing a long term performance standard recognizes the need to keep the standards in touch with reality. The standards can be set at a moderately aggressive level that is clearly beneficial and achievable. With thoughtful cost estimates, consistent with the results of independent analyses of technology costs, a long term performance standard will contribute to the significant reduction of the most significant cost in the transportation industry. [EPA-HQ-OAR-2014-0827-1336-A1 p.43]

**Responsive to consumer needs:** The approach to standards should be consumer-friendly and facilitate compliance. The attribute-based approach ensures that the standards do not require radical changes in the available products or the product features that will be available to consumers. The setting of a coordinated national standard that lays out a steady rate of increase over a long time period giving the market and the industry certainty and time to adapt to change. [EPA-HQ-OAR-2014-0827-1336-A1 p.43]

**Procompetitive:** All of the above characteristics make the standards pro-competitive. Producers have strong incentives to compete around the standard to achieve them in the least cost manner, while targeting the market segments they prefer to serve. [EPA-HQ-OAR-2014-0827-1336-A1 p.43]

## **THE COSTS OF IMPLEMENTING STANDARDS**

A final, important observation on the literature of performance standards before we turn to the Phase II proposed rule deals with the tendency for costs to be overestimated because well-designed standards trigger the competitive and innovative processes noted above. The analysis often presented in regulatory proceedings is typically static and based on current costs. On the other hand, a thoughtful, well-designed performance standard will be dynamic and facilitate multiple responses to standard compliance rather than mandate specific technologies. If companies are given broad flexibility to meet standards, they will determine the most cost beneficial approach and they will learn how to lower the cost of adopting new technologies. History has shown in virtually every other standard compliance effort, the initial cost estimates always prove to have been too high, as shown in Figure V-2. There is clear and consistent evidence across a wide range of standards that the actual costs of implementing standards were consistently well below their original projections. [EPA-HQ-OAR-2014-0827-1336-A1 p.43-44] [This comment can also be found in section 11.3 of this comment summary.]

[Figure V-2 can be found on p.44 of docket number EPA-HQ-OAR-2014-0827-1336-A1] [This comment can also be found in section 11.3 of this comment summary.]

We then examine the explanation (theory) offered for why these costs and benefits have not been reflected in market transactions. Here we address both the issue of market imperfections and the pass-through of fuel costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.45] [This comment can also be found in section 11.3 of this comment summary.]

Finally, we evaluate the overall design of the rule, according to the six criteria identified in the previous section. Because there are potentially large additional savings, we conclude with a section devoted to the question of whether the agencies have set the standards at a sufficiently high level. [EPA-HQ-OAR-2014-0827-1336-A1 p.45] [This comment can also be found in section 11.3 of this comment summary.]

### **The Efficiency Gap and Discount Rates**

In justifying the rule, the agencies begin by reprising the explanation offered in defense of the Phase I rule, pointing to five specific market failures and imperfections. They then review recent research and not only conclude that those five factors are still relevant, but they add several others that might come into play. [EPA-HQ-OAR-2014-0827-1336-A1 p.49]

In the HD Phase 1 rulemaking (which, in contrast to these proposed standards, did not apply to trailers), the agencies raised five hypotheses that might explain this energy efficiency gap or paradox: Imperfect information in the new vehicle market... Imperfect information in the resale market... Principal-agent problems causing split incentives... Uncertainty about future fuel cost savings... Adjustment and transactions costs....[EPA-HQ-OAR-2014-0827-1336-A1 p.49]

All of the recent research identifies split incentives, or principal-agent problems, as a potential barrier to technology adoption... Uncertainty about future costs for fuel and maintenance, or about the reliability of new technology, also appears to be a significant obstacle that can slow the adoption of fuel-saving technologies... access to capital can be a significant challenge to smaller or independent businesses, and that price is always a concern to buyers... Other potentially important barriers to the adoption of

measures that improve fuel efficiency may arise from “network externalities,” where the benefits to new users of a technology depend on how many others have already adopted it.... Some businesses that operate HDVs may also be concerned about the difficulty in locating repair facilities or replacement parts, such as single-wide tires... Manufacturers may be hesitant to offer technologies for which there is not strong demand, especially if the technologies require significant research and development expenses and other costs of bringing the technology to a market of uncertain demand... it can take years, and sometimes as much as a decade, for a specific technology to become available from all manufacturers..<sup>36</sup>[EPA-HQ-OAR-2014-0827-1336-A1 p.49]

Clearly, the efficiency gap that the market has failed to close can be readily explained by market barriers, obstacles, imperfections and failure. EPA/NHTSA go a step farther in this analysis and draw out an important implication of the pervasive set of market imperfections, something we have been pointing out in these proceedings for several years. When market actors are laboring under the weight of significant market imperfections, calculating discount rates on the basis of observed market behaviors reflects the totality of market factors, not simply consumer and producer preferences. [EPA-HQ-OAR-2014-0827-1336-A1 p.50]

EPA/NHTSA stated this observation with respect to payback periods, but it applies equally to discount rates. [EPA-HQ-OAR-2014-0827-1336-A1 p.50]

In summary, the agencies recognize that businesses that operate HDVs are under competitive pressure to reduce operating costs, which should compel HDV buyers to identify and rapidly adopt cost-effective fuel-saving technologies...[EPA-HQ-OAR-2014-0827-1336-A1 p.50]

However, the short payback periods that buyers of new HDVs appear to require suggest that some combination of uncertainty about future cost savings, transactions costs, and imperfectly functioning markets impedes this process. Markets for both new and used HDVs may face these problems, although it is difficult to assess empirically the degree to which they actually do. Even if the benefits from widespread adoption of fuel-saving technologies exceed their costs, their use may remain limited or spread slowly because their early adopters bear a disproportionate share of those costs. In this case, the proposed standards may help to overcome such barriers by ensuring that these measures would be widely adopted.<sup>37</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.50]

In 2008, we summarized the important role of supply side and market structural factors in affecting observed discount rates as follows; here we expand on that discussion.<sup>38</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.50]

We view the apparent high discount rate attributed to consumers as the result of other factors not the root cause of the demand-side problem. We do not accept the claim that consumers are expressing irrational preferences for high returns on efficiency investments; irrational because they appear to be a return that is so much higher than they can get on other investments they routinely have available. Rather, we view the implicit discount rate as a reflection of the fact that the marketplace has offered an inadequate range of options to consumers who are ill-informed and unprepared to conduct the appropriate analysis and who lack the resources necessary to make the correct actions.<sup>39</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.50-51]

The apparently grossly irrational discount rate reflects market imperfections and failures, not irrational consumers, a conclusion that has been clear in throughout the long history of the efficiency gap debate. [EPA-HQ-OAR-2014-0827-1336-A1 p.51]

The implicit discount rates calculated from consumer choices reflect not only individual time preferences but a whole collection of variables that may depress the ultimate level of investment. The calculated discount rate is affected by consumers' price expectations and their levels of certainty about these; the extent to which available information is imperfect, mistrusted, or ignored; the purchase of some equipment to quickly replace nonfunctioning equipment rather than to minimize life-cycle cost; the presence in the market of builders, landlords, and other purchasers who will not pay for the energy the equipment uses; the fact that consumers with limited capital do not always purchase what they would if they had more capital; differential marketing efforts for different products, and so forth. Recognizing such possibilities, some analysts say that the data reflect "market discount rates."<sup>40</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.51]

This observation on the market discount rate, combined with the recognition that a 3% discount rate is a good estimate for the consumer discount rate, provides a realistic framework for understanding consumer discount rates and applying them in economic analyses. We applaud the agencies for arriving at this view and encourage them to affirm both in the final rule so that future rulemakings can be grounded on this solid basis. [EPA-HQ-OAR-2014-0827-1336-A1 p.51]

While the very large potential benefits lead us to call on the agencies to give a hard second look at the other factors that have led it to not push the industry harder, we believe that the huge efficiency gap also sends another strong message that should not be lost in the dickering over standard levels. The massive efficiency gap is testimony to a market that has performed abysmally for an extended period of time. We urge the agencies to seize the clear evidence on the failure of the medium/heavy duty truck market with respect to efficiency to transform the terrain of decision making in setting standards. As discussed above, they have moved in the right direction in at least half a dozen ways with the analysis of the proposed rule: [EPA-HQ-OAR-2014-0827-1336-A1 p.61-62]

**Discount rate:** Recognizing real world consumer discount rate of 3% and market imperfections driving observed discount rate. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

**Efficiency Gap/Market Imperfection Analysis:** Recognizing 30 years of empirical evidence demonstrating validity of efficiency gap explanation and identifying specific barriers, imperfections and obstacles that afflict specific markets. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

**Merging energy and environmental analysis:** Recognizing major impact of fuel savings on assessment of rules. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

**Macroeconomic analysis:** Reconciling important benefit of expansion of macroeconomic activity resulting from greater fuel economy with realistic assessment of the rebound effect. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

**National security:** Looking carefully at the impact of imports on national security and consumption externalities created by large U.S. role in petroleum markets. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

**Effective design of standards:** Designing standards that "command but do not control," thereby unleashing forces of competition to ensure least cost implementation. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

We applaud the agencies for crafting the proposed rule with the above factors in mind but urge that a careful examination be given as to whether greater savings that would benefit our economy and consumers can clearly be justified. [EPA-HQ-OAR-2014-0827-1336-A1 p.62]

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23 Cooper, Mark, 2011a, Comments of Consumer Federation of America and Consumer Groups, Proposed Rule 2017 and Later Model Year, Docket Nos. Light-Duty Vehicle Greenhouse Gas Emissions, EPA-HQ-OAR-20100799; FRL-9495-2 and Corporate Average Fuel Economy Standards, NHTSA-2010-0131, February 13, 2012.

24 Cooper, Performance Standards.

25 Cooper, Performance Standards, reviews the different approaches in the appliance, building, light duty and climate change literatures. Sanne Aarnink, Jasper Faber, Eelco den Boer, Market Barriers to Increased Efficiency in the European On-road Freight Sector, Delft, October 2012, introduce these distinctions for the medium/heavy duty truck sector.

26 Consumer Federation of America, et al., 2012, Comments on the Proposed Rule 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Docket Nos. EPA-HQ-OAR-2010-0799; FRL-9495-2, NHTSA-2010-0131, 2/13/12.

29 Cooper, Performance Standards.

30 Mark Cooper, Performance Standards, examines the arguments in detail.

31 EPA-NHTSA, Greenhouse Gas Emissions Standards and Fuel Economy Standards for Medium and Heavy Duty Engines and Vehicles, Federal Register 76(179), September 15, 2011, p. 57319

36 EPA/NHTSA, NPRM, p. 4043.

37 EPA/NHTSA, NPRM, pp. 40437-40438.

38 To underscore the fact that we have been pushing for the agencies to recognize this important reality of the efficiency gap, this discussion is taken directly from our 2009 light duty comments (Mark Cooper, Comments of the Consumer Federation of America, Environmental Protection Agency, Department of Transportation, Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas, Emission Standards and Corporate Average Fuel Economy Standards, 40 CFR Parts 86 and 600, 49 CFR Parts 531,633, 537, et al., November 27, 2009, which pointed back to our 2008 comments.

39 Comment of the Consumer Federation of America, on National Highway Traffic Safety Administration Notice of Proposed Rulemaking; Docket No. NHTSA 2008-0089, RIN 2127-AK29; Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011-2015, July 1, 2008, pp. 38-40.

40 Stern Paul C., "Blind Spots in Policy Analysis: What Economics Does Not Say about Energy Use," Journal of Policy Analysis and Management,"5:2 (1986), p. 209.

43 John B. Taylor, Economics, Houghton Mifflin, 2nd Ed., glossary.

44EPA/NHTSA, p. 40154, Under

45 EPA/NHTSA, PHASE II RIA, p. 2-16.

46 EPA/NHTSA, PHASE II NOPR, p. 40143.

47 Mark Cooper, Performance Standards, showed the important role that adoption, in the form of diffusion curves, play in the analysis of the efficiency gap and the design and evaluation of standards.

48 EPA/NHTSA, PHASE II RIA, p. 2-89.

**Organization:** George Mason University Mercatus Center

Several federal benefit-cost analyses report an energy paradox among firms in competitive markets and conclude that firms would benefit from mandates to increase the use of energy-saving technologies. Such findings appear incompatible with neoclassical views that private firms in competitive markets minimize costs. The Environmental Protection Agency, for example, presumes that owners of trailers pulled by tractors belonging to others underinvest in energy-saving technologies because trailer owners incur the costs while tractor owners get the benefits. We test this hypothesis by collecting data and modeling the use of energy-saving technologies as a function of fleet size, the intensity of truck usage, and proxies for management quality. We find effects consistent with conventional models but no evidence that different ownership of tractors and trailers is associated with reduced use of energy-saving technologies on trailers. Regulators should refrain from making claims that firms underuse energy-saving technologies without first rigorously evaluating evidence for such claims. [EPA-HQ-OAR-2014-0827-1879-A2 p. 2]

**Organization:** Institute for Policy Integrity at NYU School of Law

The agencies have made several changes to the Phase 2 rule that are consistent with our previous comments. The explanation of the “energy efficiency paradox” also is consistent with many of our points on the first-mover disadvantage and the general lack of reliable information available to consumers. For more on Policy Integrity’s views on heavy-duty vehicle regulation, see our comments on the Phase 1 rulemaking.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.3]

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6 [http://policyintegrity.org/files/publications/2211\\_Regulatory\\_Report\\_2011\\_Heavy\\_Trucks\\_Rule.pdf](http://policyintegrity.org/files/publications/2211_Regulatory_Report_2011_Heavy_Trucks_Rule.pdf)

**Organization:** International Council on Clean Transportation (ICCT)

### **Market factors**

Available data and historical trends indicate the agencies include a flat reference truck efficiency baseline, with the sole exception of improvements in trailers that are linked to California’s regulations that affect trailers. The agencies’ continued consideration of fleet-wide vehicle efficiency improvements in the absence of new regulatory standards is unwarranted. The ICCT has supported many governments around the world in collecting and analyzing data. Based on our work to date, although technology improves and fleet-level efficiency improvements occur, there is not evidence to support the assumption of a new sales-fleet-averaged heavy-duty vehicle fleet CO<sub>2</sub> or fuel consumption reduction in the absence of regulations. In the case of analyzing the impact of the Phase 2 standards, including reference trailer improvements that are linked to the California regulations on trailer efficiency devices is warranted;

however, otherwise retaining flat efficiency characteristics for all engines, trucks, and tractors for scenarios would best reflect the evidence on historical trends in the U.S. [EPA-HQ-OAR-2014-0827-1180-A4 p.17] [This comment can also be found in section 8.2 of this comment summary.]

There are pervasive market barriers in the market, that have long prevented the uptake of even technologies with very attractive payback periods—for example, 6 months up to 2 years (see, e.g., Vernon and Meier, 2012; Roeth et al, 2013). Routinely, just small fractions of the fleet – a handful of technology-leading companies, representing a small fraction of the fleet, adopt technologies. The agencies consideration of technology adoption based on precise payback periods in the absence of regulation does not appear to be based on any empirical analysis of fleet-wide shifts. [EPA-HQ-OAR-2014-0827-1180-A4 p.17-18]

**Organization:** Mannix, Brian, George Washington University Regulatory Studies Center

In response to a directive from President Obama,<sup>3</sup> and using their respective statutory authorities, the Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) have jointly proposed a set of standards<sup>4</sup> to regulate greenhouse gas emissions and (almost equivalently) fuel efficiency for medium and heavy-duty engines and vehicles. In contrast to the Corporate Average Fuel Economy (CAFE) Standards that NHTSA has long administered, the vehicles covered by the current proposal are almost entirely commercial vehicles used by businesses – not by households. [EPA-HQ-OAR-2014-0827-1222-A1 p.2]

The President said: “[I]mproving gas mileage for these trucks are [sic] going to drive down our oil imports even further. That reduces carbon pollution even more, cuts down on businesses’ fuel costs, which should pay off in lower prices for consumers. So it’s not just a win-win, it’s a win-win-win. You’ve got three wins. . . And businesses that buy these types of trucks have sent a clear message to the nearly 30,000 workers who build them: We want trucks that use less oil, save more money, cut pollution.” [EPA-HQ-OAR-2014-0827-1222-A1 p.2]

Do the proposed standards create a win-win-win? And if they do, why must they be mandated? Isn’t the “clear message” sent by the businesses that buy these trucks sufficient? These are the kinds of questions that should be answered in the Draft Regulatory Impact Analysis (RIA) that accompanies the proposed standards. Unfortunately, while the RIA contains some good economic analysis, it ultimately makes claims about the standards’ fuel-saving benefits that are not plausible. The majority of the forecast benefits take the form of cost savings by the businesses that buy and use the regulated vehicles – businesses that are already well-informed about their own cost structure, and are well-positioned to make the optimum choices. Forcing businesses to make investments that they have thoroughly studied, and rejected, cannot create economic surplus. [EPA-HQ-OAR-2014-0827-1222-A1 p.2]

There are, of course, other categories of benefits detailed in the RIA that are distinct from the private fuel savings. But the credibility of the overall analysis is undermined by the fact that it appears to be hard-wired to produce a “win-win-win” result. It is as if the analysis contains a “defeat device” designed allow the standards to pass the benefit-cost test; the RIA demonstrates that the standards will produce very large net benefits on paper – benefits that the standards cannot possibly achieve on the road. [EPA-HQ-OAR-2014-0827-1222-A1 p.2]

It is important to remember why we do regulatory analysis. It is not to serve as a marketing tool, or to generate political talking points. Regulations have the force of law and, by their nature, are coercive. Before regulatory agencies use force against U.S. citizens, we ask them to justify it by demonstrating that the action will do more good than harm.<sup>6</sup> That requires an honest appraisal of who is made better or



worse off, and by how much. This RIA is designed to tell a happy story where everybody wins, but it is a false one. The claim that the private benefits due to the Phase 2 standards will many times larger than the private costs cannot be reconciled with the basic principles of benefit-cost analysis. [EPA-HQ-OAR-2014-0827-1222-A1 p.4]

### **Private Benefits**

Increasingly, agencies that issue regulations mandating increased energy efficiency have made the claim that they are producing “private benefits” – somehow making consumers better off by depriving them of the choices that they would make on their own.<sup>20</sup> These claims are always suspect, and are sometimes justified by a claim that consumers suffer from “externalities” – behavioral anomalies that prevent consumers (but not regulators) from acting in their own best interest.<sup>21</sup> Such claims become especially implausible in the case of the proposed Phase 2 standards. Under every scenario and set of assumptions, fuel savings are the largest component of benefits, accounting for more than 50 percent of all benefits.<sup>22</sup> Yet this rule, because it applies to intermediate goods (vehicles) that are bought by sophisticated users, is ideal for illustrating what is wrong with the analytical techniques that are used to produce inflated estimates of private benefits. The RIA states the problem: [EPA-HQ-OAR-2014-0827-1222-A1 p.8]

Economic theory suggests that interactions between vehicle buyers and sellers in a normally-functioning competitive market would lead HDV manufacturers to incorporate all technologies that contribute to lower net costs into the vehicles they offer, and buyers to purchase them willingly. Nevertheless, many readily available technologies that appear to offer cost-effective increases in HDV fuel efficiency (when evaluated over their expected lifetimes using conventional discount rates) have not been widely adopted, despite their potential to repay buyers’ initial investments rapidly. This economic situation is commonly known as the “energy efficiency gap” or “energy paradox.” This situation is perhaps more challenging to understand with respect to the heavy-duty sector versus the light-duty vehicle sector. Unlike light-duty vehicles – which are purchased and used mainly by individuals and households – the vast majority of HDVs are purchased and operated by profit-seeking businesses for which fuel costs represent a substantial operating expense. Nevertheless, on the basis of evidence reviewed below, the agencies believe that a significant number of fuel efficiency improving technologies would remain far less widely adopted in the absence of these proposed standards.<sup>23</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.8-9]

The RIA notes that one explanation for apparently irrational behavior on the part of regulated businesses is “. . . requirements of other regulations on HDVs.”<sup>24</sup> The RIA does not identify what these requirements are, nor does it explain how issuing conflicting regulations is supposed to make things better. It offers other candidate theories to explain the anomaly: [EPA-HQ-OAR-2014-0827-1222-A1 p.9]

Imperfect information in the new and used vehicle markets. Imperfect or asymmetrical information is often invoked as a reason to regulate, but it is difficult to make that case here. Vehicle buyers know how they plan to drive the vehicles, with what loads, under what conditions (altitude and temperature), and at what speeds. The RIA describes the industry as highly sophisticated and notes that some HDV buyers actually test the vehicles (including tractor-trailer combinations) for their performance under field conditions, with actual loads and drivers. This is far better information about fuel economy than EPA and NHTSA can ever hope to have. [EPA-HQ-OAR-2014-0827-1222-A1 p.9]

Principal-agent problems. The RIA speculates that the HDV buyer may not be directly responsible for its future fuel costs, or the individual who will be responsible for fuel costs may not participate in the HDV purchase decision. These are routine matters of internal corporate management or marketplace bargaining. Companies are very good at figuring out their cost structure, and all the evidence in the RIA

indicates that they put a great deal of effort into getting the fuel economy right. The only parties to all these transactions who may have a principal-agent problem are the regulatory agencies, and that is a reason to refrain from regulating, rather than a reason to intervene. [EPA-HQ-OAR-2014-0827-1222-A1 p.9]

Uncertainty about future fuel cost savings. “HDV buyers may be uncertain about future fuel prices, or about maintenance costs and reliability of some fuel efficiency technologies.” And rightly so. Any casual observation of fuel prices in recent years leads to the conclusion that investments in fuel economy, even if they work exactly as intended, are among the riskiest investments that a business might make.<sup>25</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.9-10]

Adjustment and transaction costs. These include the “costs associated with training drivers to realize potential fuel savings enabled by new technologies, or with accelerating fleet operators’ scheduled fleet turnover and replacement to hasten their acquisition of vehicles equipped with these technologies.” But these are real costs, and need to be accounted for in the benefit-cost analysis. Regulations cannot create economic benefits by instructing businesses to ignore these costs. EPA states: [EPA-HQ-OAR-2014-0827-1222-A1 p.10]

Other explanations for the limited use of apparently cost-effective technologies that do not involve market failures include HDV operators’ concerns about the performance, reliability, or maintenance requirements of new technology under the demands of everyday use, uncertainty about the fuel savings they will actually realize, and questions about possible effects on carrying capacity or other aspects of HDVs’ utility.<sup>26</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.10]

These are not “failures of the HDV market,” however; they are rational business decisions. Regulators’ attempts to override them can only produce net private costs, not private benefits. Take, for example, uncertainty about fuel savings, which causes HDV buyers to discount such projected savings. One factor in this uncertainty is the price of fuel; the graph below is the retail price reported by Washington State’s Department of Transportation: [EPA-HQ-OAR-2014-0827-1222-A1 p.10]

[Graph can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1222-A1]

Investments in fuel-saving technology are among the riskiest investments that businesses make. And there are more risks beyond the price risk. Right now, millions of buyers of light Volkswagen diesel vehicles are very disappointed to learn that they are not getting the performance that they thought they would get. Buyers of HDVs must recognize that fuel-saving technology do not always deliver what they promise. [EPA-HQ-OAR-2014-0827-1222-A1 p.11]

Uncertainties like this are one reason why the apparent discount rate that businesses apply to fuel-saving technologies is so high. Yet the RIA applies discount rates of 3 and 7 percent. It is standard practice for the government to use risk-free discount rates to its own investments, because the government is large enough to self-insure, and no one project is more than a small component of a very large portfolio of government projects. But buyers of HDVs generally are not using government funds. It is inappropriate to apply the parameters of public finance to private businesses that face real opportunity costs, capital constraints, and financial risks. It does not create economic value when regulation forces private businesses to forego higher or more certain investments in order to make mandated investments. Before applying a risk-free social discount rate to the stream of private costs and benefits associated with a regulation, the capital costs imposed on businesses and individuals should be converted to a consumption-equivalent stream, using the actual discount rate of the businesses and individuals who experience them. [EPA-HQ-OAR-2014-0827-1222-A1 p.11-12]

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25 David R. Henderson, “The Economics of Fuel Economy Standards,” *Regulation Magazine*, 1985, 47. <http://object.cato.org/sites/cato.org/files/serials/files/regulation/1985/1/v9n1-6.pdf>

26 RIA, p. 8-4.

The most troubling aspect of the private benefit numbers is the extent to which the agencies believe that coercive regulation, even in the absence of any externalities, will make businesses more economically efficient. [EPA-HQ-OAR-2014-0827-1222-A1 p.12]

Some of these explanations imply failures in the private market for fuel-saving technology beyond the externalities caused by producing and consuming fuel, while others suggest that complications in valuing or adapting to technologies that reduce fuel consumption may partly explain buyers’ hesitance to purchase more fuel-efficient vehicles. In either case, adopting this proposed rule would provide regulatory certainty and thus generate important economic benefits in addition to reducing externalities.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.12]

The RIA has it backwards. These are not failures of the private market; these are failures of the economic analysis. Forcing businesses to make bad investments may provide regulatory certainty, but it emphatically does not “generate important economic benefits.” Some businesses may see this type of regulatory certainty as privately advantageous because it protects them from competitors, drives out small businesses, and creates barriers to entry and innovation. But this business support is not evidence of economic benefit; rather, it suggests that there are additional economic harms that will flow from the regulation. [EPA-HQ-OAR-2014-0827-1222-A1 p.12]

## **Conclusion**

In conducting this Phase 2 rulemaking, EPA and NHTSA have completed extensive engineering and economic research, which is integrated into a Regulatory Impact Analysis that forecasts large benefits, mostly in the form of private fuel savings. Unfortunately the analysis fails to recognize that competitive markets are far better informed, and far better motivated, to pursue these fuel savings efficiently. The RIA’s attempts to explain that limiting businesses’ options will make them more efficient are not persuasive. The proposed Phase 2 standards seem likely to reduce both competition and innovation in MDV and HDV markets, resulting in additional costs not documented in the RIA. The net effect on U.S. households will be higher costs, not savings. There are other external benefits that might be used to justify the standards, but an honest RIA would acknowledge that these come at a price. This is not a win-win-win proposal. [EPA-HQ-OAR-2014-0827-1222-A1 p.12]

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3 Remarks by the President on Fuel Efficiency Standards for Medium and Heavy-Duty Vehicles, February 18, 2014.

4 “Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles—Phase 2; Proposed Rule.” *Federal Register* Vol. 80, No. 133, July 13, 2015 (Book 2 of 3 Books), pp. 40137–40766.

6 Executive Order 12866: Regulatory Planning and Review. September 30, 1993.

20 For example, Miller (2015) calculates that private benefits comprise 88% of all benefits from energy efficiency standards. Miller, Sofie E. “Whose Benefits Are They, Anyway? Examining the Benefits of Energy Efficiency Rules 2007 – 2014.” The George Washington University Regulatory Studies Center, Washington, DC. September 2, 2015.

21 Dudley & Mannix, “Please Don’t Regulate My Internalities,” Journal of Policy Analysis and Management, 2015. <http://www.appam.org/pointcounterpoint-please-dont-regulate-my-internalities/>

22 See Table 8-38, RIA p. 8-88.

23 RIA, p. 8-3.

24 RIA, p. 8-4.

27 RIA, p. 8-5.

**Organization:** NAFA Fleet Management Association

Additionally, the proposed standards place greater strain on driver and technician resources (capability), which are two vocational areas where fleets are becoming more challenged to hire enough (and qualified) employees. [NHTSA-2014-0132-0111-A1 p.2-3] [This comment can also be found in section 11.12 of this comment summary.]

Many fleets have seen an increase in downtime, which has manifested itself in driver productivity issues, shop capacity concerns and an overall increase in the number of spare vehicles required to have on hand to ensure that enough units are available to serve customers. [EPA-HQ-OAR-2014-0827-1011 p.3] [This comment can also be found in section 11.12 of this comment summary.]

Lastly, fleets have had to increase training significantly to stay on top of the changes that have increased our technician counts across the country. [NHTSA-2014-0132-0111-A1 p.3] [This comment can also be found in section 11.12 of this comment summary.]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

According to the NPRM, the agencies “recognize that there is some uncertainty in projecting costs and effectiveness, especially for those technologies not yet widely available, but believe that the thresholds proposed for consideration account for realistic projections.” (Emphasis added). Whereas the agencies are content with the uncertainty of costs and effectiveness of the technologies, owner-operators do not unfortunately have that luxury. The livelihood of an owner-operator, who frequently operates his or her business on small profit margins, depends on affordable and reliable equipment in order to compete and survive in a highly competitive industry. OOIDA strongly believes that the market should drive fuel efficient technologies instead of expensive mandates. The agencies stated in their proposed rule that “both public and confidential historical information shows that tractor trailer fuel efficiency improved steadily through improvements in engine efficiency and vehicle aerodynamics over the past 40 years.” In particular, these improvements have been driven by fleet owners and owner-operators seeking fuel efficient trucks, as fuel is the number one expense of every trucking operation. The average one truck owner-operator spends approximately \$70,000 in fuel every year.<sup>3</sup> If there was affordable and reliable technology which improved fuel efficiency by 24% over the 2017 baseline, there would be no need of a mandate, as truck drivers would be more than willing to purchase such equipment. [EPA-HQ-OAR-2014-0827-1244-A1 p.5-6]

As part of the proposed rule the agencies stated, “We request comment on the sufficiency of the proposed Phase 2 structure, lead time, and stringency to avoid market disruptions. We note an important difference, however, between standards for criteria pollutants, with generally no attendant fuel savings, and the fuel consumption/GHG emission standards proposed today, which provide immediate and direct financial benefits to vehicle purchasers, who will begin saving money on fuel costs as soon as they begin operating the vehicles. It would seem logical, therefore, that vehicle purchasers (and manufacturers) would weigh those significant fuel savings against the potential for increased costs that could result from applying fuel-saving technologies sooner than they might otherwise choose in the absence of the standards.” (Emphasis added). While it would seem logical on paper, the real-world effect of costly and unreliable technology will prevent any owner-operator or fleet owner from purchasing such a vehicle. Again, fuel is the largest cost for the owner of a truck, and therefore reducing fuel consumption is crucial in operating a successful and viable business. Wherefore, it is of the utmost importance for regulators to allow innovation on part of the OEMs to continue by not overly constraining engine design.<sup>18</sup> If OEMs were able to produce an affordable fuel efficient vehicle, then both owner-operators and fleet owners would readily purchase them in the market. Forcing unproven technologies will only impede the agencies objectives. [EPA-HQ-OAR-2014-0827-1244-A1 p.14-15]

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3 OOIDA Foundation, Owner-Operator Member Profile Survey 2014, OOIDA (July 2014).

18 Complete Vehicle Standards for Heavy-Duty Trucking.

**Organization:** Truck Renting and Leasing Association

However, TRALA has several concerns about the Proposed Standards, which we have set forth below: (1) the industry is self-motivated to conserve fuel, thus reducing GHG emissions through market forces instead of regulatory mandates [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**The Truck Renting & Leasing Industry is Self-Motivated to Conserve Fuel, Thus Reducing Tailpipe GHG Emissions through Market Forces, Not Regulation**

The truck renting & leasing industry is self-motivated to seek fuel saving technologies without regulation to mandate that outcome. Through market forces, companies compete every day on aspects of unit performance, including improved fuel performance. Fuel consumption, of course, is a significant cost of doing business for fleet owners and operations. Because of this, we question the entire premise of the regulatory action – i.e., that governmental mandates are necessary to achieve desired societal objectives. Further, it must be recognized that as a consequence of this, trucks are already highly efficient leaving few remaining gains to be had. [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Organization:** Utility Trailer Manufacturing Company

**The cost-benefit calculation is flawed because it fails to give safety adequate consideration and weight.**

The aerodynamic devices specified by the EPA are relative newcomers to the market. Manufactured of plastic, fiberglass, and light metal, they are easily damaged as the trailers travel over the road and railroad crossings, or – in the case of trailer tails – as drivers routinely back into docks, fences, and other trailers. Some number of these devices will become detached in over-the-road operations, resulting in

some number of increased accidents. [EPA-HQ-OAR-2014-0827-1183-A1 p.17][This comment can also be found in section 5.1 of this comment summary]

The additional technologies are also likely to increase accidents and the injuries and fatalities associated with them. As noted previously, adding the aerodynamic technologies to trailers that otherwise would run at full permitted weight will mean that cargo equal to the weight of the devices will have to be transported on additional trips. There is a correlation – some would say direct – between miles driven and accidents/injuries/fatalities. The Agencies have not accounted for this important societal cost in performing their cost-benefit analysis. [EPA-HQ-OAR-2014-0827-1183-A1 p.17][This comment can also be found in section 5.1 of this comment summary]

Finally, the effect of implementing a combination of technologies on a large scale is not yet sufficiently evaluated to be certain that there will not be unintended consequences. Other than its own side skirt, Utility Trailer does not know of any other aerodynamic device that has been certified to meet or exceed relevant DOT regulations. For example, some vendors market devices to cover the ends of axles, claiming they will reduce drag. But covering the wheel end may reduce airflow, causing the components to run hotter. Before installing such devices, a prudent manufacturer would require approval from the axle supplier, the bearing supplier, the hub supplier, the oil-seal and hubcap supplier, the lubricant supplier, the brake supplier, the wheel supplier, and the tire supplier. [EPA-HQ-OAR-2014-0827-1183-A1 p.17-18][This comment can also be found in section 5.1 of this comment summary]

#### **Response:**

The agencies discuss the existence of the energy efficiency gap and its role in the market for fuel-saving technologies for HD vehicles in Preamble Section IX.A. and RIA Chapter 8.2. The commenters display a split of opinions on the existence of the efficiency gap and possible explanations of it. CARB, CALSTART, CFA, Institute for Policy Integrity at NYU School of Law (IPI), and ICCT support, either in whole or in part, the agencies' arguments for potential barriers to market adoption. Caterpillar Inc. et al., CEI, Mr. Mannix (George Washington University Regulatory Studies Center), George Mason University Mercatus Center (Mr. Lutter), NAFA Fleet Management Association, OOIDA, Truck Renting and Leasing Association (TRALA), and Utility Trailer Manufacturing Company (UTMC) express skepticism or raise concerns about the agencies' discussion. Here we first provide responses related to the supportive comments, and then to the skeptics. In both cases we begin with the general issues, and then provide more detailed responses to detailed critiques.

#### **11.1.4 Response: Comments supportive of the agencies' energy paradox discussion**

The commenters who are generally supportive of the agencies' discussion for the most part agree that the energy efficiency gap exists and that the hypotheses raised in Preamble Section IX.A and RIA Chapter 8.2 provide potential explanations for the efficiency gap. They often provide some additional support for these hypotheses.

CFA notes that the benefits of the standards are six times larger than the costs and asks the agencies for "better documentation and support for the decision not to set the standard at a higher level" and "urge that a careful examination be given as to whether greater savings that would benefit our economy and consumers can clearly be justified." In fact, the agencies did very carefully consider an array of alternatives with varying standards and GHG/fuel consumption reductions; our decisions in setting each standard are well documented throughout our Preamble, especially in our discussions of individual sectors in Sections II-IV and summarized in Preamble Section X. In the final program, the agencies'

careful assessment of new data and comments has resulted in increases in our estimates of market penetration and effectiveness of key technologies, leading to increases in stringency such as with the diesel engine standards. The agencies are adopting these standards because, based on the information available at this time and careful consideration of all comments, we believe they best fulfill our respective statutory authorities when considered in the context of available technology, feasible reductions of emissions and fuel consumption, costs, lead time, safety, and other relevant factors. The agencies consider the standards to represent a reasonable choice under Section 202(a) of the CAA and the maximum feasible under NHTSA's EISA authority at 49 U.S.C. 32902(k)(2).

CFA expects that the cost savings will be passed along to consumers. EPA has not made a determination of the final disposition of cost savings; see the discussion of employment impacts associated with the fuel savings in Preamble Section IX.L.3.c and RIA Chapter 8.11.3.3. CFA argues as well that the net benefits may be underestimated, due to exclusion of the full value of externalities. The agencies have monetized external benefits and costs when the underlying research is sufficient to support that monetization; see Preamble Section IX and RIA Chapter 8 for the benefit-cost analysis, and in particular Section IX.G. and RIA Chapter 8.5 for monetized GHG impacts, Section IX.H. and RIA Chapter 8.6 for monetized non-GHG health impacts, Section IX.I. and RIA Chapter 8.9 for energy security impacts, and Section IX.J. and RIA Chapter 8.7 for other impacts. Preamble Section IX.K. and RIA Chapter 8.10 summarize the benefits and costs. CFA lauds the standards for being long-term, technology neutral, product neutral, responsive to industry needs, and responsive to consumer needs. The agencies have considered these factors in its deliberations related to the standards. We agree as well that "the implicit discount rates calculated from consumer choices reflect not only individual time preferences but a whole collection of variables that may depress the ultimate level of investment," and that these rates should not be used for calculating net social benefits.

### **11.1.5 Response: Comments skeptical of the agencies' energy paradox discussion**

#### ***11.1.5.1 General Concern***

The concerns raised in skeptical comments generally center on the idea that private markets provide sufficient incentives to lead to adoption of all cost-effective fuel-saving technologies. CEI, Mr. Mannix, OOIDA, and TRALA argue that it is "implausible" (Mr. Mannix) that the standards produce "private benefits," gains to vehicle buyers in fuel savings that exceed increased technology costs, because private markets should already provide all cost-effective technology. They consider the hypotheses presented by the agencies either to represent rational, business-based reasons that companies have not adopted the technologies, such as higher or additional costs, or to be not well supported. Mr. Lutter provides a working paper that states that the agencies should conduct empirical analysis of inefficiency in firms' use of technologies before claiming that firms are operating inefficiently.

We note first that the purpose of the standards is not to provide private benefits, as TRALA in particular suggests; nor are the standards being promulgated out of "ideological zeal for 'greening' the U.S. transport system" (CEI). Rather, the standards are contributing to EPA's Clean Air Act obligation to reduce GHG emissions -- that is, emissions which contribute to the greenhouse gas air pollution which endangers public health and welfare (CAA section 202 (a)(1)). Emissions of GHGs are "externalities," impacts of private market behavior that do not accrue solely to the participants in the private markets. Those who generate externalities bear only a fraction of the consequences of their generation; as a result, those who generate them will not have appropriate incentives to avoid their production. Control of externalities is widely accepted as a rationale for government intervention in private markets. The fuel savings, in this context, are an ancillary benefit or a reduction in opportunity costs associated with the GHG reductions, though they are clearly a very large one.

The evidence of these net savings is the expected technology costs and effectiveness. If those estimates are reasonably correct, and take into account all relevant costs and benefits (including such factors as reliability), then an energy efficiency gap exists, and the net savings from these standards are real. Explaining why the gap exists is a separate and difficult challenge, because of the difficulties involved in developing tests of the different possible explanations. (As discussed further below, Mr. Lutter presents one such analysis. It examines one particular form of one hypothesis, and does not find evidence to support that hypothesis). The difficulties in developing tests to explain the gap, or assertions of the unlikelihood of the explanations offered, do not provide evidence that the gap doesn't exist. Arguing against the hypotheses that the agencies have offered does not affect the question of existence, but rather the reasons for its existence.

#### ***11.1.5.2 Additional Costs***

Demonstration of costs that are understated or not included in the analysis, or benefits that are overstated, would be evidence that the efficiency gap may not exist. Caterpillar, Mr. Mannix, NAFA Fleet Management, OOIDA, and UTMC express concerns in particular about maintenance and reliability problems. Reliability comments are addressed in RTC Sections 1.5 (Lead Time); 3.4 (Projected Engine Technologies, Effectiveness, & Cost); 4.3 (Projected Tractor Technologies, Effectiveness, and Cost); 4.5 (Compliance Provisions and Flexibilities for Tractor Standards); 5.1 (Trailers, General Comments); 5.3 (Proposed Trailer Standards for CO<sub>2</sub> and Fuel Consumption); 6.2 (Proposed Vocational Vehicle Standards for CO<sub>2</sub> and Fuel Consumption); 6.3 (Projected Vocational Vehicle Technologies, Effectiveness, & Cost); 7.3 (Projected Pickup and Van Technologies, Effectiveness, and Cost); and 8 (Stringency). Except for UTMC's comments about aerodynamic devices, the issues raised by these commenters are not specific to these standards nor to these technologies. NAFA Fleet Management, for instance, cites increases in maintenance and repair costs from 2008 to 2013 in its comments; the HD GHG Phase 1 program did not begin until MY 2014. The effects of the standards on maintenance expenditures are discussed in Preamble IX.D. and RIA Chapter 7.2.3. As discussed there, in our continuing effort to provide sound estimates of the benefits and costs of the standards, the FRM accounts for maintenance costs for more technologies than in the NPRM. The effects of the aerodynamic standards on trailer safety is discussed in Preamble IV.A(2)(d)).

#### ***11.1.5.3 Comments on the Agencies' Hypotheses***

As discussed previously, the agencies' determination of an efficiency gap is based on the analysis of costs and benefits. We agree that the large ancillary benefits from the fuel savings suggest questions about the efficiency of the market for fuel efficiency in HD vehicles. The agencies have not determined which, if any, of these hypotheses are true and thus explain the efficiency gap. All of these hypotheses have been raised in publications or in comments. We review the evidence on each in Preamble Section IX.A. and RIA Chapter 8.2. As noted above, the positive commenters generally support the plausibility of some or all of these explanations. The skeptical commenters generally dismiss them either as implausible, or as arguments supporting the efficiency of the market for fuel efficiency.

Some commenters provide thoughts specific to five hypotheses discussed in Phase 1:

Imperfect Information: The agencies hypothesize that buyers are skeptical of the claims of manufacturers related to fuel-saving technologies (Preamble Section IX.A, RIA Section 8.2). CEI and Mr. Mannix find this hypothesis troubling because it implies that the agencies have information on the effectiveness of these technologies that the private sector does not. In particular, it argues that the gap should be smallest for semi-truck owners, because the SmartWay Program has been providing that



sector with information for a number of years; yet the savings to semi-truck owners are substantially larger than the savings to vocational or HD van and pickup owners.

This comparison of gains to tractor/trailers with gains to vocational or HD van and pickup owners does not provide evidence against the asymmetric information hypothesis, because the differences between these vehicle types are not limited to access to the SmartWay Program. Class 7 and 8 vehicles travel many more miles per year: the useful life of a Class 8 tractor, for instance, is 10 years or 435,000 miles (see Preamble Table III-6), while for vocational vehicles, pickups, and vans, the useful life is 150,000 miles or 15 years (see Preamble Section V.D.1). This difference in use has a great effect on the potential net benefits. Second, the diversity of purposes and designs in the vocational vehicle fleet is much greater than in the tractor fleet; thus, the effectiveness of technologies to address the vocational vehicle is likely to be much more variable than in the tractor fleet. If there are economies of scale in developing efficiency technologies, the greater variability in the vocational vehicle fleet may reduce innovative options in that sector. Because the differences between Class 7 and 8 vehicles on the one hand, and vocational vehicles, pickups, and vans on the other, go beyond access to the SmartWay Program, this difference in net benefits does not provide insight into the asymmetric information hypothesis.

Imperfect information in the resale market. CEI says that, “To our knowledge, nobody claims the resale market fails to consider the value of technologies that enhance vehicle reliability, performance, comfort, and amenities.” Mr. Mannix similarly argues that “it is difficult to make that case here.” As discussed in Preamble Section IX.A and RIA Section 8.2, Klemick et al. 2015, Roeth et al. 2013, and Aarnink et al. 2012<sup>205</sup> found evidence both in favor of and against the hypothesis of imperfect information in the market for used HDVs.

Principal-agent problems causing split incentives. CEI states that, even if split incentives exist, they do not necessarily imply under-investment in fuel economy. We agree that the presence of split incentives does not guarantee under-investment, but we believe that it creates that possibility. Mr. Mannix considers companies to be capable of solving these problems internally, and regulatory agencies instead to be the ones with this problem. We agree that its incentives and those of the HD industry are not aligned; we do not expect the private sector to put the same weight on GHG emissions as the agency does. We continue to consider private-sector split incentives to be a potential problem in the private sector.

CEI also comments that the proposed rule “postulates a split incentive that works the other way” – in particular, that drivers don’t care about fuel costs unless they have financial incentives, while owners do care. This example comes from Vernon and Meier,<sup>206</sup> whose study finds that split incentives “have the potential to significantly increase fuel consumption through avoided investments, insufficient maintenance, and fuel-wasting practices.” In this case, the owner may not face disincentives to install fuel-saving technologies; in fact, the owner may consider investing in technologies (for instance, a

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<sup>205</sup> Klemick, Heather, Elizabeth Kopits, Keith Sargent, and Ann Wolverton (2015). “Heavy-Duty Trucking and the Energy Efficiency Paradox: Evidence from Focus Groups and Interviews.” Transportation Research Part A 77: 154-166; Roeth, Mike, Dave Kircher, Joel Smith, and Rob Swim (2013). “Barriers to the Increased Adoption of Fuel Efficiency Technologies in the North American On-Road Freight Sector.” NACFE report for the International Council on Clean Transportation; Aarnink, Sanne, Jasper Faber, and Eelco den Boer (2012). “Market Barriers to Increased Efficiency in the European On-road Freight Sector.” CE Delft report for the International Council on Clean Transportation.

<sup>206</sup> Vernon, David and Alan Meier (2012). “Identification and quantification of principal-agent problems affecting energy efficiency investments and use decisions in the trucking industry.” *Energy Policy*, 49(C), pp. 266-273.

variable speed limiter, or an efficient automatic transmission) that limit a driver's ability to use excess fuel. We raised this possibility, among others where there may be disincentives to technology investment, as examples of the complexity of motivations involved in fuel savings and the choice of technologies. As discussed above, our finding of an efficiency gap does not hinge on this one hypothesis.

Mr. Lutter submits a working paper<sup>207</sup> that examines data collected from observing tractors with box trailers on a convenience sample of 3 stretches of highway and along one road trip. The authors find that, for the two outer tires observed on one side of trailers, less than half were both low-rolling-resistance (LRR) trailer tires; some had LRR tractor tires, some mixed tractor and trailer tires, and some mixed conventional and LRR tires. They offer as potential explanations for this odd mixing that companies are extending the use of tractor tires on trailers, potential cost advantages in bulk purchase of tires, management costs, or belief that the correct tires are not as efficient as claimed. They then regress the existence of side skirts (an aerodynamic device) on controls that include fleet miles per year divided by fleet size (average miles per truck), log of fleet size, compliance variables, and whether the tractor and trailer differ in ownership (based on U.S. Department of Transportation registration numbers). They do not find a statistically significant or negative relationship when the trailer has different ownership than the tractor. This finding does not provide evidence in support of the split-incentives problem between tractors and trailers. They conclude that the agencies should review empirical evidence more carefully "before using estimates of large net economic gains in rulemakings" (p. 30), and allocating resources to collect data for such an analysis.

As the discussion above indicates, the evidence for the efficiency gap is the analysis showing that cost-effective fuel-saving technologies are not adopted. Split incentives provide one hypothesis to explain the existence of the gap. As discussed above, split incentives can take many forms; split incentives specifically related to the difference in ownership between tractors and trailers are one part of that hypothesis. Thus, the Fraas et al. (2016) paper is one piece of evidence on one hypothesis. While its results on side skirts may be consistent with neoclassical economics, it does not actually provide evidence on the existence of the efficiency gap for side skirts – that is, whether the side skirts save more money than they cost. We also note that the evidence presented on LRR tires does not suggest best or consistent practices for use of those tires on trailers. Finally, the paper's conclusion that the agencies conduct a broader data collection effort suggests that the authors themselves consider this work exploratory rather than conclusive; we agree with its assessment of the study as exploratory.

Preamble IX.A. and RIA Chapter 8.2 include our review of all evidence that we have found on the efficiency gap in HD vehicles. While the authors of the paper may consider their data collection efforts to have been "relatively inexpensive and quick" and therefore easily implemented by the agencies, data collection by federal agencies is governed in part by the Paperwork Reduction Act, which typically requires internal and public review of data collection methods and survey design before a data collection protocol may be implemented. Even if observation of vehicles at specific places were not subject to those requirements, the agencies would take into consideration potential public response to federal observation of vehicles before it instituted such an effort.

Uncertainty about future cost savings. CEI and Mr. Mannix agree that this hypothesis may explain lack of adoption of fuel-saving technologies and characterize it as prudent buyer behavior. As discussed in Preamble Section IX.A. and RIA Chapter 8.2, if all buyers prudently wait for reduced uncertainty before

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<sup>207</sup> Fraas, Art, Randall Lutter, Zachary Porter, and Alexander Wallace (2016). "The Energy Paradox and the Adoption of Energy-Saving Technologies in the Trucking Industry." Working Paper, Mercatus Center, George Mason University. EPA-HQ-OAR-2014-0827-1879.

adopting new technologies, then effective technologies may not be adopted. In addition, uncertainty about future fuel cost savings should provide incentives for a risk-averse company to invest in fuel-saving technology: if fuel prices unexpectedly increase, fuel-saving technology reduces the impacts.

Adjustment and transactions costs. CEI agrees that this hypothesis may explain lack of adoption of fuel-saving technologies, as a cost of innovation and the need to have personalized information. As discussed regarding imperfect information, not having personalized information can be a barrier to adoption. Mr. Mannix mentions various costs, including concerns about vehicle quality and utility. As discussed regarding additional costs, commenters have not documented increased reliability or maintenance costs associated with technologies to reduce GHG emissions; rather, the references are to concerns over controls of non-GHG emissions, including nitrogen oxides (NO<sub>x</sub>). Because the technologies for controls of those pollutants are not the same as those for GHG reductions, any problems associated with those controls do not provide evidence on problems associated with GHG-reducing technologies.

CEI raises an alternative hypothesis: that EPA's diesel-engine emission standards have hindered HD fuel economy. While some of what CEI states is correct, it overstates that role in the context of the energy paradox. It is true that some first generation NO<sub>x</sub> controls included fuel consumption penalties as manufacturers retarded fuel injection timing to lower peak combustion temperatures and pressures. However, the opposite is true for SCR technology, which actually allowed manufacturers to improve fuel consumption. Another flaw in the CEI hypothesis is that it applies only for engines and engine manufacturers. It does not explain choices made with respect to vehicle technologies, such as improved transmissions. For many of these technologies, it is actually the component suppliers that make the investments to develop technology. CEI provides no basis to believe that emission control costs borne by engine manufacturers would have any impact on investments by suppliers of other key components such as transmissions, axles, and aerodynamic devices. Finally, in the context of the likelihood of new NO<sub>x</sub> controls sometime during the Phase 2 time frame, the CEI hypothesis would seem to be more supportive of a flatter reference case than a more dynamic scenario.

CEI suggests that HD vehicle buyers may "pre-buy," that is, increase purchases of vehicles just before the standards go into effect, and reduce their purchases afterwards, resulting in temporary layoffs. As discussed in Preamble IX.F.2 and RIA Chapter 8.4.2, the 2010 NAS HD report noted that there was some evidence of pre-buy in response to the 2004 and 2007 heavy-duty engine emissions standards, but it also recognized that fuel economy improvements that can offset purchase costs will lessen those potential impacts. See also Chapter 11.7.2 of this Response to Comments. A working paper by Rittenhouse and Zaragoza-Watkins (2016)<sup>208</sup> investigates pre-buy and identifies it at the time of the 2007 standards, but not around the time of 1998, 2002, or 2010 criteria pollutant standards. They find that sales and production increased in the 7 months before the 2007 standards, and dropped afterward by about the same amount. The evidence on employment is less clear; their findings suggest a possible increase in hours before the standards, but they do not find a decrease afterward. Its data go through January 2015. It does not examine pre-buy when the Phase 1 standards went into effect; scatter plots of sales residuals do not show major outliers (that would suggest pre-buy or post-rule reductions) except for the 2007 standards. EPA disagrees that any lessons from the 2007 NO<sub>x</sub> standards regarding pre-buy are likely to apply to the HD GHG standards.

In sum, the agencies find that the commenters have not provided specific evidence to change the results of the benefit-cost analysis. As a result, we still find an energy efficiency gap. As discussed in Preamble

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<sup>208</sup> Rittenhouse, Katherine, and Matthew Zaragoza-Watkins (2016). "Strategic Response to Environmental Regulation: Theory, and Evidence from the U.S. Freight Truck Industry."

IX.A. and RIA Chapter 8.2, we have identified a number of potential explanations for the existence of the gap, but we make no definitive finding on the cause.

## 11.2 Vehicle-Related Costs

**Organization:** ABC Bus Companies, Inc.

On the face value of these extremely large documents, it seems that a huge compliance burden to the coach manufacturer's as well as a huge maintenance burden to motorcoach operators will be a realistic outcome. This seems to be proven true as we have experienced in the Phase 1 implementation. ABC is concerned about the long term reliability of increased emission technologies and unreliable cost estimates that are projected so far into the future. [EPA-HQ-OAR-2014-0827-1430-A2 p.1]

The numbers of 'Skilled Technicians' available to the motorcoach industry are becoming more limited every time more and new vehicle technology is introduced. With the average motorcoach fleet being only 10 buses, it is nearly impossible for an operator to have the expensive tools, software, hardware, and technical training needed to maintain the technologies proposed in Phase 2. Motorcoach operators are still trying to cope with the Phase 1 elevated operating costs. Small fleets could be put into a position to forgo the bus business altogether because of mounting infrastructure costs and federal red tape. The unintended consequence of these actions would be that more cars and light trucks would be on the US highways as motorcoach operators could go away. Much of the Phase 2 cost estimates focus on reduced fuel consumption as reasons for implementing and justifying these proposed standards. However, estimated fuel savings can be quickly eaten up by administrative paper work, increased equipment costs, untested technology, stranded passengers, etc. [EPA-HQ-OAR-2014-0827-1430-A2 p.1-2]

The current position that CARB has taken forcing Phase 1 technologies on vehicles not engineered to accept these components has substantially increased the financial burden upon small operators to provide economic transportation in the State of CA. If this were to occur on a national basis, the same outcome could be seen. [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

Given the low numbers of intercity coach bus sales, these motorcoach manufacturers are limited to components from the Class 7 and 8 truck suppliers. This can mean extra engineering costs and delayed implementation of proposed standards. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

### **Response:**

The Phase 1 requirements applicable to motor coaches were predicated solely on an improvement to the rolling resistance of tires. The agencies fail to understand how that requirement has led to motorcoach operators having difficulty coping with the Phase 1 operating costs. EPA does not believe that the Phase 2 requirements could lead to more cars and light trucks on US highways due to motorcoach operators going out of business. EPA and NHTSA have in place a set of GHG and fuel economy standards applicable to cars and light trucks that will be implemented through 2025. So requirements are being placed on both industries and both sets of requirements provide very large benefits relative to their costs. The final standards also provide optional custom chassis standards. One of the subcategories which could utilize these standards are motorcoaches. The agencies believe that these optional standards ease the potential compliance burden and address many of the concerns expressed in this comment.

**Organization:** Allison Transmission, Inc.

The RIA Section 2.12.3.1 summarizes the cost estimates related to adding two additional gears for vocational vehicles. Allison believes that the DMC of \$413 in 2018 is understated. A more complex architecture will add weight, and most likely length which will result in a higher material cost than the transmission with fewer gears. A “clean sheet of paper” design and validation process would be required and one design would not be adequate to cover the breadth of LHD, MHD, and HHD vehicles. Additionally, the manufacturing capital costs are higher for HDV transmissions over LDV transmissions because the HDV manufacturers do not have a common cadence for introduction of changes. This requires the transmission manufacturer to build both the old and new versions of a transmission until the market can be shifted to a common configuration. Allison’s experience is that this transition time is years, not months. The capital costs include, but are not limited to facility, machinery and equipment, and tooling. Since the cost recovery for the transmission manufacturer is included in the DMC, Allison’s assessment it that the DMC is understated to reflect both increased material costs and investment cost recovery for new transmissions. [EPA-HQ-OAR-2014-0827-1284-A1 p.15]

#### EPA and NHTSA Underestimate Costs, Precluding Alternative 4

EPA has estimated that manufacturers would need an additional \$6.5 Million/year investment for the years 2021-2024 (\$26Million in total) to achieve Alternative 4. It is unclear in the RIA how much of this investment is for hybrids instead of other technologies. Allison, with the support from an ARRA grant from the U.S. Department of Energy, invested over \$130 Million for a hybrid system for heavy-duty trucks, which far exceeds hybrid cost estimates in this rulemaking. We recognize that there is investment as part of the proposal’s baseline that is additive to the \$26 Million referenced above. In our view, the amount of investment in this area that would be required to make a significant impact on the adoption of hybrids in the market is much greater than that assumed by EPA and NHTSA. [EPA-HQ-OAR-2014-0827-1284-A1 p.53]

Investments for heavy-duty hybrids will be made by component suppliers, not the vehicle manufacturers. The battery, inverter, and motor suppliers must make investments in addition to the system supplier. In this regard – for a small market like the heavy-duty hybrids – a significant investment, under current conditions, must be seen as risky and unlikely to occur. In general, private sector investments will only be made if there are reasonable prospects of earning a return on the investment through volume sales. Since EPA’s assumption is that the technology will be purchased by the vehicle manufacturer at the DMCs as shown in the RIA Tables 2-180, 2-181, and Table 2-182, investments will be recovered by the suppliers through the DMC. Allison believes the DMC estimates are significantly too low to account for the total cost of the components and the investment cost recovery. [EPA-HQ-OAR-2014-0827-1284-A1 p.53]

As a general matter, Allison believes that many of the costs projected for the regulatory options that were considered by EPA and NHTSA and that are presented as alternatives in this rulemaking are understated.<sup>18</sup> This underestimation of costs is fundamental to EPA and NHTSA’s ability to determine whether an alternative is consistent with statutory authority that requires EPA to give “appropriate consideration to the cost of compliance”<sup>19</sup> and which requires NHTSA to adopt “cost-effective” standards.<sup>20</sup> In this rulemaking, the projection of costs is tied directly to the stringency of standards. Cost projections affect the estimated penetration rates for different technologies and thereby EPA and NHTSA’s calculation of what level of stringency is appropriate and feasible. [EPA-HQ-OAR-2014-0827-1284-A1 p.13]

18 For example, the EPA Light-Duty Technology Cost Analysis, Report on Additional Case Studies (RIA Chapter 2 Reference 123) served as a basis for the statement “the direct incremental cost to build a six-speed wet dual clutch transmission was determined to be roughly \$100 less than the cost of a six-speed automatic transmission. We estimate the components and engineering to design a heavy-duty torque converter automatic transmission are at least as costly and complex as those to design a dual clutch transmission. Therefore, the agencies estimate switching from AT to DCT would have zero incremental cost for vocational vehicles.” (RIA page 2-121) Allison does not believe that this report is a valid basis on which to make relative cost assumptions for HDVs. The referenced report was based on front wheel drive transmissions with different gear schemes and much higher volumes that offer lower cost opportunities based on manufacturing processes.

19 CAA section 202(a)(2).

**Response:**

Allison takes exception to our estimate for adding two gears to an automatic transmission. We have based our estimate on an actual tear down of a light-duty automatic transmission and have then scaled that estimate upward by a factor of 6 (based on torque differences between light-duty and heavy-duty vocational). We believed at proposal and continue to believe that this is a reasonable estimate of the cost associated with adding two gears to an existing automatic transmission. Allison has qualified why they think our estimate is too low but, unfortunately, has not provided any quantitative information that would help develop an estimate that Allison would find more agreeable. Therefore, we continue to use the same estimate as used in the proposal except for updates from 2012\$ to 2013\$.

This remainder of Allison’s comment is really directed at the proposed Alternative 4 which the agencies have rejected in the final rules due to concerns over lead time, pace of standard phase-in and overall risk associated with technology implementation. Further, the proposal did use a cost estimate for the dual clutch transmission on urban and multipurpose vocational vehicles that was cost neutral to an automatic transmission, and a cost estimate for heavy HD regional vocational vehicles that was cost neutral to an AMT, or \$3864 (direct manufacturing cost, 2012\$, in 2018, see draft RIA Table 2-152). For the final rules, we are not projecting any use of this type of transmission for compliance. Because we have rejected Alternative 4 and are not projecting any use of dual clutch transmissions in vocational vehicles, we believe that the commenters concerns about the cost effectiveness of the standards and concerns over how that cost effectiveness is impacted by our dual clutch transmission costs, should be obviated.

The commenter also mentions concerns over the R&D estimates, especially with respect to Alternative 4 and hybrid technologies. Importantly, we are not finalizing Alternative 4, but we are projecting hybrid technologies to meet the final standards. We provide further detail about our R&D estimates below (in this Section 11.3) in our response to Daimler Trucks North America.

**Organization:** American Trucking Associations (ATA)

**Market Penetration Rates for Certain Tractor Technologies are Overly Aggressive**

The agencies’ estimated market penetration rates (“MPRs”) form the cornerstone of the rule. If these MPRs are set too high, original equipment manufacturers (“OEMs”) will be facing an uphill battle from the start in meeting their targets. The MPRs appear to be optimistically aggressive, resulting in overly stringent emission standards. The stringency of the standards should be set based on the needs of the market, realistic goals, and on products customer can afford to purchase. Targets under the rule should not rely on the optimism of technology providers who stand to financially benefit from the setting of high, and possibly unrealistic, standards. Customers should not be forced to buy technologies in order

for an OEM to meet a regulatory target. If Phase 2 results in customers being led down a path to purchase technologies that are not proven, cost-effective, or reasonable for a fleet's applications, fleets will keep their vehicles and trailers longer and will pre-buy in advance of the changes, followed by a subsequent no-buy after the new standards take effect. We have witnessed these buying patterns frequently, the most recent being in 2002 and 2006. A repeat of this pattern will delay both environmental and fuel consumption aims and impede the success of the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.5]

ATA formed a Fuel Efficiency Advisory Committee ("FEAC") comprised of fleet and trailer representatives to offer perspectives and provide guidance to ATA on the rule. Over the last two years the FEAC has met with EPA, NHTSA, OEMs, and suppliers on a regular basis to share data, information, industry survey results, and provide overall input. The FEAC developed 15 Guiding Principles on the Phase 2 Rule which have served as the framework for ATA's positions.<sup>2</sup> Two specific principles relating to the introduction of new technologies are of critical importance to the trucking industry, namely: (1) the advancement of GHG and fuel consumption reductions must be based upon sound science and must be economically achievable, and (2) such standards must not be technology-forcing. [EPA-HQ-OAR-2014-0827-1243-A1 p.5]

Another example is the 2004-2010 rulemakings to reduce particulate matter and nitrogen oxide emissions from on-road heavy-duty engines. EPA estimated the proposed standards would add a cumulative cost of more than \$5,000 to a new vehicle. In reality, the trucking industry saw record-setting cost increases of more than \$20,000 per new vehicle, a four-fold increase.<sup>6</sup> Ancillary costs incurred by fleets as a result of these rulemakings include missed and late loads and, in some cases, lost hauling contracts. Fleet owners also run the risk of losing drivers if they are forced to operate trucks having new, unproven technologies while other fleets continue to operate vehicles with proven technologies. The trucking industry can ill-afford to lose any drivers as we currently face a severe shortage of 35,000 drivers.<sup>7</sup> In fact, this figure could balloon to nearly 200,000 drivers by 2025 given current employment trends. While it remains uncertain as to how costs over a decade away were derived, it is a fact that several of these costs will be off by several orders of magnitude. [EPA-HQ-OAR-2014-0827-1243-A1 p.10-11]

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2 See Appendix 1, ATA Fuel Efficiency Guiding Principles (July 22, 2014).

6 Calpin, Patrick & Esteban Plaza-Jennings, A Look Back at EPA's Cost and Other Impact Projections for MY 2004-2010 Heavy-Duty Truck Emissions Standards, American Truck Dealers (February 2012).

7 American Trucking Associations, Economics Department.

**Response:**

The agencies respond to market penetration rate comments related to tractors in Chapter 4 of this RTC, trailers in Chapter 5 of this RTC, vocational vehicles in Chapter 6 of this RTC and pickups and vans in Chapter 7 of this RTC. Regarding comments pertaining to pre-buys associated with earlier criteria pollutant regulations, these comments are not germane to this GHG and fuel consumption regulation; we address such comments in Chapter 15.10.4 of this response to comments.

**Organization:** BYD Motors

*BYD Trucks*

BYD's current battery electric trucks are approximately 3 times as expensive as diesel trucks. In order to reduce the price gap original equipment manufacturers must make sizable investments in research and development and manufacturing scale. Similar investments have already been made by BYD in the bus market and as a result current electric buses are priced at only a 60% premium over diesel buses, a premium at which the fuel and maintenance savings result in approximately a 3 year payback and a favorable total cost of ownership. We believe a similar achievement is possible in the truck markets, driven by the following cost drivers: [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.229.]]

- The largest cost for electric vehicles is the batteries and BYD has achieved a 7% year over year improvement during each of the last 4 years. We are forecasting a 10% annual improvement each year through 2020. [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.229.]]
- Price will also be reduced from scale economies from investing in large scale manufacturing for components and assembly, and from purchasing power from ordering large quantities from vendors. Based on similar price reductions from buses and taxis, BYD estimates a 15% price reduction once our truck models are broadly commercialized. [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.229.]]
- Lastly, BYD will include amortized engineering costs in the price for initial truck orders. After recouping those investments from the initial 1,000 orders for each truck model, BYD will be able to drop price by an additional 10%. [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.229.]]

These price reductions alone will make electric trucks compelling by 2020. However, customers will also experience significant maintenance and fuel savings with electric trucks, which will drive adoption. Fleets generally consider a 3 year payback when assessing these savings. Combining the price reduction outlined above with 3 years of operational savings results in electric trucks that are more affordable than diesel trucks, a scenario that is realistic by 2020. An analysis for four different BYD model trucks is shown below. [EPA-HQ-OAR-2014-0827-1182-A1 p.1-2]

[Table of BYD model trucks analysis can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1182-A1]

**Response:**

The agencies appreciate this comment. We note that our attempt is to estimate costs since pricing involves many factors outside the purview of our regulatory analyses.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Indirect cost estimates**

The NPRM requests comment on the estimation of indirect costs. CARB staff supports the use of indirect cost multipliers over retail price equivalent multipliers to capture the difference in research costs associated with varying technology complexities. [EPA-HQ-OAR-2014-0827-1265-A1 p.183]



**Response:**

Thank you for your comment. EPA agrees that the ICM approach provides a better cost estimate associated with regulatory programs.

**Organization:** Consumer Federation of America (CFA)

**THE COSTS OF IMPLEMENTING STANDARDS**

A final, important observation on the literature of performance standards before we turn to the Phase II proposed rule deals with the tendency for costs to be overestimated because well-designed standards trigger the competitive and innovative processes noted above. The analysis often presented in regulatory proceedings is typically static and based on current costs. On the other hand, a thoughtful, well-designed performance standard will be dynamic and facilitate multiple responses to standard compliance rather than mandate specific technologies. If companies are given broad flexibility to meet standards, they will determine the most cost beneficial approach and they will learn how to lower the cost of adopting new technologies. History has shown in virtually every other standard compliance effort, the initial cost estimates always prove to have been too high, as shown in Figure V-2. There is clear and consistent evidence across a wide range of standards that the actual costs of implementing standards were consistently well below their original projections. [EPA-HQ-OAR-2014-0827-1336-A1 p.43-44].]

[Figure V-2 can be found on p.44 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

We then examine the explanation (theory) offered for why these costs and benefits have not been reflected in market transactions. Here we address both the issue of market imperfections and the pass-through of fuel costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.45]

Finally, we evaluate the overall design of the rule, according to the six criteria identified in the previous section. Because there are potentially large additional savings, we conclude with a section devoted to the question of whether the agencies have set the standards at a sufficiently high level. [EPA-HQ-OAR-2014-0827-1336-A1 p.45]

Other benefits include reduced fueling time and increased freight hauling. These benefit the trucking industry directly and might well be reflected in the reduction of the cost of transportation service. [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

The largest source of costs is the technology and maintenance costs of adding fuel saving technologies. Other costs, involving factors like increased congestion and accidents resulting from carrying more freight are small. [EPA-HQ-OAR-2014-0827-1336-A1 p.49]

**Response:**

Thank you for your comments and we agree that “a thoughtful, well-designed performance standard will be dynamic and facilitate multiple responses to standard compliance rather than mandate specific technologies. If companies are given broad flexibility to meet standards, they will determine the most cost beneficial approach and they will learn how to lower the cost of adopting new technologies.”

**Organization:** Daimler Trucks North America LLC

**Alternative 4** – In section 2.7.11 of the RIA, the agencies recognize that the Alternative 4 raises costs to manufacturers and vehicle buyers due to the pull-ahead of technology, which reduces the possibility of learning effects and increased mark-ups. We agree with the agencies that Alternative 4 increases costs, although we question whether the agencies’ analysis covers all of the increased costs. 2.7.11 of the RIA [EPA-HQ-OAR-2014-0827-1164-A1 p.74]

DTNA has reservations about the agencies’ cost-benefit analysis. First and foremost, the agencies underestimate the costs (both up-front costs and indirect costs) of several of the technologies on which the agencies premise the proposed rules. For example, the agencies assume that the cost of an APU is approximately \$3,000 (based on RIA Tables 2-26 to 2-28 for penetration rates and Tables 2-36 to 2-38 for penetration rate-adjusted costs), when in fact the cost is closer to [redacted]. The agencies could have found correct information just from DTNA’s sales information. But instead, by using a cost a fraction of the real one, the agencies incorrectly found that APUs are significantly more cost-effective than they really are. Another similar example is the assumption that manufacturers can change the aftertreatment system for \$7. (See RIA Table 2-11, and note that the application rate is or should have been 100%, as changes to aftertreatment will likely have to be made across the product line due to certification requirements and the realities of engine manufacturing). Changing an aftertreatment is not so simple. It involves a major tear up the filter, catalyst, coatings, as well as redesigning the combustion system in the engine and control logic to align with the new aftertreatment design. Any one of these changes dwarfs the \$7 per vehicle number. In fact, the costs of changes cannot be taken in a vacuum; each part affects the others (which is why we recommended a full-vehicle approach to regulation). [EPA-HQ-OAR-2014-0827-1164-A1 p.127]

Second, in some cases, the agencies used questionable prices for technologies, such as the price of tires, estimated relying on prices from studies (in some cases studies over 10 years old) as opposed to real-world data. How have the agencies improved their cost estimates by responding to the comments made by peer reviewers of the Tetra Tech/Southwest Research cost report? Again, the agencies could have used DTNA’s sales information for realistic prices, which would have resulted in a decreased cost-effectiveness compared to the agencies’ estimates. Third, we believe that the agencies failed to properly account for the increased maintenance and replacement costs for FE technologies. In the Preamble (80 FR 40325) the agencies state “In this proposal, the only maintenance costs we have quantified are those for tire replacement, as described in Section IX.C.3.” Given that the agencies have stated this rule will be technology-forcing and the level of sophistication of the technologies the agencies assume will be used to meet the new standards, it does not seem reasonable to only credit increased maintenance costs to that of low rolling resistance tires. For example, based on the agencies’ assumed market of APUs – it should be the case that these stand-alone diesel engines will require maintenance at regular intervals which will increase overall maintenance costs of a vehicle. [EPA-HQ-OAR-2014-0827-1164-A1 p.127]

Again, the agencies could have used DTNA’s sales information for realistic prices, which would have resulted in a decreased cost-effectiveness compared to the agencies’ estimates. [EPA-HQ-OAR-2014-0827-1164-A1 p.128]

Third, the agencies underestimate the costs of research and development required to bring to market the technologies on which the regulations were premised. The agencies assume \$240M per year for four years to develop all of the technologies required for the Phase 2 program, for a total of \$960M. By comparison, the Super Truck program cost approximately \$80M and took five years, yet it involved just one type of vehicle and did not require R&D into manufacturing processes. The agencies expect that manufacturers could do the necessary R&D on hundreds of types of disparate vehicles and their production processes, in a shorter time frame, and with only twelve times the cost. That is simply unrealistic. [EPA-HQ-OAR-2014-0827-1164-A1 p.128]

Fourth, the agencies overestimate the value of the learning effect. For example, the agencies assume that manufacturers will begin learning from WHR in 2015-2017 and accelerating in 2018, 2019, and 2020. (See RIA Section 2.12.2.15 and Table 2-136). But that technology is not slated for production in any of those years. It is currently only in early development in laboratories like our Super Truck ones. So the agencies are incorrect in calculating learning effect benefits so early. Conversely, the agencies seem to assume there remains room for some learning effects with APUs, a technology that has been around for so long that the agency acknowledges “this technology is on the flat portion of the learning curve.” (See RIA Section 2.12.6.1.). This assumption is questionable. In short, there are a number of potentially faulty assumptions regarding learning effects with the various technologies. [EPA-HQ-OAR-2014-0827-1164-A1 p.128]

Fifth, the agencies underestimate compliance costs. Most glaring of the errors is the assumption of an industry-wide annual cost for powertrain testing of \$335,000 or less than \$100,000 per major manufacturer. With the agencies premising so much of vehicle-side improvements on “deep integration,” which we understand to be demonstrable only through powertrain testing, and with powertrain testing costing on the order of \$100,000 per powertrain, the agencies are orders of magnitude<sup>3</sup> wrong on this cost. Similarly, the agencies failed to account for rear axle test facilities, testing, and reporting costs. The agencies failed to account for additional costs of general reporting, as increasing the number of GEM inputs require manufacturers to better track and control each input in order to ensure compliance. The agencies failed to account for the vastly increased cost of aerodynamic testing that would be required under the agencies’ proposed program, given that (among other things) the program requires F\_alt\_aero testing for all major models. In short, the agencies dramatically underestimated compliance costs. [EPA-HQ-OAR-2014-0827-1164-A1 p.128]

There are several other concerns that have been raised about the agencies’ cost-benefit analyses, including the concerns raised in ERG’s report Peer Review Of “Costs Of Medium- And Heavy-Duty Vehicle Fuel Efficiency And Emissions Reduction Technologies For My 2019 – 2022,” April 21, 2015. For example, the reviewers were concerned that numbers were not based on sufficient literature search, that the tire cost numbers were inappropriate, that NHTSA’s study appears not to have taken account for the costs associated with FE technologies’ adding weight that push vehicles over legal weight thresholds, etc. [EPA-HQ-OAR-2014-0827-1164-A1 p.129]

The agencies should have considered the cost to a heavy-duty vehicle operator of being stranded by the side of the road with a breakdown, a risk that the agencies recognized (80 FR 40236) but failed to quantify. The operator generally has a load to deliver by a certain time and thus must get someone to pick up that load for him. He may lose business from shippers who see him as unreliable if he fails to deliver a load. He may have to get his vehicle towed for repairs, to pay for roadside assistance, or to spend his (valuable) time doing his own repairs. New and added technologies on a vehicle increase the risk of vehicle operators incurring such costs, notwithstanding our warranties and our best efforts to avoid any failures. The agencies should have increased technology costs for all technologies by a risk-adjusted amount reflecting these costs. [EPA-HQ-OAR-2014-0827-1164-A1 p.129]

The agencies should have included in costs to carriers in regards to weight of new technologies on their vehicles in decreased carrying capacity. Heavy-duty vehicles are subject to Bridge Law limitations on their loads. Any increased technology on a vehicle, be it a WHR system or a small additional computer, decreases the load that the vehicle can haul. For certain of our customers, who haul indivisible loads that take their vehicle to its maximum capacity under the law, any increased tare weight means that the vehicle cannot haul the load, such that mere pounds added mean a complete loss of work. The agencies should have factored in the potential for lost carrying capacity and for entirely lost loads as a result of

the technologies that the agencies use to premise the Phase 2 standards. [EPA-HQ-OAR-2014-0827-1164-A1 p.130]

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3 PEER REVIEW OF “COSTS OF MEDIUM- AND HEAVY-DUTY VEHICLE FUEL EFFICIENCY AND EMISSIONS REDUCTION TECHNOLOGIES FOR MY 2019 – 2022” PEER REVIEW REPORT APRIL 21, 2015 Submitted to: U.S. Department of Transportation National Highway Traffic Safety Administration

**Response:**

Regarding the first point made by the commenter, that the agencies underestimate the costs (both up-front costs and indirect costs) of several of the technologies on which the agencies premise the proposed rules. The commenter first points to our estimated APU cost stating that the agencies assume that the cost of an APU is approximately \$3,000 (based on RIA Tables 2-26 to 2-28 for penetration rates and Tables 2-36 to 2-38 for penetration rate-adjusted costs). In fact, the agencies estimated the cost of an APU at \$4853 (Direct manufacturing cost (DMC) in 2012\$ applicable in 2014, see proposed RIA Chapter 2.12.6.1), considerably higher than the \$3000 cost erroneously suggested by the commenter. In the final rules, the agencies have increased that cost estimate to \$5882 (DMC in 2013\$ applicable in 2014, see final RIA Chapter 2.11.6.1). Regarding the cost of aftertreatment improvements, the commenter suggests that we estimated the cost at \$7 when, in fact, we estimated the cost at more than double that amount at \$16 (DMC in 2012\$ applicable in 2014, see proposed RIA Chapter 2.12.2.1). In the final rules, we carry the same cost as the proposal with updates to 2013\$; the final rule cost is estimated at \$16 per vehicle (DMC in 2013\$ applicable in 2014, see final RIA Chapter 2.11.2.1).

Regarding the second point that “the agencies used questionable prices for technologies, such as the price of tires, estimated relying on prices from studies (in some cases studies over 10 years old)”, we have chosen to base our tire costs on the National Research Council’s 2010 report which showed a \$30 price estimate. Using that value, we removed the indirect costs (by dividing by 1.36) to arrive at our final cost estimate of \$22 per tire (direct manufacturing cost, 2013\$). That cost is an incremental cost for the lower rolling resistance tire relative to a standard tire and is not meant to reflect to full cost of the tire.

Regarding the third point, that the agencies failed to properly account for the increased maintenance and replacement costs for FE technologies since the agencies had considered such costs only for lower rolling resistance tires, the agencies agree and have significantly increased those costs for the final rules. We now have estimated maintenance costs for many technologies, as described in detail in the final RIA Chapter 7.2.3.

Another comment states that the agencies underestimate the costs of research and development required to bring to market the technologies on which the regulations were premised. The comment states that the agencies assume \$240M per year for four years to develop all of the technologies required for the Phase 2 program, for a total of \$960M. The commenter misunderstands an important element of our cost estimates. Normal R&D spending is included in the markups used to estimate indirect costs. That normal R&D spending is on the order of 3-4% of revenues. The final RIA Chapter 7.2.1.1 shows that EPA has estimated the technology costs at just under \$26 billion (2013\$, discounted to 2015 at a 3 percent discount rate, MYs 2018-2029). If 3.5 percent of that is R&D, then the R&D spending would be roughly \$898 million. To that, we have added an additional R&D spending of \$818 million (2013\$,

discounted to 2015 at a 3 percent discount rate, MYs 2018-2029). The total R&D spending estimated is roughly \$1.7 billion (2013\$, discounted to 2015 at a 3 percent discount rate, MYs 2018-2029).

Another comment states that the agencies have overestimated the effect of learning, especially with respect to waste heat recovery and APUs. However, the updated WHR costs for the final rules are “based” in 2021 with learning cost reductions being applied in 2022 and forward. As a result, no learning-based cost reductions are being applied in years prior to our projected implementation. As for APUs and the application of learning impacts, EPA generally believes that industry never stops learning and applying cost reductions to technology.

The agencies do not believe that the added technology, some of which reduces weight, will result in increased vehicle weight such that weight limits will be exceeded. As for drivers being stranded due to breakdowns, we believe that this comment stems from earlier criteria pollutant standards and technologies employed to comply with those requirements. We do not believe that the technologies expected in response to the new standards will result in any increase in breakdowns or driver strandings.

**Organization:** Diaz, Miguel

The inclusion of aerodynamic trailers and the engines is one advance technology that should be included in the society since we have the technology to implement stronger standards. However, many of these points raise multiple concerns that should be revised and not taken lightly. [EPA-HQ-OAR-2014-0827-1848-A1 p.2]

First, many of these technologies are to be applied to most of the trailers and trucks to reduce the fuel used in these vehicles by 2025, but not every driver has a strong economic situation to acquire many of these technologies. Some of them don’t possess the most recent models that could facilitate the users to get repairs, advance technology or upgrades to their vehicles. EPA should concern about implementing solutions and strategies before actually imposing new restrictions to those users that can’t afford upgrading their vehicles every 5 years. For example, some trucks cannot be equipped with fuel efficient tires or change their fuel usage to another more efficient because their model is outdated. They continue to use the same old elements that cause the same level of emissions and constantly deteriorate through time. A more reasonable concern should be impose restrictions to the manufacturers to avoid the further production of pollutant-elements. They should also give a certain amount of time to those persons who are struggling to acquire a more recent model, but make them understand that they should stop buying old repairs and the most harmful fuel to stop the amount of emissions that are actually being produce. [EPA-HQ-OAR-2014-0827-1848-A1 p.2]

**Response:**

The agencies believe that the commenter is suggesting that manufacturers be required to apply new, GHG reducing technology (“impose restrictions to the manufacturers to avoid the further production of pollutant-elements”) and is concerned that owners of today’s trucks should not be required to equip existing trucks with new technology (“some trucks cannot be equipped with fuel efficient tires or change their fuel usage to another more efficient because their model is outdated”). The final standards require the former and do not require the latter. Therefore, the commenter should not be concerned, if we interpret correctly those concerns.

**Organization:** Environmental Law and Policy Center

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 217.]

Second, because trucks consume so much fuel, this regulation is cost-effective. Paying a little more now for a more fuel efficient truck will result in huge savings at the pump. In fact, tractor trailer owners can repay their costs and start earning money on this investment in just two years. Overall, the new regulations are expected to save society \$230 billion over the life of this program. And when truckers are buying 75 billion less gallons of diesel fuel, that money is available to spend on other things that strengthen our domestic and local economies.

**Response:**

The agencies agree that the new standards are cost-effective.

**Organization:** FedEx Corporation

3. Return on Investment: Phase 2 must not force technology that does not reduce the total cost of ownership for equipment. It is our objective and desire that technology investment produce a payback within the first 18 months of operation. [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

**Response:**

The agencies estimate that the Phase 2 rule will significantly reduce the total cost of ownership for nearly all of the equipment subject to the final standards (the one possible exception being motor homes). We do not agree that the 18 month payback “bogey” is the correct bogey for any GHG or fuel consumption related rulemaking. EPA is setting these, and all of our transportation-related GHG standards, due to the need to control climate changing emissions. EPA does not set these standards to provide fuel savings or cost paybacks to buyers or drivers of vehicles. We estimate a payback metric because we know that the buyers and users of impacted vehicles find that metric to be of interest. However, the payback metric is not used in our determination of the appropriateness of proposed or final standards.

**Organization:** First Industries Corporation

The extremely wide variety of applications our trucks are placed in (over the highway, heavy load and in-field services) creates an extremely important requirement to incorporate a wide variety of variables into any decisions concerning costs and serviceability of new and unproven technologies. [EPA-HQ-OAR-2014-0827-1145-A2 p.1]

The heavy-duty industry—both truck manufacturers and truck purchasers—has faced regulations requiring historic emissions reductions in the past several decades. Our customers and our OEM have met these challenges, but not without enormous development costs, resource demands, and increased product cost, as well as significant costs associated with warranties and customer downtime. [EPA-HQ-OAR-2014-0827-1145-A2 p.1]

As dealers, we are on the frontline of customer relations. We experience the same frustration they do when additional controls force truck prices upward. Over the past 7 years our customers have stretched budgets to purchase new or newer used Medium Duty (MD) and Heavy Duty (HD) vehicles equipped with the latest technology, from the 2007 standards through 2010 and into Phase 1. With Phase 2, there is a serious concern among our customer base that the new technology will only end up costing more

and doing less. In fact, there is anticipation of a major pre-buy should the standards fail to address the real world cost concerns and potential penetration rates of barely emerging technology. [EPA-HQ-OAR-2014-0827-1145-A2 p.1-2]

EPA and NHTSA must ensure that their assumptions about various technologies match with market reality and that their cost estimates are comprehensive and accurate so that environmental benefits and efficiency gains are realized in a logical and cost-effective way. Our customers need it. [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

In our direct review of the proposed standards, there are three key areas in the Phase 2 Proposed Rule that require further agency consideration and revision. In order to better understand the marketplace, the agency needs to reevaluate technology penetration rates and the actual cost and payback periods of these proposed technologies. Specifically: [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

(1) EPA's penetration rates for vicarious technologies are too aggressive, resulting in overly stringent emission standards [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

#### EPA's Market Penetration Rates for Various Technologies Are Overly Aggressive

We understand our customers and their unique equipment needs. For dealership operations to be successful we rely on our OEM to provide us with quality products that will work for the customers that have come to know and trust us. When we are responding to proposed regulation it is out of concern for our customers. We feel that the stringency of the standards should be based on products customer can actually afford to purchase. Customers should not be forced to buy technologies in order for an OEM to meet a regulatory target. [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

If a regulation requires customers to buy technology that is not proven, cost-effective, or reasonable for the customer's application, customers will keep their vehicles longer and will pre-buy vehicles in advance of the emission standard changes, leading then to a subsequent no-buy after the new standards take effect. This happened in 2005 & 2006 when a record number of HD Vehicles were sold. Our customers purchased equipment ahead of the 2007 engine standard. Thousands if not hundreds of thousands of those trucks are still on the road today across the United States, besides California. [EPA-HQ-OAR-2014-0827-1145-A2 p.2]

#### **Response:**

Much of this comment seems to focus on the 2007/2010 criteria pollutant rulemaking rather than the Phase 2 GHG/fuel consumption rule. Please see our other responses in Section 11.7.1 below, such as those to comment EPA-HQ-OAR-2014-0827-1922-A1, pertaining to specific concerns about pre-buy. With regard to the issue of technology penetration rates, we discuss these in more detail in their respective chapters above (Chapter 3 – Engines, Chapter 4 – tractors, Chapter 5 – trailers, Chapter 6 – vocational vehicles, as well as in chapter 2 of the RIA in the respective sections dealing with each of these standards.

**Organization:** Idle Smart

**2. Extended Idle technology costs – direct, indirect and incremental – are driven by outdated inputs that are drawn from source material and calculations that are incomplete and, more importantly, do not reflect current market dynamics.** As with any model, the validity of the outputs and conclusions are directly correlated to the rigor and precision of the inputs. EPA and NHTSA

estimated the cost APUs based on the costs discussed in the Phase 1 rule. That technology was estimated at \$4,586 (DMC, 2008\$, in 2014). With updates, that cost becomes \$4,853 (DMC, 2012\$, in 2014) for Phase 2. [EPA-HQ-OAR-2014-0827-1128-A1 p.2]

These estimates substantially understate the true costs of an APU and rely upon information that is, at best, dated. For example, many of the inputs to the Phase 1 rule were driven by a study completed on behalf of the EPA over 5 years ago (Investigation of Costs for Strategies to Reduce Greenhouse Gas Emissions for Heavy-Duty On-Road Vehicles). While it's interesting that the aforementioned report, completed in 2010, highlighted that midrange APUs cost in the range of \$8,000-\$9,000 (installed) and that some are as much as 50% more expensive<sup>8</sup> (but yet still came up with the \$4,586 value in Phase 1), it is nonetheless unclear why the Phase 2 process did not utilize the substantial market data at its disposal to update its estimates to reflect today's market reality and changes that have taken place over the past five years. [EPA-HQ-OAR-2014-0827-1128-A1 p.3]

For example, in the report that accompanied the work performed by Southwest Research Institute (SwRI) in collaboration with the NHTSA on fuel efficiency and emissions reduction technologies, total incremental price for a diesel APU is stated to be \$10,000 and \$9,187.77 at production volumes of 50,000 and 300,000 units, respectively. Using either of those values in the Total Cost as Applied to a Technology Package (TCp) from the Phase 2 draft increases the TCp for Idle Reduction technology by over 110% in 2027 (\$5,508 vs. \$2,596) and Tractor Technology Incremental Costs in the 2027 Model Year by over 22% (\$12,842 vs. \$15,754) [EPA-HQ-OAR-2014-0827-1128-A1 p.3]

Qualitatively, and outside of our own distribution channel checks which would substantiate these findings, the peer review completed in April, 2015 of Costs of Medium- and Heavy-Duty Vehicle Fuel Efficiency and Emissions Reduction Technologies for MY 2019 – 2022 (referenced above)<sup>9</sup> highlights similar deficiencies in quality, scope, and rigor of the methodology used to calculate the incremental retail prices. Comments range from “the literature review was not thorough” through “I think it is a matter of clearly showing what they are doing. This is missing from this report overall” and perhaps even more telling is that half of the peer reviewers, using a scale of 1 (Acceptable as is) to 4 (Not acceptable), rated the Costs report a 3, or “Acceptable with major revisions.”<sup>10</sup> Without accurate inputs and with a cost model that underestimates the true incremental cost, the Phase 2 implementation runs the risk of not meeting its well-intentioned and important GHG emissions and fuel goals. [EPA-HQ-OAR-2014-0827-1128-A1 p.3]

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8 Investigation of Costs for Strategies to Reduce Greenhouse Gas Emissions for Heavy-Duty On-Road Vehicles, July, 2010

9 Peer Review of Costs of Medium- and Heavy-Duty Vehicle Fuel Efficiency and Emissions Reduction Technologies for MY 2019 – 2022, Task Order 0003 Under Contract DTNH22-13-D-00298

10 Peer Review of Costs of Medium- and Heavy-Duty Vehicle Fuel Efficiency and Emissions Reduction Technologies for MY 2019 – 2022, Task Order 0003 Under Contract DTNH22-13-D-00298

**Response:**

In the final rules, the agencies started with an estimated APU price of \$8,000 (retail price, 2013\$). From there, we have adjusted the cost to arrive at a direct manufacturing cost of \$5882 (DMC, 2013\$, applicable in MY2014)). So the \$4800 value mentioned by the commenter has been adjusted upward to \$5882, and should be understood to be a direct manufacturing cost. This is explained in Section III.D of



the Preamble and in the final RIA Chapter 2.11.6.1. The commenter has done much to attempt to discredit the estimate used in the proposal but has done little to improve upon our estimate by providing a citable value that could be used. EPA notes that using “market data,” as suggested, is not really a viable strategy for EPA. Market data is generally in the form of prices for a given device or piece of technology which has little to no real relevance to the actual cost of that device (cost being the metric sought by EPA, not price). This is particularly true when “prices” can vary according to quantities ordered, so 1 device might be priced at \$10,000/unit while 500 might be priced at \$8000/unit. The “cost” behind each of those “prices” would be lower, to some extent anyway, and roughly similar regardless of the quantity ordered. This is part of what makes *cost* estimation so difficult.

**Organization:** International Foodservice Distributors Association

While IFDA supports efforts to reduce greenhouse gas emissions and increase fuel efficiency, it is critical that the Phase 2 final rule focus on achieving the greatest efficiency improvements at the least overall cost. EPA and NHTSA must not use outsized assumptions requiring the adoption of unproven technologies to justify stricter emissions targets that will prove impossible to meet. Customers depend on efficient cost effective service from foodservice distributors to provide Americans with the food away from home experience they have come to expect. It is important that any final rule be achievable without forcing equipment end users to pay for additional technology that is unproven, unnecessary or does not meet the requirements of each unique transportation operation. [EPA-HQ-OAR-2014-0827-1258-A1 p.2]

Thank you for the opportunity to comment on this rulemaking. IFDA urges both EPA and NHTSA to work closely with industry to ensure any final rule is cost effective, based on realistic assumptions of technological innovation and adoption and does not result in unnecessary cost increases for transportation companies and the consumers who rely on them. [EPA-HQ-OAR-2014-0827-1258-A1 p.2]

Engine manufacturers were able to use off the shelf technologies to meet the Phase 1 emissions requirements. Even with this readily available technology, the average cost per vehicle increased far more than EPA estimates. While EPA estimated an average increase of between \$1,200 and \$1,900 per new vehicle depending on size, the industry saw increases of up to \$20,000, making the return on investment on this new equipment extremely questionable. A second round of cost increases, which are likely to be even more significant given the advanced nature of the technology required would result in exploding transportation costs that would ripple throughout the American economy. [EPA-HQ-OAR-2014-0827-1258-A1 p.2]

**Response:**

The agencies have worked closely with industry and have developed a final set of standards that we consider to be cost effective, technologically feasible and necessary for the purpose of environmental protection. We do not agree with the assertion that the return on investment is not reasonable. However, we note that return on investment is not the purpose of the new standards – protection of the environment and reduced fuel consumption is the purpose while a favorable return on investment is a favorable side effect.

Regarding the comment about Phase 1 costs between \$1,200 and \$1,900 and actual increases being \$20,000, we believe this comment is really directed at the 2007/2010 criteria pollutant rule rather than the Phase 1 HD rule (which had higher tractor cost estimates than the \$1,200 to \$1,900 noted). We respond to such comments in Section 15 of this document.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

The draft stringency requirements assume market penetration rates for technologies. If those assumptions are inaccurate, the regulation will be undermined as customers are forced to adopt technologies that are not cost effective or do not provide real world benefits. We have heard credible concerns from several stakeholders regarding penetration rates and costs of several technologies discussed in the draft proposal. For example, assuming a 15% penetration rate for waste heat recovery by 2027 seems overly optimistic considering it is not currently in the market. The proposal also assumes this technology will cost up to \$11,000. Of course, the actual costs are unknown and new technology often cost more than anticipated. Moreover, the additional costs for maintenance and downtime need to be fully accounted for. Also, the potential benefits of waste heat recovery vary substantially depending on the duty cycle and powertrain. The same can be said for other new technologies. [EPA-HQ-OAR-2014-0827-1248-A2 p.8]

The 60% penetration rate for 6x2's is potentially problematic considering that six states have laws limiting tire and axle loading in such a way that 6x2's cannot be used as intended. Fleet owners are not likely to purchase trucks that cannot operate in all 50 states. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

Underestimating the costs of technologies could further complicate compliance and lead to unintended consequences. Higher technology costs lengthens payback period. New technologies generally require increased warranty costs, increased maintenance costs, and costs associated with increased downtime. We urge EPA and NHTSA to reexamine their cost assumptions to ensure they are based on the most accurate data. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

UAW members and their families remember the disruption of forcing unproven technology to market and urge the EPA and NHTSA to strive for a regulation that promotes fuel-efficiency and emission reducing technology that is cost-effective and reliable for a market that is sensitive to cost of ownership and real world operational benefits. If customers have to buy technologies just so an OEM can reach a target, they are more likely to pre-buy. We strongly support ongoing dialogue between the EPA, NHTSA and other stakeholders that aim for continuous improvement in testing protocols and cost estimates. [EPA-HQ-OAR-2014-0827-1248-A2 p.9]

**Response:**

We respond to comments regarding technology penetration rates in Sections 3 through 6 of this document. We have developed an updated costs for waste heat recovery and describe that in Chapter 2.11.2.15 of the final RIA. We have reduced our technology penetration rates of 6x2 axles relative to the proposal, now showing a 30 percent penetration and only on Class 8 tractors. We include increased warranty costs as part of the indirect cost markups, and we have significantly increased our estimated maintenance costs relative to the proposal by including many more technologies expected to require maintenance.

**Organization:** Midwest Truckers Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 265-266.]

The cost associated with achieving this goal and the payoff time may be a little bit debatable, but even conservative figures that have been suggested point to a tangible return of extra dollars invested to improve fuel economy. Of course it depends on the number of miles traveled that will determine the payback level also, be it a local truck or be it an over the road truck.

For our average member, we expect a four-year payback based on the reality that regional and local drivers are not going to meet the same expectations as a fleet of over the road vehicles. And based on a typical depreciation schedule, the local and short haul trucks are going to be around longer, possibly meaning that an even bigger return on investment may be possible because they do keep that truck maybe up to 10 years.

**Response:**

Thank you for your comments. The agencies agree that the longer a vehicle meeting the new standards is kept, the greater the return via fuel savings on the upfront investment. Further, that vehicle will continue to provide savings to subsequent owners/drivers for its full life.

**Organization:** National Automobile Dealers Association (NADA)

**NEW TRUCK AND ENGINE STANDARDS MUST BE AFFORDABLE AND MUST NOT COMPROMISE PERFORMANCE**

Even in years when freight demand is high and the industry is profitable, only a few hundred thousand potentially regulated trucks and engines are built for sale nationwide. This number pales in comparison to the 10-17 million new light-duty vehicles sold nationwide each year. Moreover, while light-duty customers often may not place a high value on fuel efficiency, fuel cost is the number one variable cost for the trucking industry. Consequently, the final rule should leverage, not resist, the fact that an acceptable return on investment is critical to commercial motor vehicle purchasers. [EPA-HQ-OAR-2014-0827-1309-A1 p.3-4]

Top of mind for commercial truck customers are their practical work needs. Vehicle and drivetrain features must meet expected use conditions. Every commercial vehicle potentially covered by the Phase 2 proposal has a work purpose that must be met through the design, specification, ordering, and manufacture process. And customer needs can vary widely. To its credit, the Phase 2 proposal builds on the Phase 1 rule's attribute-based categories for combination tractors and avoids cross-cutting mandates for vocational trucks. On the other hand, the proposal's technology forcing nature and potential for overly stringent mandates could force manufacturers to offer products that unduly limit customer choice through reduced vehicle performance or increased vehicle cost. [EPA-HQ-OAR-2014-0827-1309-A1 p.4]

Cost is always a concern. The fact that some of the nation's largest fleets can afford to be "early adopters" and to experiment with new fuels and high-cost technologies, while commendable, is by no means representative. The vast majority of prospective new truck buyers are businesspersons who must carefully consider the up-front cost of vehicle features, especially during times when credit is tight and/or freight rates and profit margins are low. [EPA-HQ-OAR-2014-0827-1309-A1 p.4] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.71.]]

To be effective, commercial fuel economy mandates must pass economic muster. Prospective customers almost always have the option to keep existing vehicles on the road longer, opting for enhanced maintenance and repair strategies that may even include engine and/or vehicle re-building.

Alternatively, customers may meet their needs with a used truck or tractor, often at a cost significantly lower than that of a new federally-compliant vehicle. Again, fuel efficiency/GHG mandates must be affordable and cost justifiable up front to be successful in the marketplace. [EPA-HQ-OAR-2014-0827-1309-A1 p.4] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, pp.71-72.]]

New mandates must not compromise or even appear to compromise vehicle performance, a lesson taught by the disruptive introduction of new commercial vehicle emissions mandates in 2004, 2007 and 2010. Commercial customers will avoid expending the substantial investments necessary to purchase new vehicles when they fear they'll face significant performance compromises, such as reduced freight hauling capability or increased downtime. Especially with respect to engine and other drivetrain components, improving one performance feature (such as fuel efficiency) must not diminish others. [EPA-HQ-OAR-2014-0827-1309-A1 p.4]

**Response:**

The agencies do not believe that there will be a loss of performance due to the new standards. Instead, we believe that the new fuel consumption characteristics of these engines and vehicles will be attractive and preferred by future buyers. We discuss more about pre-buys in Section 11.7.2 of this document.

**Organization:** Navistar, Inc.

Each of the discussions in this Comment should be read with the cost analysis in mind, as all of the concerns expressed in this Comment also have a direct bearing on costs. For instance, when the rule effectively advances a deadline as a result of the structure of the rule, and that impact is not recognized by the cost analysis in the NPRM, that calls into question EPA's assumptions as to the cost of developing the technology. The provision of less lead time compresses the time the manufacturer has available to develop the technology and necessarily increases development costs. In addition, the penetration rates of new technologies are similarly very questionable and these assumptions are reflected throughout the rule; if they are incorrect, then the agencies' assumptions as to costs and payback periods are wrong as well. [EPA-HQ-OAR-2014-0827-1199-A1 p.6]

It is difficult for Navistar to adequately comment on the cost analysis, since the underlying assumptions are so far off. However, one important area where we suspect the analysis is off is engine costs, driven by engine model year. As discussed further below, Navistar calculates that a compliant engine will have to be created more than a year before the nominal date when the standards take effect, in order to have an engine fuel map to use with GEM. If one looks at the estimates of costs in the RIA, costs for tractor/trailers are shown as \$0 prior to 2021, except as they relate to trailers.<sup>6</sup> This is not accurate, as costs will begin earlier than that, in order to generate compliant engines and engine maps prior to 2021. None of the cost estimates show those accelerated costs. That is just one example that demonstrates how the underlying assumptions can throw off cost estimates. [EPA-HQ-OAR-2014-0827-1199-A1 p.6]

In addition, there were significant costs that were not predicted for Phase 1, that we think will be even higher in Phase 2. One of these is the cost of technology to track the data for reporting and managing the data necessary to comply with a rule this complex. This cost ran into several million dollars for Navistar. However, this cost is not even part of the estimate for the Proposed Rule. On that point alone, the agencies have underestimated the cost of this rule. In this regard, we also completely agree with the EMA comments. [EPA-HQ-OAR-2014-0827-1199-A1 p.7]

For these reasons and others we believe the cost analysis is flawed and understates the costs of the Proposed Rule. The ramifications of this are considerable. If pay back periods are incorrect, customers

will simply overhaul and keep their current vehicles longer instead of purchasing new, more efficient vehicles. The industry will also be damaged, since it will not be able to sell as many vehicles as it would have in the absence of the regulations and the vehicles it does sell will be more costly. [EPA-HQ-OAR-2014-0827-1199-A1 p.7]

The vehicle certification procedure will use the greatly expanded and updated Phase 2 GEM model. The Phase 2 GEM requires many more inputs than the Phase 1 GEM including engine fuel maps, torque curves, transmission type, gear ratios, number of gears, etc. The more complex GEM is required to properly estimate the vehicle fuel use and CO<sub>2</sub> emissions from Phase 2 vehicles. However, providing the input data for GEM and run the GEM model will require large investments in upgrading vehicle manufacturer IT systems. This investment is on the order of several million dollars per manufacturer. In addition to the IT cost the labor cost to track and report all of the inputs to GEM and generate the annual reports will increase dramatically. [EPA-HQ-OAR-2014-0827-1199-A1 p.41]

It is not clear that EPA has accounted for this compliance cost in the Phase 2 cost estimates. Page 7-6 of the RIA has an annual cost estimate of \$95,000 and \$240,000 industry-wide for vocational and tractor, respectively, powertrain test reporting. This estimate is well below the actual IT and reporting costs that are being realized for Phase 1 and that will be realized for Phase 2. EPA must adequately estimate all new compliance costs for the Phase 2 implementation. [EPA-HQ-OAR-2014-0827-1199-A1 p.41]

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6 RIA at 7-3.

**Response:**

In the proposal, the agencies estimated *additional* compliance costs at roughly \$6 million every year. For the final rules, we have increased that estimate by nearly double to \$11 million every year. Importantly, those costs are *in addition* to the costs already included in the indirect cost markups used in estimating technology costs. In the final rules, we estimate that our indirect costs account for over \$300 million per year in the early years and up to \$700 million per year in the later years of the program (2027-2029). Some portion of that \$300 to \$700 million annual indirect costs would include the compliance costs that are included in the markups we use to estimate indirect costs.

The commenter is correct that our analysis does not show these costs occurring the year prior to implementation and, instead, shows them occurring in conjunction with implementation. The costs are in fact accounted for; it is simply an issue of presentation. We have gone back and forth on this presentation issue in the past – showing costs in advance at times and showing costs aligned with implementation at times. Showing costs in advance often times has confused readers expecting to see costs aligned with implementation. Showing costs aligned with implementation has confused readers who understand that some costs occur in year(s) prior to implementation. The important thing is that we have included all of the costs that we believe will be incurred, and that our cost estimates reflect costs incurred in years preceding actual compliance with the standards.

**Organization:** North American Die Casting Association (NADCA)

NADCA is also concerned about the cost-benefit analysis conducted and encourages the Administration to adopt more realistic expectations of the expenses involved in the research, development, and commercialization of these new technologies. The Association and its members invest millions each year to develop new technologies and the latest production methods to improve their global

competitiveness. A concern raised by others is not only the costs involved with investing in the research, but also whether customers will pay a higher price for the finished product as manufacturers must ultimately pass along some of the additional costs to the purchaser. [EPA-HQ-OAR-2014-0827-1283-A1 p.3]

**Response:**

The agencies believe we have provided realistic expectations of the expenses involved in R&D associated with the final standards. The commenter has not provided any data or suggested revisions to the analysis estimates. We expect that customers will pay a higher price for finished products given that the costs for those products will be likely be higher. However, we expect significant fuel savings as a result of those increased upfront costs. Further, we expect significant environmental and social benefits associated with the final standards.

**Organization:** Odyne Systems LLC

Odyne believes fleet adoption rates of plug-in hybrid technology – a technology Odyne Systems has developed and deployed in partnership with the DOE and private fleets – will exceed the 10% market penetration rate assumed by the EPA in the proposed rule by 2027 and at fuel consumption and emission reduction levels (16% specifically for vocational) far beyond the current projections for various applications of vocational vehicles. [EPA-HQ-OAR-2014-0827-1239-A1 p.3] [[This comment can also be found in EPA-HQ-OAR-2014-08267-1372, p.229.]]

*ROI Projections*

The sales price of a PHEV system in 2021 is estimated to be approximately \$15,400 based upon a total cost of components of \$10,000, and including installation cost of \$800 and gross margin of 30%. [EPA-HQ-OAR-2014-0827-1239-A1 p.14]

2021 ROI of 3 years: Annual fuel savings are estimated to be over 1000 gallons per year based upon telematics data from the current vehicles in operation, at 250 workdays per year and 4 gallons per day of fuel savings as shown in Table 2. At an estimated cost per gallon of fuel in 2021 (includes price of fuel per gallon, labor cost during estimated refueling time and non-productive miles driven to reach refueling station) of \$4 per gallon in 2021, total savings per year including engine maintenance and fuel savings is estimated to be \$5000 per year, resulting in a payback in years of approximately 3 years, significantly shorter than goals discussed by the EPA of 6 years for vocational trucks. [EPA-HQ-OAR-2014-0827-1239-A1 p.14]

The sales price of a PHEV system in 2027 is estimated to be approximately \$10,000 based upon the total cost of components of \$6,500, and including installation cost of \$500 and gross margin of 30%. [EPA-HQ-OAR-2014-0827-1239-A1 p.14]

[Table 2, 'Odyne Fuel Consumption, can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1239-A1]

2027 ROI of 2 years: Annual fuel savings are estimated to be over 1000 gallons per year based upon telematics data from the current vehicles in operation, at 250 workdays per year and 4 gallons per day of fuel savings as shown in Table 2. At an estimated cost per gallon of fuel in 2027 (includes price of fuel per gallon, labor cost during estimated refueling time and non-productive miles driven to reach refueling station) of \$4 per gallon in 2027, total savings per year including engine maintenance and fuel savings is

estimated to be \$5000 per year, resulting in a payback in years of approximately 2 years, significantly shorter than goals discussed by the EPA of 6 years for vocational trucks. [EPA-HQ-OAR-2014-0827-1239-A1 p.15]

**Response:**

The projections of technology adoption should be viewed as a potential path toward compliance and not the path. If the commenter is correct about the benefits of hybridized systems, then we would expect that the market will move toward that approach to compliance. Certainly nothing in the Phase 2 rules impedes such market acceptance. We discuss comments regarding the rationale behind our vocational vehicle hybrid technology penetration rates in Section 6.3 of this Response to Comments.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

[Table 1 can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1244-A1]

Though the agencies have estimated rather high penetration rates, EPA has historically overestimated penetration rates while also underestimating the cost to OEMs to implement the required changes to the engine and drive-train. [EPA-HQ-OAR-2014-0827-1244-A1 p.12]

**The Cost/Benefit Equation**

The agencies estimated a \$10,000 to \$13,000 increase in the cost of a new truck and a \$1,400 increase for a new trailer by MY 2027 as part of Alternative 3. OOIDA believes that these estimates are far below the actual costs of proposed technologies, and thereby suggests that the agencies reevaluate their cost and benefit analysis in order to more appropriately reflect reality. For example, the agencies have estimated that the cost of an APU will be \$4,327 by MY 2027. Nonetheless, the OOIDA Foundation, which has received two grants through EPA and the SmartWay Program in order to assist OOIDA members in purchasing APUs, has helped over 500 members purchase and install APUs in their truck. The average cost however was \$8,000 with an additional installation cost of between \$100 and \$500. According to the market today, an APU produced by Thermo King costs \$11,000. Moreover, the agencies failed to include maintenance costs within their analysis as APU's require standard service maintenance after a minimum of 2,000 hours of operation, the cost of which is approximately \$250. The agencies have grossly underestimated the cost of APU's, and thus have created false benefits and costs in their analysis, especially considering the agencies excessively high adoption rates. [EPA-HQ-OAR-2014-0827-1244-A1 p.40]

In addition to the underestimation of APUs, the agencies have not properly addressed the costs associated with LRR tires. Because of their lessened tread depth, LRR tires do not have the same lifespan as other tires, meaning that they will need to be replaced more often. The agencies have failed to recognize that the purchasing of tires is not the only cost an owner-operator must account for, instead labor costs, which include the removal of the wheel, removal of the tire, mounting of the new tire, balancing of the wheel, remounting of the wheel, and finally the FET, must be considered over the useful value life of 10 years. The table below is an example of such a cost. [EPA-HQ-OAR-2014-0827-1244-A1 p.40]

[Table 2 can be found on p.41 of docket number EPA-HQ-OAR-2014-0827-1244-A1]

A total cost of \$336.71 for fees which do not include the actual tire is substantial. This fee would be repeated for each axle, which for a standard 18-wheeler would amount to \$1,434.32. While the agencies

“expect minimal increases in maintenance costs under the proposed standards, having estimated increased maintenance costs associated only with installation of lower rolling resistance tires,” OOIDA believes that the agencies did not adequately analyze the costs of maintenance associated with the proposed technologies. [EPA-HQ-OAR-2014-0827-1244-A1 p.41]

### **Cost of Trailers**

In addition to the increase in price for a tractor, the agencies projected a \$1,400 increase for a new trailer by MY 2027 as part of Alternative 3. According to the California Air Resource Board, the retail price for a set of side skirts, which weigh between 150 and 350 pounds on average depending on the material, length, and configuration of the skirt, ranges between \$1,000 and \$2,600, not including the cost of installation, front trailer fairings cost between \$800 and \$1,000, and rear trailer fairings cost approximately \$2,000.<sup>47</sup>

[Table 4 can be found on p.43 of docket number EPA-HQ-OAR-2014-0827-1244-A1]

The costs detailed above do not take into account annual maintenance costs, which are projected to be almost \$300 annually, or replacement costs, for example a trailer side skirt can cost between \$80 and \$500. Additionally, it is imperative to note that some owner-operators, and most fleet owners, own more than just one trailer, while also hauling different types of cargo. Overall, the current trailer to truck ratio is approximately 2.8. Therefore, you can expect these costs to double for many owner-operators. [EPA-HQ-OAR-2014-0827-1244-A1 p.43-44]

Ultimately, the potential economic savings must be more concrete or proven in order for these proposed technologies to present a good enough incentive for owner-operators to purchase new, more expensive trucks and trailers. [EPA-HQ-OAR-2014-0827-1244-A1 p.44]

Is it more than probable that the increased price of both a truck and trailer will mean that some truck owners will not be able to afford to purchase new equipment (or even afford a used truck with an increased price). A dramatic increase in the price of a truck and trailer might act as an incentive for many truck owners to hold on to their older equipment for a longer period of time, therefore not gaining the benefit of the promised improved fuel economy and denying the agencies their projected gains in air quality improvement. [EPA-HQ-OAR-2014-0827-1244-A1 p.44]

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47 Initial Statement of Reasons: Proposed Regulation to Reduce Greenhouse Gas Emissions from Heavy-Duty Vehicles, CARB (December 2008), pg. 50-54.

### **Response:**

The commenter notes the “cost” of an APU at \$8000. The agencies interpret that “cost” to be the “price” paid for the APU. In the final rules, we have started with an estimated APU price of \$8,000 (retail price, 2013\$). From there, we have adjusted the cost to arrive at a direct manufacturing cost of \$5882 (DMC, 2013\$, applicable in MY2014). So the \$4800 value mentioned by the commenter has been adjusted upward to \$5882, and should be understood to be a direct manufacturing cost (see final RIA 2.11.6.1). Importantly, we seek the cost of the device, not the price paid at point of sale which includes many factors beyond the scope of our analysis. The commenter also notes that we failed to consider maintenance on the APU. While true of the proposal, we have changed that in the final rules by estimating maintenance costs at \$300 (APU), \$310 (battery APU) and \$400 (APU with DPF) at 100,000



mile intervals (see final RIA 7.2.3). These estimates appear to be in-line with the commenter's suggested maintenance costs.

As for the comment regarding lower rolling resistance tires and tread wear, we respond fully to that issue in Section 4.3 of this RTC document.

We have not included maintenance costs associated with aero treatments on trailers due to lack of data that could be used to support the estimates. The commenter suggests an annual maintenance cost of \$300 but provided no data or study upon which that estimate was based. It is possible that the estimate is based on anecdotal evidence of a small number of problem installations rather than an average of all trailers equipped with aero treatments. Without the study it is not possible for us to know. Since we are not aware of widespread maintenance issues surrounding aero treatments on trailers, we have not included any increased maintenance costs.

**Organization:** Recreational Vehicle Industry Association (RVIA)

RVIA contracted with John Dunham and Associates<sup>31</sup> (Dunham) to assess the economic impact that compliance with the proposed Phase 2 standards could have on the motorhome industry. The methodology for this model is available in Appendix C. In simplistic terms, Dunham's model assumes that some change in price will have an impact on motorhome sales (shipments)<sup>32</sup> and that this impact on sales will in turn impact industry jobs, wages, economic output, government tax revenue, etc. RVIA asked Dunham to estimate the economic impacts for the following four scenarios: [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.7 and 11.12 of this comment summary]

**Scenario 1:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.7 and 11.12 of this comment summary]

**Scenario 2:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.7 and 11.12 of this comment summary]

**Scenario 3:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.7 and 11.12 of this comment summary]

**Scenario 4:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.7 and 11.12 of this comment summary]

The results of Dunham's assessment for 2021MY, 2024MY and 2027MY are found in the following three tables below. Additional details are located in Appendix D. [EPA-HQ-OAR-2014-0827-1261-A1 p.21][This comment can also be found in section 11.7 and 11.12 of this comment summary]

[Charts, economic impacts, can be found on p.21-22 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

In RVIA's view, Scenario 4 represents the most likely outcome. Scenario 4 reflects costs based on an ICM that is more representative of actual practice in the motorhome industry which, as we have already discussed, is distinctly different from other vocational vehicle segments (largely because motorhomes are not purchased for commercial purposes). [EPA-HQ-OAR-2014-0827-1261-A1 p. 22] [This comment can also be found in section 11.7 and 11.12 of this comment summary]

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31 John Dunham & Associates (JDA) is an economic specialist in regulatory analysis. JDA generates economic and fiscal impact studies from a national level down to geographic regions, municipalities, marketing areas or Federal and state legislative districts. See <http://guerrillaeconomics.com/>.

<sup>32</sup> According to John Dunham and Associates, the base elasticity for motorhomes is -0.905, suggesting that a 10 percent change in prices will reduce demand by 9 percent (see Appendix C).

**Response:**

We respond in Section 11.12 to these comments raised by RVIA. Note, however, that the final standards include an optional custom chassis standard for motorhomes which are based on different technologies than those addressed in the comment, and should result in a standard which is less costly (should a motorcoach OEM choose to certify to that standard).

**Organization:** Triple Decker Transport Ltd.

As the trucks become more expensive fewer Owner Operators will be able to afford the "newest" technology thereby decreasing the desired effect on the GHG Emissions. While the desired increased fuel economy will potentially mitigate the "overall" cost of the new trucks, THE UPFRONT COST will be higher and this money will have to be financed [EPA-HQ-OAR-2014-0827-0908-A1 p.2]

I still remember the original EPA quote of the 2004 -2010 standards costing approximately \$6500-\$7500 USD per truck. The actual capital costs were \$30,000 plus the extra's we suffered (listed above)! Since the EPA missed so badly on these cost estimates I am terrified that the "Real World Cost" will be over \$25,000 for the latest GHG Proposals. [EPA-HQ-OAR-2014-0827-0908-A1 p.3]

The moniker that this regulation only affects the OEM is incorrect. The OEM will pass on the cost to the purchaser. We will suffer again if the newest technology is not proven BEFORE we buy it. [EPA-HQ-OAR-2014-0827-0908-A1 p.3]

**Response:**

The agencies have made every effort to provide the best estimate possible of the costs of the standards. We respond to comments regarding our earlier criteria pollutant rules in Section 15.10.4 of this Response to Comments. We fully understand that the standards do not impact only the OEM but also the end purchaser and all of society. For that reason, we have estimated the net social benefits of the rule which are substantially positive.

**Organization:** Truck Renting and Leasing Association

**The Agencies Underestimate Compliance Costs & Fail to Appreciate the Unique Economic Position of the Truck Renting & Leasing Industry**

The Proposed Standards are historic in scope and complexity, regulating a wide array of customized vehicles including a broad range of tractor applications, utility trucks, street sweepers, concrete mixers, local delivery trucks, dump trucks, buses, motor coaches, and more. They come on top of similar regulations implemented under Phase 1 of the program. Over the last eight years, the agencies have compelled the trucking industry to absorb approximately \$20,000 - \$30,000 in additional costs to the price of a truck for technology, some of which has not always worked properly or as quickly as was promised because the manufacturers were not given sufficient time to perfect those technologies. Proposed Standards, at 40153. Under the Proposed Standards, at minimum an additional \$11,680 per truck would be incurred. Id. at 40165. It is important to note that these figures do not even include the costs of the 12% Federal Excise Tax that is imposed on the purchase price of any truck with a Gross Vehicle Weight Rating of 33,000 pounds or more. [EPA-HQ-OAR-2014-0827-1140-A1 p.2-3]

The costs shown by the agencies are for the average of all vehicles in that regulatory subcategory based on technology penetration rates. To develop “average costs,” the agencies effectively divided the cost of technologies by the number of engines/trucks estimated to be sold in the future. This methodology is invalid as customers will actually pay the increase in the cost of the individual technologies they are forced to buy; stated another way, purchasers pay the actual cost of a vehicle, not the average cost. The agencies’ costing methodology does not reflect the cost of a vehicle with the technologies installed, since that vehicle must absorb 100% of the technology cost. All vehicles will not need or have all technologies, but some, like waste heat recovery, are expensive items as the agencies note. This means the cost will not be a few hundred dollars in 2021, but rather thousands of dollars of added cost for the vehicle that has it installed. In fact, the agencies estimate waste heat recovery alone will cost as much as the average cost per vehicle of the entire rule. [EPA-HQ-OAR-2014-0827-1140-A1 p.3]

Moreover, these elevated costs will be borne over a shorter vehicle life that results from inclusion of advanced technology with scant operational experience in the real world. The leasing industry’s experience to date with the types of technologies discussed in the Proposed Standards is a shortening in vehicle life. Several years ago, it was not unusual for a leasing company to operate a unit up to approximately 1 million miles. In recent years, however – to include under Phase I of the program – it is not unusual for units to be removed from service after only 750,000 miles. This means higher costs of vehicles are spread out over less time and with less available use. [EPA-HQ-OAR-2014-0827-1140-A1 p.3]

And while the truck leasing industry is happy for its customers to save money, the Proposed Standards end up imposing disparate, and potentially punitive, costs on leasing companies. This is because most of the Proposed Standards’ savings are anticipated to arise during vehicle operations when less fuel would be consumed. Accordingly, TRALA members will be forced to raise lease and rental rates. Like any other business, they will pass on much of these cost increases, rather than simply absorbing all of the costs themselves. [EPA-HQ-OAR-2014-0827-1140-A1 p.4]

Thus, the supposed savings to customers because of improved fuel efficiency could prove illusory, because they will be nullified by the increased lease and rental rates. The Proposed Standards’ mandated inclusion of advanced technologies could add an additional layer of increased lease costs that would primarily be borne by the vehicle’s lessee. The additional layer of increased lease costs could arise, for example, from the greater level of maintenance that the agencies are requiring. [EPA-HQ-OAR-2014-0827-1140-A1 p.4]

**Response:**

Regarding inclusion of the federal excise tax, this tax is not included in our cost estimates since the tax is not paid by the original equipment seller but rather by the end purchaser. While we recognize that the tax is a cost to the end purchaser, it is actually a transfer payment within the context of the benefit-cost analysis since that tax is passed back to society via tax supported services. Similarly, our benefit-cost analysis does not include fuel taxes when calculating fuel savings. In our payback analysis, we do include the excise tax since the payback analysis is meant to be a consideration from the perspective of the end purchaser. Similarly, in the payback analysis, we include retail fuel prices (i.e., inclusive of taxes) since those are the prices paid for the fuel by the user.

The comment regarding the “average” vehicle versus the vehicle equipped with a specific device or devices is an interesting take on our analysis. However, in aggregate, the average cost estimated in our analysis is the best and most meaningful measure of the projected cost of the new standards. We do not expect that a “maximum” or a “minimum” technology tractor will be built. Instead, we estimate that, on average, tractors will gradually improve fuel consumption and decrease GHG emissions such that a variety of prices and performance characteristics will continue to be available. Just because every vehicle is not “average” does not mean that we are underestimating costs, nor are we overestimating costs.

The commenter also is concerned about vehicle lifetimes being cut short due to the new standards. We do not believe that the technologies expected in response to the new standards will result in any decreased lifetimes. Further, we are not aware of any data that suggests that vehicle lifetimes have been cut short due to the Phase 1 rule which is only in its third year of implementation or, what was probably meant by the comment, the 2007/2010 criteria rule.

As for the agencies failing to recognize the unique position of the truck renting and leasing industry, we are not quite sure what the commenter would suggest we do. We are requiring new trucks to meet more stringent GHG and fuel consumption standards. We expect that new trucks, purchased by leasing companies will cost more in the future. We expect those trucks to consume less fuel thereby saving money for those buying their fuel. Those savings should not be nullified by increased lease and rental rates any more than they would be nullified by increased purchase costs for buyers of new tractors. How the truck costs and savings are shared between truck lenders and truck lessees, is beyond the scope of our analysis.

**Organization:** United Parcel Service (UPS)

Market Penetration Rates for Tractor Technologies are Overly-Aggressive

UPS fully supports the ATA's position on this issue. In particular we agree that assuming overly aggressive market penetration (MPR) rates will likely result in reliance on unproven technologies. [EPA-HQ-OAR-2014-0827-1262-A1 p.2]

This will lead to fleets holding on to their fleets longer and pre-buying in advance of the introduction of unproven technologies. ATA cites the years of 2002, 2006, and 2009, in which the industry reduced truck buys because of, or in anticipation of, rulemaking where the industry was uncomfortable about the technology being pressed upon them. In our own case, UPS normally purchases 600 — 800 trucks a year, but in 2003, we bought only 1 class 8 diesel truck, in 2005 we bought only 8 of them, and in 2010, we bought only 3. [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

UPS also agrees with the 15 Guiding Principles adopted by the Fuel Efficiency Advisory Committee (FEAC) as UPS participated in the FEAC. [EPA-HQ-OAR-2014-0827-1262-A1 p.4]

## Technology Costs Remain Suspect

UPS fully supports the following from ATA's comments. In the beginning of our comments we have already discussed the trucking industry's unfortunate experience with the diesel emissions control systems available to meet the 2007/10 Diesel Emission Rule. In our fleet, the actual cost of these systems, including maintenance, was about 4 times what EPA predicted. [EPA-HQ-OAR-2014-0827-1262-A1 p.6]

'ATA believes the agencies underestimated the costs of various technologies making the payback period on these technologies much longer than is stated in the proposed rule. A fleet owner typically demands an 18-month payback on technology purchases. If the actual cost payback extends beyond 24 months, it will likely lead to the risk of increased fleet pre-buys/low-buys/no-buy scenarios. The Phase 2 Rule currently envisions a 24-month payback period. If variables such as technology costs, MPRs, and fuel costs are not accurate, fleet payback periods for equipment will not be recognized during the period of equipment ownership. Moreover, likely additional costs for maintenance and downtime for new technologies need to be wholly accounted for under the rule. If payback on equipment purchases is pushed beyond ownership periods, there is little or no incentive for fleets to make the initial investments in technologies under Phase 2. [EPA-HQ-OAR-2014-0827-1262-A1 p.7]

'The trucking industry remains wary of future cost projections of the agencies. A good example of why ATA remains skeptical of such projections is the recent rulemaking to reduce particulate matter and nitrogen oxide emissions from on-road diesel engines commonly referred to as the EPA's 2007/2010 Diesel Engine Emissions Rule. The EPA estimated that the proposed standards would add about \$1,200 to \$1,900 per new vehicle depending on the vehicle size. However, the trucking industry saw record-setting cost increases up to \$20,000 per new vehicle which equates to an increase between 1,567% and 1,667%. Additional costs incurred by fleets under the phase-in of the 2007 standards included missed loads, late loads, and lost hauling contracts.' [EPA-HQ-OAR-2014-0827-1262-A1 p.7]

## Increased Warranty, Maintenance and Downtime Costs Should be Included

UPS fully supports the following comments from the ATA as it is consistent with our fleet's experience: [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

'The proposed Phase 2 standards represent a more technology-forcing approach than Phase 1, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. Past experience with emerging technologies in heavy-duty engines has shown that warranty claims, where an operator takes a vehicle out of service to a maintenance facility to have a part under warranty replaced, tend to be higher during the initial years of introduction. [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

'As shown in Appendix 3, based on warranty claims data required to be submitted to CARB, particulate filter-related warranty claims were at 35% during their initial year of introduction (2007), decreased to 18% during the second year and fell to 4% during the fifth year (2011, the last year of data provided). Similarly, SCR-related warranty claims were at 20% during their initial year of introduction (2010) and decreased to 10% during the second year (2011). Also of note is how other technologies were affected during the introduction of a new technology. For example, warranty claims for engine/ECM/other components increased from 22% prior to the introduction of particulate filters to 90% during the first year this technology was introduced.' [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

UPS agrees with ATA that additional warranty, maintenance and downtime costs result when new or significantly altered technologies are introduced. It appears the proposed rule only includes increased maintenance costs associated with tires. UPS also agrees with ATA's requests of the agencies to further examine the warrantee claims and operational cost data to develop an algorithm that accounts for additional warranty, maintenance and downtime costs as part of the final rule. [EPA-HQ-OAR-2014-0827-1262-A1 p.8]

**Response:**

We respond to comments regarding pre-buys in Section 11.7.2 of this Response to Comments. Further, we do not believe that extending paybacks beyond 24-months will result in pre-buys/low-buys/no-buys.

We have included far more maintenance costs in the final rules than in the proposal (see final RIA 7.2.3). In addition, while important in considering levels of standards and presenting impacts of standards, we do not determine nor set new standards based on payback metrics. Lastly, many of the UPS comments pertain to prior rulemaking efforts about technologies that are not expected for use to comply with the new standards being set via this GHG/fuel consumption rule.

**Organization:** Volvo Group

**Testing Burden**

Additional testing for GHG/Efficiency certification adds to the engineering development workload and reduces our capacity to implement changes. Engineering budgets and resources are limited to the amount that can be supported from product sales margins, so all added burdens detract from actual product development. Beyond the testing requirements carried over from Phase 1 to support the redundancy of a separate engine standard, new testing required or expected in this proposed rule includes engine mapping, aerodynamic testing, vehicle chassis dyno testing, powertrain testing, axle testing, and possibly alternative engine testing. These all have the effect of elevating cost for each related development program or siphoning off budget for development. [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

**COST ANALYSIS PROCESS**

The Agencies' cost analysis of compliance for engine and vehicle manufacturers, as well as impacts to end-users, is woefully underestimated. [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

**Indirect Cost Determination as Inputs to MHD and HHD Manufacturers**

As noted in Preamble section 2.12.1.2, the Agencies used Indirect Cost Multipliers (ICMs) to determine markup factors that have the benefit over the previous method of including technology complexity to determine expected retail pricing. The ICM is calculated as: [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

$$\text{ICM} = (\text{direct cost} + \text{adjusted indirect cost}) / (\text{direct cost})$$

Direct costs cover those costs directly associated with producing one unit (e.g. materials, labor, and warranty). Indirect costs are all costs associated with producing one unit that are not direct costs (e.g. R&D and Sales and Administration costs). The adjusted indirect cost takes into consideration the fact that indirect costs may not be the same for different technologies. [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

This method was used for cost estimation of the light duty MYs 2012-2016 and MYs 2017-2025 rulemakings, as well as for the HD Phase 1 rulemaking. [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

One shortcoming, however, is the lack of consideration for return on investment in the determination of the ICMs. After the development of the LD ICMs for the aforementioned rulemakings and the publication of a peer-reviewed report the Agencies revised the methodology to account for an internal rate of return on investments. In the Phase 2 rulemaking the Agencies are applying this new methodology to the heavy-duty pickup and van cost projections since “the manufacturers involved in this segment of the heavy-duty market are the same manufacturers that build light-duty trucks.” However, for MHD and HHD combination tractors, vocational vehicles, and heavy-duty engine cost projections the Agencies are using the Phase 1 ICMs which do not account for a return on the cost of capital. It is unclear why the Agencies have determined that accounting for a return on investment only applies to LD engine and vehicle manufacturers, but they state that “There was no serious disagreement with this approach in the public comments” to any of the above mentioned rulemakings. This commenter believes that this was likely due to an oversight given the sheer volume of documentation or potentially limited understanding on behalf of the commenters. [EPA-HQ-OAR-2014-0827-1290-A1 p.33]

Regardless, it is Volvo Group’s position that any industry should be considered as requiring a return on its investment related to all indirect costs associated with the development and marketing of new technology, with the MHD and HHD engine and vehicle industries being no exception. As such, Volvo Group requests the Agencies revise the MHD and HHD cost calculations for the Phase 2 rule to account for a reasonable return on investment. The Preamble does account for net present value in Table IX-3, but uses a 3% and 7% discount rate which is insufficient to cover the cost of capital to heavy vehicle manufacturers, let alone account for a positive net profit. [EPA-HQ-OAR-2014-0827-1290-A1 p.34]

### **Learning Effect Methodology**

Volvo Group disagrees with the Agencies analysis of cost reduction based on learning curve effects (reference RIA section 2.12.1.3) in that the base assumption assumes a doubling of volume in a fixed two year period. For a steep curve, used for new and highly complex technologies, this corresponds to a 20% cost reduction. [EPA-HQ-OAR-2014-0827-1290-A1 p.34]

It is understood that for more mature technologies the steep portion of the curve is not used in favor of a flatter curve with varying degrees of learning-based cost savings, but Volvo Group does not support the reductions in the first few years on many of the “flat curves” shown in Table 2-101 and Figure 2-33, as we have not experienced these levels of cost reduction without focused initiatives and associated investment. As well, since the learning effect curves are based on volume growth and many of the technologies accounted for in the referenced section are put into production in “cliff events” (Friday to Monday production change), it is unclear whether even the shallowest curve could be realized. [EPA-HQ-OAR-2014-0827-1290-A1 p.34]

[Table, Year-by-year Learning Curve Factors for the Learning Curves Used in this Analysis, can be found on p.34 of docket number EPA-HQ-OAR-2014-0827-1290-A1]

[Graph, Year-by-year Learning Curve Factors for the Learning Curves Used in this Analysis, can be found on p.35 of docket number EPA-HQ-OAR-2014-0827-1290-A1]

### **Technology Costs**

In performing cost analysis of technologies the Agencies have severely underestimated those costs, even when accounting for conversion from 2012\$ to expected MY 2021\$. In addition, the technology costs are subject to misunderstanding due to the 2012\$ conversion and the penetration rate inclusion in the package costs. One example of this is Waste Heat Recovery, which is assumed at a total cost of \$10,780 in 2012\$ in calendar year 2021, but with the penetration rate of 1% applied the cost is given as \$105 in 2012\$. It is also unclear why the costs for WHR go down annually from 2018 given no penetration until 2021 (this may be a conversion effect, but the only table found in the RIA and Preamble for conversion to 2012\$ was for 2005-2013). [EPA-HQ-OAR-2014-0827-1290-A1 p.35]

As noted above, Volvo Group has significant concerns regarding technology costs as determined by the Agencies. To be brief Volvo Group is only providing examples for one current and one future technology, but the concerns can be addressed to nearly all technology cost determinations. [EPA-HQ-OAR-2014-0827-1290-A1 p.35]

### **The Cost of Downtime**

Though EPA and NHTSA mention the high cost of downtime in both the RIA and the Preamble, they have ignored these costs in their analysis for the rule. They have also not considered the additional fuel spent in the case of a break down and the resultant pollutants generated. [EPA-HQ-OAR-2014-0827-1290-A1 p.36]

Most large fleets today must purchase 3%-5% more trucks than necessary for their freight demand, to be available to replace down trucks. Even then, once a truck does go down, the fleet must dispatch a tow truck to recover it. If the repair cannot be made immediately, they must send another truck sometimes many hundreds of miles to recover the load and carry it to its final destination. If the load is time sensitive they could be liable for penalties for missed delivery timing. The driver must be transported home, or to the location of another truck and load. Any repair parts not available locally must be sent by expedited freight to minimize the amount of time the truck is in the shop. If the truck was not towed to a fleet's own maintenance facility they must then send a driver to recover the unit once it has been repaired. Added up, these costs can total thousands of dollars and account for significant additional burned fuel. Smaller fleets that do not have the capital to purchase additional trucks to sit idle waiting for break downs must absorb all of these costs while losing revenue. [EPA-HQ-OAR-2014-0827-1290-A1 p.36-37]

### **Additional Concerns**

There are a few additional concerns Volvo Group would like to note in brief, where the Agencies have not considered the following at realistic levels or have not included them in their cost analysis: [EPA-HQ-OAR-2014-0827-1290-A1 p.37]

- Reliability and durability issues potentially resulting in tens to hundreds of millions of dollars in warranty costs to the vehicle manufacturer and increased cost of ownership to the ultimate purchaser in the form of more down-time and increased repair costs beyond the warranty period.
- Resale values that do not reflect added purchase cost of technologies (and may even be reduced for complex technologies that drive up maintenance cost) driving down the ultimate purchaser's vehicle lifetime earnings.
- Customer expectations of a 12-18 month payback period on vehicle purchases.



Despite this backdrop of growing pressure to further regulate NO<sub>x</sub> emissions from medium and heavy-duty vehicles, there has been little consideration given to this anticipated demand in the Phase 2 notice. This is a considerable oversight, given not only the well documented inverse relationship between NO<sub>x</sub> and CO<sub>2</sub> emission for internal combustion engines<sup>10</sup>, but also considering the impact to manufacturers' resource demands if they must develop an even broader array of technologies to simultaneously reduce NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1290-A1 p.59][This comment can also be found in section 15.8 of this comment summary]

The development necessary to meet the proposed GHG standards should not be taken lightly. In many ways, we're embarking into a new era. The development work to meet the NO<sub>x</sub> and PM reduction challenges required by EPA's 2004/2007/2010 standards was based on widespread deployment of mostly singular technologies – first Exhaust Gas Recirculation, then Diesel Particulate Filters, and finally Selective Catalytic Reduction. In this Phase 2 GHG regulation, however, EPA and NHTSA are counting on manufacturers to develop a series of technologies, each targeting a subset of applications. Manufacturers lack the development capacity to meet the multiple, parallel development demands for Phase 2. Waste-heat recovery, stop-start, hybrids in widely different vocational applications, engine/transmission control integration, etc. – all of these are major engineering challenges. On top of this is the strong possibility that this will be complicated by, and supplemented with, additional development to address NO<sub>x</sub> reductions is not even considered in the NPRM. There are limitations to the capabilities of manufacturers to deliver on all fronts. Overstressed delivery demands lead to product launches with poor reliability and delayed purchases, which undermine all stakeholders' goals. [EPA-HQ-OAR-2014-0827-1290-A1 p.59-60][This comment can also be found in section 158 of this comment summary]

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10 EPA even established a formula for the NO<sub>x</sub>/GHG tradeoff in the Alternative CO<sub>2</sub> Standards – 40 CFR Part 1036.620.

**Response:**

The commenter states, with regard to EPA's indirect cost multipliers used for HD tractors, "One shortcoming, however, is the lack of consideration for return on investment in the determination of the ICMs. After the development of the LD ICMs for the aforementioned rulemakings and the publication of a peer-reviewed report the agencies revised the methodology to account for an internal rate of return on investments. In the Phase 2 rulemaking the agencies are applying this new methodology to the heavy-duty pickup and van cost projections since "the manufacturers involved in this segment of the heavy-duty market are the same manufacturers that build light-duty trucks." The commenter also states that "for MHD and HHD combination tractors, vocational vehicles, and heavy-duty engine cost projections the agencies are using the Phase 1 ICMs which do not account for a return on the cost of capital." This statement reflects a lack of understanding with EPA's development and use of ICMs. In the draft RIA supporting the Phase 1 proposal, we stated, with regards to our HD ICMs, "The ICMs used in this analysis include a factor for profit that is a 0.05 share of direct costs, as calculated in the RTI report, for the Class 7/8 tractor, vocational vehicles, and heavy-duty engine cost projections." (see EPA-420-D-10-901, page 2-4) So, in fact, the HD ICMs have always included a factor for the return on capital and, therefore, there is no omission to correct.

The commenter also states that learning effects and their impacts on technology costs have been overestimated. However, the commenter provides no better or suggested learning effects. Importantly,

the commenter does not appear to suggest that learning effects are not real. In the absence of better estimates, however, in general, used the same learning effects in the final rules as in the proposal.

As for technology costs and conversions to 2012\$ while showing costs in MY2021, and the application of learning effects in years prior to any adoption, we are confused by the first and understanding of the second. As regards the first, the proposed analysis calculated all monetized values in terms of 2012\$. That use of 2012\$ has no relation to the year in which the estimates are valid. It simply means that all values are expressed in 2012\$ and, should a future study make use of the values in the analysis, the values should be adjusted from 2012\$ terms to the dollars used in that future study. In other words, a widget costing \$100 in 2012\$ will cost \$100 in 2012\$ regardless of the year, absent any cost reductions that may occur in the production of that widget. If, in some future analysis, all monetized values are expressed in terms of 2018\$, then the \$100 (in 2012\$) widget will, presumably, cost something slightly more given the effects of inflation and, again, absent any learning effects that may occur. Again, this discussion ignores the possible impacts of learning effects. As for the application of learning effects to technologies despite lack of adoption, this is a valid point for some of our technologies, notably waste heat recovery in the context of the proposal (note that, for waste heat recovery, our final cost estimate does not show learning occurring in years prior to implementation in 2021). Cost estimation is admittedly an inexact science. Some cost estimates assume early days of a technology's existence, while others assume full production and adoption. This is how we form the "base" or "basis" of our cost estimates. For something like waste heat recovery, the systems have changed considerably since their first days on development vehicles. Costs for those systems have come down despite lack of adoption of the systems in the market. In short, we attempt to develop the best cost estimates available and to estimate how those costs might change over time. Admittedly, overestimating learning effects could lead to overly aggressive standards. However, underestimating them could lead to inappropriately lax standards. We strive to determine that middle, most likely outcome, and have documented the reasonable basis for each of our assumptions and conclusions.

As regards the costs of downtime, we understand that such costs can be significant. However, the commenter makes no specific comment nor provides specific data upon which to estimate such costs in association with the technologies expected to be used in response to the new GHG/fuel consumption standards. As noted in other responses, one reason the agencies are not adopting pulled ahead standards (alternative 4) is due to the possibility of inadequately tested technology leading to downtime and incurred costs.

As regards the other concerns stated by the commenter, we note that ICMs do include factors to cover warranty costs. The commenter provides no data pertinent to concerns over reliability. Issues surrounding potential future NO<sub>x</sub> regulations are not germane to these GHG and fuel consumption standards.

**Organization:** Walmart Transportation

We support a strong Phase 2 rule that will drive innovation in truck technologies to viable solutions at a pace that ensures the technologies will have the intended triple bottom line outcomes without unintended consequences. Estimates of penetration rates, commercialized cost, and ROI of new technologies are most robust when gained through independent lab and real world testing, as well as from a survey of diverse stakeholders including the component manufacturers, OEMs, and users. Even within one subset like the long-haul combination tractor-trailer market, results will be heavily dependent on duty cycle and application. Within this complex environment, the trucking industry has proven its ability to innovate and drive efficiency when given the right flexibility, incentives and resources. [NHTSA-2014-0132-0117-A1 p.1]

**Response:**

Thank you for your comments.

**Organization:** Werner Enterprises

In many aspects, the proposed rule could be detrimental to our business through the projected increase in costs of trucks, engines, and trailers. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

There are several key areas the Agencies need to address: [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

- Penetration rates for various technologies are too aggressive, resulting in overly stringent emission standards. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

**Response:**

We respond to issues surrounding technology adoption rates in the individual and respective sections of this Response to Comments document, as well as the respective sections of RIA Chapter 2.

**Organization:** XL Hybrids

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 241-242.]

One, we recommend improvements to the hybridization cost models. The learning curve cost models in the regulatory impact analysis table 2-100 for mild and strong hybrids does not appear to account adequately for the highly specialized manufacturing cost and scaling that is unique to the lithium battery market.

**Response:**

We would be interested in understanding what sorts of improvements should be made. However, no details were provided by the commenter.

### **11.3 Changes in Fuel Consumption and Expenditures**

**Organization:** ABC Bus Companies, Inc.

1) ABC supports improved fuel economy as a means to provide economic transportation to rural areas of the country and efficient movement of passengers as a way to reduce highway congestion and CO<sub>2</sub> emissions. [EPA-HQ-OAR-2014-0827-1430-A2 p.2]

**Organization:** Amy's Kitchen et al.

The availability of fuel-efficient trucks is critical to reducing our carbon footprints as well as our fuel costs. Shippers already spend \$650 billion a year on trucking services,<sup>iii</sup> and fuel costs account for 39% of the per mile cost of owning and operating a truck. As compared to the proposed standards, a 40% reduction in fuel use would cut an additional 200,000 barrels of oil daily in 2035<sup>iv</sup> and provide 33% more in fuel cost savings. Strong efficiency standards for heavy trucks will help our companies avoid billions of dollars in fuel costs and at the same time support the U.S. economy by keeping product

transportation affordable and insulating freight costs from volatile global and regional crude oil prices. [NHTSA-2014-0132-0232-A1 p.3]

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iii The State of Logistics 2014, Council for Supply Chain Management Professionals, June 2014.

iv Newly Proposed Heavy-Duty Truck Efficiency Standards for 2018-2029. Cambridge: Union of Concerned Scientists, 2015. Web. 12 Feb. 2016. <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/proposed-truck-standards#.Vr4kJIQw3ww>.

**Organization:** Burger, Mark

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 133-134.]

There are five risk factors to fuel prices in the near and long term. First is possible global pricing of carbon emissions. At \$25 to \$50 per metric ton, that can mean adding \$10 to \$20 to the price of a barrel of oil, or up to 25 to 50 cents per gallon of fuel. The second global risk factor is a geopolitical event up to and including warfare that could disrupt or interrupt oil and gas shipments. The last one is declining rates of extraction by cost or available resources.

For U.S. supply and pricing, there are two major risks to oil and gas prices and supply. First is the lifting of the ban on petroleum exports and development of robust infrastructure to facilitate shipment, especially for liquefied natural gas. The result will likely be U.S. prices of oil and gas moving upward toward global market prices.

At present there is only about a 10 percent spread between Brent and West Texas intermediate petroleum prices. The greater risk, however, is U.S. natural gas prices rising to European or Asian levels of two to four times greater. The other risk factor is shale extraction of petroleum and natural gas may be far more short-lived than traditional extraction. Combined with exports to higher priced markets puts the U.S. gasoline and diesel consumer at greater risk. It also neutralizes the premise that shifting heavy truck fuel from diesel to natural gas will be a cost saver without higher efficiency standards.

**Organization:** California Interfaith Power and Light

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p.105.]

And, as we heard, these will have benefits for companies in fuel savings and energy efficiency.

**Organization:** City of West Hollywood

Fuel is the largest expense for many vehicle fleets. Improvements in fuel economy represent a crucial way for government fleets to control costs while continuing to deliver exemplary service. [NHTSA-2014-0132-0056-A1 p.1]

The 2011 standards will deliver on the order of \$50 billion in cumulative fuel savings to vehicle owners and operators over time. The standards will reduce fuel consumption in the overall heavy-duty vehicle fleet by 390,000 barrels per day in 2030 - roughly equivalent to the amount of oil we import each year

from Iraq. However, we can accomplish more. According to analysis by experts, by 2025 we have the potential to cut fuel consumption of new trucks by at least 40 percent compared to 2010 levels. Standards that extend beyond 2025 could achieve even larger savings. [NHTSA-2014-0132-0056-A1 p.2]

**Organization:** Clean Fuels Ohio (CFO)

Opportunities improving truck fuel efficiency are also great (and growing) based on already-existing technologies and others in the R&D pipeline that show future promise: [EPA-HQ-OAR-2014-0827-1192-A1 p.1]

According to EPA data, the second phase rule is expected to save vehicle owners \$170 billion in fuel costs while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons over the lifetime of vehicles sold under the program. [EPA-HQ-OAR-2014-0827-1192-A1 p.1]

**Organization:** Consumer Federation of America (CFA)

Section IV examines analyses of the technological potential for and cost of reducing freight truck fuel consumption. We show that there is a great deal of technically feasible and cost beneficial fuel savings available. [EPA-HQ-OAR-2014-0827-1336-A1 p.9]

## **POTENTIAL FUEL AND COST SAVINGS FOR MEDIUM AND HEAVY DUTY TRUCKS**

### **LIGHT DUTY TECHNOLOGY EXPERIENCE AS CONTEXT FOR HEAVY DUTY STANDARDS**

In 2002, after the first gasoline price spike of the 21<sup>st</sup> century, the National Academy of Science undertook an analysis of the technological potential to increase the fuel economy of light duty vehicles.<sup>18</sup> It concluded that there was substantial opportunity to reduce fuel economy at relatively low costs. They determined that the value of the fuel savings was larger than the cost of the technology needed to reduce fuel use. As shown in Figure IV-1, other well-respected research reached similar conclusions over the course of the decade. [EPA-HQ-OAR-2014-0827-1336-A1 p.25]

[Figure IV-1 can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Although there were differences in the estimates, a clear consensus emerged showing a significant amount of economic benefit in developing new fuel saving technologies. This universal conclusion was a key reason why the doubling of the fuel economy standards for light duty vehicles (CAFE) was adopted in 2012. It was particularly significant that this standard was fully supported by diverse segments of the market including: car companies, unions, consumer groups, and environmentalists. [EPA-HQ-OAR-2014-0827-1336-A1 p.25-26]

Figure IV-2 shows the development of new light duty vehicle mileage since the adoption of fuel economy standards. The CAFE program was instituted by legislation in 1975. Mandated increases ceased in 1986. The Energy Independence and Security Act of 2007, reformed and restarted the program. The first proposed rule was issue in 2008 and went into effect in 2011. In 2009, standards through 2016 were proposed. The long term rule to double fuel economy was finalized in 2012. [EPA-HQ-OAR-2014-0827-1336-A1 p.26]

[Figure IV-2 can be found on p.26 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

## **MEDIUM AND HEAVY DUTY TRUCK TECHNOLOGY EFFICIENCY TECHNOLOGY CURVES**

The consensus around the potential for increased fuel economy and the results of recent increases in the standard in the light duty vehicle arena provide an important context for the heavy duty truck rule. The medium and heavy duty truck sector is a much more complex product space than light duty vehicles. Nevertheless, while there are different types of vehicles, equipment configurations, and use patterns, a similar consensus has emerged with respect to medium and heavy duty trucks—expenditures on fuel efficient technology will be more than offset by savings in fuel costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.26-27]

Figure IV-3 presents fuel savings in terms of percentage reduction (rather than gallons) for tractor trailers. Tractor trailers, defined as Class 8 trucks, are the most significant category of medium and heavy duty trucks, accounting for 60-75 percent of the fuel consumption for medium and heavy duty trucks. Therefore, throughout this analysis we focus attention on these vehicles. [EPA-HQ-OAR-2014-0827-1336-A1 p.27]

As Figure IV-3 shows, various studies predict that significant percentages of fuel reduction (10-20%) can be made with technology investments of \$10,000-\$20,000. In addition, substantial percentages of reduction (40-50%) can be made with investments of \$40,000-\$50,000.<sup>19</sup> This high reduction in fuel consumption is for Class 8 trucks, and other categories may not present equally rich fuel saving potential, but the potential is substantial in all classes of trucks.<sup>20</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.27]

[Figure IV-3 can be found on p.28 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Compared to the figures for light duty vehicles, the cost of adding efficiency technologies to heavy duty trucks may appear large. However, heavy duty trucks are driven many more miles and fuel costs between \$100,000-\$150,000 annually. Given the much larger number of miles driven per year of heavy duty trucks and the much lower mileage per gallon, as well as the higher cost of diesel, the average annual expenditure on fuel for heavy duty trucks is almost **ten** times the expenditure for light duty vehicles.<sup>21</sup> A ten percent reduction in fuel consumption will support a much larger investment in fuel saving technology. [EPA-HQ-OAR-2014-0827-1336-A1 p.28]

With estimates of the technology costs and fuel savings, the National Research Council report on medium and heavy duty trucks simplifies the cost benefit analysis by focusing on the cost side and not making assumptions about fuel prices (See Figure IV-4). Instead of engaging in the uncertain and sometimes contentious exercise of projecting fuel costs over long periods, the National Research Council estimates the price per gallon that would be necessary to break even on an investment that incorporates technologies to reduce fuel consumption in medium and heavy duty trucks. [EPA-HQ-OAR-2014-0827-1336-A1 p.29]

[Figure IV-4 can be found on p.29 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

NRC includes a discount rate, representing the time value of money, set at 7% to compare the estimated costs of saved fuel to projections for the future cost of fuel.<sup>22</sup> As shown in Figure IV-4, the NRC estimated that fuel prices would have to be just \$1.09 per gallon for a very large investment in new technology to earn a 7% real rate of return. As actual fuel prices are currently over three times this

amount and expected to rise over time, the payout from these technologies would far exceed their cost. [EPA-HQ-OAR-2014-0827-1336-A1 p.29-30]

In Figure IV-4, we have also converted the results of several other recent studies to this break-even approach. While there are some differences among these studies, there is a clear consensus that large investments in increasing the fuel economy of medium and heavy duty trucks are very attractive. All but one of the analyses show that investments in technology to improve fuel economy would earn more than the 7% discount rate at diesel prices of \$2 and substantially more at higher gas prices. [EPA-HQ-OAR-2014-0827-1336-A1 p.30]

EIA's projected fuel prices over the next quarter century will average close to \$4.00 per gallon, as shown in Figure IV-5. With average prices that high, over the next 25 years, the investment in energy saving technology would yield a very attractive return. [EPA-HQ-OAR-2014-0827-1336-A1 p.30]

Figure IV-6 shows the size of potential fuel savings compared to technology costs. It suggests that a goal of cutting tractor trailer fuel consumption by 40 to 50 percent is economical in the long run. In order to cut fuel consumption in half, one must double the fuel economy of the vehicle. [EPA-HQ-OAR-2014-0827-1336-A1 p.30]

This is exactly the target that was adopted for light duty vehicles in the 2012 CAFE rule. For example, if you reduce consumption by 50%, the breakeven cost of fuel is \$1.50, which means that as long as fuel is more than \$1.50, the cost of technology will be a money saver. [EPA-HQ-OAR-2014-0827-1336-A1 p.30]

These analyses leave little doubt that there is a significant amount of technology available that would lower the consumption of fuel in the medium and heavy duty truck sectors at a very attractive cost. Consumer savings would be substantial. The next question is, why hasn't the marketplace witnessed these investments. [EPA-HQ-OAR-2014-0827-1336-A1 p.30]

[Figures IV-5 and IV-6 can be found on p.32 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

We begin with a discussion of the fuel savings benefits and the technology costs that must be incurred to achieve the reduction in fuel consumption. Although we recognize there are other economic costs and benefits, these make up the vast majority of the total costs and benefits. They are the most obvious consumer pocketbook benefits and costs. Because they are direct and not externalities, in a properly functioning market they would be reflected in the investment decisions that affect energy consumption. The analysis shows they are not, indicating significant market imperfections, obstacles and failures. [EPA-HQ-OAR-2014-0827-1336-A1 p.45]

## **DIRECT ECONOMIC IMPACTS**

Our discussion of economics developed a simple economic criteria as a way to easily summarize the very complex economic analysis – the cost of saved energy. EPA/NHTSA start with this approach, which is derived by dividing the real, discounted economic costs (including capital and maintenance costs), by the total number of gallons saved.<sup>32</sup> The results are eye-popping. For the proposed rule, the improvement in fuel economy works out to a cost of only \$0.40 per gallon. [EPA-HQ-OAR-2014-0827-1336-A1 p.45-46]

As discussed below, the agencies estimate that over the lifetime of heavy duty vehicles produced for sale in the U.S. during model years 2018–2029, the proposed standards [Alternative 3] would cost about

\$30 billion and conserve about 75 billion gallons of fuel, such that the first measure of cost effectiveness would be about 40 cents per gallon. Relative to fuel prices underlying the agencies' analysis, the agencies have concluded that today's proposed standards would be cost effective...[EPA-HQ-OAR-2014-0827-1336-A1 p.46]

Our current analysis of Alternative 4 also shows that, if technologically feasible, it would have similar cost effectiveness but with greater net benefits (see Chapter 11 of the draft RIA). For example, the agencies estimate costs under Alternative 4 could be about \$40 billion and about 85 billion gallons of fuel could be conserved, such that the first measure of cost effectiveness would be about 47 cents per gallon. However, the agencies considered all of the relevant factors, not just relative cost effectiveness, when selecting the proposed standards from among the alternatives considered. Relative cost effectiveness was not a limiting factor for the agencies in selecting the proposed standards. It is also worth noting that the proposed standards and the Alternative 4 standards appear very cost effective, regardless of which reference case is used for the baseline, such that all of the analyses reinforced the agencies' findings.<sup>33</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.46]

With fuel prices projected to be about \$4.00 per gallon, there is no doubt that the investment induced by the proposed rule would be very beneficial. The other measures of economic impact tell the same story. The value of fuel savings are over six times as large as the technology costs associated with the rule and over five times as large as the total cost. The payback period is less than two years for tractor trailers, which account for 65 percent of the total costs and savings of the rule, less than 4 years for medium and heavy duty pickups and vans, and less than 7 years for vocational vehicles. [EPA-HQ-OAR-2014-0827-1336-A1 p.46]

The economics of the standard are so highly favorable that they raise a concern that is in the opposite direction of the usual concern about standards--Why didn't the agencies include additional technologies that would yield very positive economic returns? As suggested by the quote above, there are other considerations, in addition to simple economics, that come into play, which led the agencies to reject including technologies that would increase costs and benefits moderately and yield a cost per gallon of only \$0.47. We will address this question at the end of this section. [EPA-HQ-OAR-2014-0827-1336-A1 p.46-47]

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18 Transportation Research Board, National Research Council, 2002, *Effectiveness and Impact of Corporate Average Fuel Economy*, National Academy of Sciences.

<sup>19</sup> It is important to note that a 50% fuel consumption decrease is equal to a 100% increase in fuel economy. In other words, when the fuel economy doubles, the fuel consumption is cut in half.

<sup>20</sup> For example, the American Council for an Energy Efficient Economy estimates potential fuel savings from two phases of technology improvement at between 30% and 46% for heavy duty pickups and vans and Class 8 trucks respectively, <http://aceee.org/files/pdf/fact-sheet/hd-oil-reduction.pdf>. There are many opportunities to reduce fuel consumption that have been studied recently. See for example, Ben Sharpe and Nigel Clark, Trailer technologies for increased heavy-duty vehicle efficiency, Technical, market, and policy considerations, International Council on Clean Transportation, June 2013; Donald W. Stanton, Systematic Development of Highly Efficient and Clean Engines to Meet Future Commercial Vehicle Greenhouse Gas Regulations, Safe International, 2013-01-2421, September 2013; TA Engineering, DOE SuperTruck Program Benefits Analysis, December 20, 2012. It should also be noted that the cost analyses are being updated and, reflecting the findings in Cooper, 2013, the actual costs are likely to be lower than early estimates.



<sup>21</sup> Energy Information Administration, Monthly Energy Review for fuel consumption, of 4, 26 gallons per heavy duty truck of 4126 gallon and 460 gallons per light duty vehicle in 2011. Diesel was over 7% more expensive than gasoline.

<sup>22</sup> The discount rate also refers to the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows... takes into account not just the time value of money, but also the risk or uncertainty of future cash flows; [investopedia.com/terms/d/discountrate.asp](http://investopedia.com/terms/d/discountrate.asp)

<sup>32</sup> EPA/NHTSA, PHASE II NOPR, p. 40169, lists the cost per gallon saved as the first of three ratios of cost Effectiveness.” It is the only one of the three that is based on economics. The other two ratio involve the value of greenhouse gas reductions.

<sup>33</sup> EPA/NHTSA, NPRM, p. 40169.

**Organization:** Diaz, Miguel

While the transportation system is only responsible for just 27%, is a really big number when you consider that is the second group that most emissions produce after electricity. The measures taken by EPA are indeed the right call and a smart decision for it will help to reduce millions of dollars in oil use, reduce billions of greenhouse gas emissions, and start reducing the extraction of the world’s natural resources that are limited like petroleum. Even though, only 7 percent of the vehicles are considered to be freight trucks now days, they use about 1/4 of the fuel currently used in the country. They (the vehicles) produce a huge quantity of emissions and demand for oil, equipment and resources. [EPA-HQ-OAR-2014-0827-1848-A1 p.1-2][This comment can also be found in section 9.3 of this comment summary]

**Organization:** Energy Ohio Network

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014. As travel among heavy- duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1331-A1 p.1]

Fuel is the single largest expense to motor carriers – accounting for nearly 40 percent of operating costs, or about \$73,000 annually for a combination trailer that gets about 6.5 miles to the gallon (mpg).<sup>5</sup> These charges are passed on to consumers through higher priced products. The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-1331-A1 p.1-2]

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3 <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>; <https://www.census.gov/prod/2011pubs/acs-15.pdf>;

4 [http://www.eia.gov/forecasts/aeo/section\\_deliveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm)

5 <http://atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf>; [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Technology-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf)

**Organization:** Environment America and other local citizens across America

Fuel is the largest expense for many vehicle fleets.[1] Improvements in fuel economy represent a crucial way for government fleets to control costs while continuing to deliver exemplary service.

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[1] <http://www.automotive-fleet.com/article/story/2013/11/fleet-operating-costs-remain-flat-in-2013.aspx>

**Organization:** Environmental Defense Fund (EDF)

## **B. Increased efficiency provides savings across the supply chain**

A more robust final rule will also deliver greater economic benefits. More efficient heavy-duty trucks secure cost savings across the entire supply chain – from the fuel cost savings by independent drivers and fleets who purchase the vehicles, to shippers who deliver goods, to the American consumers who buy those goods. [EPA-HQ-OAR-2014-0827-1312-A1 p.17]

The average semi-truck today burns 20,000 gallons of diesel fuel a year – the same volume of fuel used by 50 new passenger cars.<sup>77</sup> Accordingly, fuel has been the largest single cost for trucking fleets, accounting for 39% of the cost of ownership in 2013.<sup>78</sup> More efficient trucks drive down the fuel costs for drivers and fleets. An analysis by EDF and others found that a robust rule that reduces fuel consumption by 40 percent over 2010 levels could save average tractor-trailer owners and drivers about \$30,000 per year in fuel.<sup>79</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.18]

EDF and CERES examined how strong standards would affect the cost of moving freight by trucks, finding that strong standards will save companies nearly \$10 billion dollars in 2030, as the cost-per-mile to move freight would decrease by \$0.06 per mile. [EPA-HQ-OAR-2014-0827-1312-A1 p.18]

By 2040, these savings could grow to \$34 billion annually, as the net effect of the second phase of the standard alone could reduce the per-mile cost of moving freight by 21 cents.<sup>80</sup>[EPA-HQ-OAR-2014-0827-1312-A1 p.18]

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77 Assumes Class 8 truck VMT of 120,000 miles and average fuel economy of 6.1 MPG, and sedan VMT of 11,318 and average fuel economy of 31 MPG. Energy Information Agency (EIA), Annual Energy Outlook 2014, Table 68; Freight Transportation Energy Use. Heavy Duty Fuel Efficiency, Existing Trucks by Size Class. University of Michigan Eco-Driving Index available at [www.umich.edu/~umtriswt/data/UMTRI\\_sales-weighted-CAFE\\_April-2015.xls](http://www.umich.edu/~umtriswt/data/UMTRI_sales-weighted-CAFE_April-2015.xls); and Federal Highway Administration, Table VM-1 American Public Transit Association's Public Transportation Fact Book Tables 8, 16, and 21.

78 American Transportation Research Institute, An Analysis of the Operational Costs of Trucking, (September 2013), available at <http://truckexec.typepad.com/files/atri-operational-costs-of-trucking-2013-final.pdf>.

79 EDF et al., Big Fuel Savings Available in New Trucks, (2014), available at <http://www.edf.org/sites/default/files/content/trucksavingsfactsheet-2014-06-11.pdf>.

80 EDF and CERES, EPA/NHTSA Phase 2 Fuel Efficiency and Greenhouse Gas Standards for Heavy-Duty Trucks: Projected Effect on Freight Costs, (May 2015), available at <http://business.edf.org/files/2015/06/EDF-Ceres-Report-Truck-Rule-Phase-2-Effect-on-Freight-Rate.pdf>.

**Organization:** Mass Comment Campaign sponsored by anonymous 3 (email) - (308)

Today, freight trucks account for only seven percent of the vehicles on the road, but guzzle roughly one-quarter of all fuel. Indeed, freight trucks are the fastest growing source of oil use and climate pollution in the transportation sector. The proposed standards would significantly reduce oil use, saving 1.8 billion barrels of oil and 1 billion metric tons of carbon pollution over the lives of the trucks sold. These cost-effective improvements would not only save truck drivers more than \$170 billion in fuel costs, those fuel savings will be passed on to consumers as goods are shipped to market. [EPA-HQ-OAR-2014-0827-1477-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by Sierra Club (email) - (26,917)

Today, freight trucks account for only 7 percent of the vehicles on the road, but guzzle roughly one-quarter of all fuel. Indeed, freight trucks are the fastest growing source of oil use and climate pollution in the transportation sector. The proposed standards would significantly reduce oil use, saving 1.8 billion barrels of oil and 1 billion metric tons of carbon pollution over the lives of the trucks sold. These cost-effective improvements would not only save truck drivers more than \$170 billion in fuel costs, those fuel savings will be passed on to consumers as goods are shipped to market. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

Analysis shows that we can reduce new truck fuel consumption 40 percent by 2025, compared to 2010 trucks. [EPA-HQ-OAR-2014-0827-0814-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by The League of Conservation Voters (LCV) (web) - (6,603)

Analysis shows that we can reduce new truck fuel consumption 40 percent by 2025, compared to 2010 trucks. If the standard is strengthened to this target, it would save an additional 200,000 barrels of oil per day in 2035, and avoid an additional 40 million metric tons of global warming emissions annually--equivalent to shutting down 12 coal-fired power plants. [EPA-HQ-OAR-2014-0827-1228-A1 p.1]

**Organization:** Mass Comment Campaign sponsored by Union of Concerned Scientists (email) - (28,135)

Heavy-duty trucks account for only seven percent of the vehicles on the road, but consume roughly one-quarter of all fuel. Furthermore, heavy-duty trucks are the fastest growing source of oil use in the transportation sector. The proposed standards would cut oil use by over a million barrels every two days. The standards would also save truck drivers more than \$170 billion in fuel costs, and those savings would be passed on to consumers through lower goods prices. [EPA-HQ-OAR-2014-0827-0913-A1 p.1]

Analysis by the Union of Concerned Scientists (UCS) shows that we can cost-effectively reduce new truck fuel consumption 40 percent by 2025. If the proposal is strengthened in line with UCS analysis, it would save an additional 200,000 barrels of oil per day in 2035 and avoid an additional 40 million metric tons of global warming emissions annually--equivalent to shutting down 12 coal-fired power plants. [EPA-HQ-OAR-2014-0827-0913-A1 p.1]

**Organization:** Mazza & Sons, Inc.

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014. As travel among heavy duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>4</sup> [EPA-HQ-OAR-2014-0827-0915-A1 p.1]

Fuel is the single largest expense to motor carriers - accounting for nearly 40 percent of operating costs, or about \$73,000 annually for a combination trailer that gets about 6.5 miles to the gallon (mpg).<sup>5</sup> These charges are passed on to consumers through higher priced products. The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-0915-A1 p.1-2]

The first round of truck standards, affecting model year 2014 through 2018 vehicles, is estimated to save a total of \$50 billion in fuel costs and reduce carbon pollution by 270 million metric tons. Finalizing a strong second phase rule will generate \$230 billion dollars in net benefits to the U.S. over the lifetime of vehicles sold between 2021 and 2027.<sup>6</sup> Vehicle owners will save \$170 billion while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons under the regulatory timeframe. Furthermore, a new long-haul truck owner in 2027 will recoup the upfront cost of more efficient technologies less than 2 years through fuel savings. [EPA-HQ-OAR-2014-0827-0915-A1 p.2]

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3 <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>;  
<https://www.census.gov/prod/2011pubs/acs-15.pdf>;

4 [http://www.eia.gov/forecasts/aeo/section\\_deliveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm)

5 <http://atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf>; [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Technology-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf)

6 <http://www.epa.gov/otaq/climate/documents/420f15903.pdf>

**Organization:** Momentum Wireless Power

The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-0755-A1 p.2]

The first round of truck standards, affecting model year 2014 through 2018 vehicles, is estimated to save a total of \$50 billion in fuel costs and reduce carbon pollution by 270 million metric tons. Finalizing a strong second phase rule will generate \$230 billion dollars in net benefits to the U.S. over the lifetime of vehicles sold between 2021 and 2027.<sup>6</sup> Vehicle owners will save \$170 billion while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons under the regulatory timeframe. Furthermore, a new long-haul truck owner in 2027 will recoup the upfront cost of more efficient technologies less than 2 years through fuel savings. [EPA-HQ-OAR-2014-0827-0755-A1 p.2]

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6 <http://www.epa.gov/otaq/climate/documents/420f15903.pdf>

**Organization:** Moms Clean Air Force

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 65.]

If finalized as proposed, the standards would cut oil use by over a million barrels every two days. By not burning that oil, the United States would over the lifetime of trucks affected by the rule avoid one billion metric tons of global warming emissions. That's roughly equivalent to the emissions created by powering all U.S. households for a year. That creates not only cleaner air, but a future that our children can count on.

I think we need to do more than the proposed standard. To protect our children, we need standards to be strengthened to achieve 40 percent fuel savings by 2025. If the final proposal is strengthened in this way, it would save an additional 200,000 barrels of oil per day and avoid an additional 40 million metric tons of global warming emissions annually, which is the equivalent to shutting down 12 coal-fired power plants. Imagine the incredible impact that would have on children's health and all of our futures.

**Organization:** Natural Resources Defense Council (NRDC)

Fuel efficiency and carbon pollution standards can also help truck manufacturers be more resilient in the face of market changes outside of their control. For example, fuel-efficient vehicles will be less vulnerable to sales declines when diesel and gasoline fuel price spikes. On the other hand, fleets dependent on fuel-guzzling vehicles will have to spend more to fuel their fleet and their budgets for new vehicle purchases will shrink. [EPA-HQ-OAR-2014-0827-1220-A1 p.11]

**Organization:** Navistar, Inc.

Another item of concern relates to the basis for adoption rates as influenced by oil and diesel prices. The RIA uses the early 2014 Annual Energy Outlook (AEO) forecast for expected diesel prices. Since then, the projections have dramatically decreased.<sup>7</sup> A May 2015 forecast shows a reference crude oil price in 2020 that is approximately \$20 per barrel lower in the 2015 estimate than in the AEO2104 estimate used in the RIA.<sup>8</sup> Within the period covered by the rule the projection is lower at all points by approximately \$20 a barrel. The primary/reference fuel price in 2020 and 2027 (interpolated) are 14% and 10%, respectively, lower in the 2015 forecast than the 2014 forecast (while the average for 2020 and 2027 is 6% lower). [EPA-HQ-OAR-2014-0827-1199-A1 p.6]

Looking specifically at diesel price forecasts, one sees the same revision downward. For example, the AEO2015 shows diesel prices at \$3.17 per gallon in 2020, as opposed to the \$3.67 forecast from 2014

used in the RIA.<sup>9</sup> The table below shows the differences in the estimates between the 2014 and 2015 AEO forecasts for the relevant time periods. [EPA-HQ-OAR-2014-0827-1199-A1 p.6-7]

| <b>Diesel Fuel Prices</b> | <b>2020</b> | <b>2025</b> | <b>2030</b> |
|---------------------------|-------------|-------------|-------------|
| 2014 AEO Estimate         | \$3.67      | \$3.98      | \$4.20      |
| 2015 AEO Estimate         | \$3.17      | \$3.49      | \$3.84      |
| Percentage reduction      | 13.6%       | 12.3%       | 8.6%        |

Clearly, the estimated price of diesel over the years encompassed by this rule declined significantly. Reducing fuel costs by 10% would add 6-12 months to vocational and bus payback periods, which are already calculated in the RIA at 5-6 years. This payback period will meet or exceed the expected life of many of these vehicles. Larger fleets are also able to reduce fuel costs by 30% by purchasing in bulk with long-term contracts and other mechanisms, which can add approximately 6 months to tractor payback periods. [EPA-HQ-OAR-2014-0827-1199-A1 p.7]

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7 Annual Energy Outlook 2015, available at [http://www.eia.gov/forecasts/aeo/pdf/0383\(2015\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf)

<sup>8</sup> See summary comparison of AEO2015 reference case with AEO2014 at U.S. Energy Information Administration presentation “Lower oil prices and the energy outlook” at slide 11, available at: [http://www.eia.gov/pressroom/presentations/sieminski\\_06222015.pdf](http://www.eia.gov/pressroom/presentations/sieminski_06222015.pdf)

<sup>9</sup> AEO2015 at A125, Table A12.

**Organization:** Ohio Sustainable Business Council (SBC)

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014. As travel among heavy duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1177-A1 p.1]

Fuel efficiency is good for business. Fuel is the single largest expense to motor carriers –accounting for nearly 40 percent of operating costs, or about \$73,000 annually for a combination trailer that gets about 6.5 miles to the gallon (mpg).<sup>5</sup> These charges are passed on to consumers through higher priced products. [EPA-HQ-OAR-2014-0827-1177-A1 p.1]

The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-1177-A1 p.2]

The first round of truck standards, affecting model year 2014 through 2018 vehicles, is estimated to save a total of \$50 billion in fuel costs and reduce carbon pollution by 270 million metric tons. Finalizing a strong second phase rule will generate \$230 billion dollars in net benefits to the U.S. over the lifetime of vehicles sold between 2021 and 2027.<sup>6</sup> Vehicle owners will save \$170 billion while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons under the regulatory timeframe. Furthermore, a new long-haul truck owner in 2027 will recoup the upfront cost of more efficient technologies less than 2 years through fuel savings. [EPA-HQ-OAR-2014-0827-1177-A1 p.2]

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3 <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>;  
<https://www.census.gov/prod/2011pubs/acs-15.pdf>;

4 [http://www.eia.gov/forecasts/aeo/section\\_deliveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm)

5 <http://atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf>; [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Technology-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf)

6 <http://www.epa.gov/otaq/climate/documents/420f15903.pdf>

**Organization:** Operation Free

There are economic problems with oil, too. Global supply cannot keep up with demand. The price will keep going up, hitting all of us at the pump. With this rule, vehicle owners will save an average of \$170 billion in fuel costs over the lifetime of the vehicles sold. Increasing truck efficiency saves money, which will be reflected in the price of consumer goods. Furthermore, when the price of oil spikes, the military must repurpose funds away from training, maintenance, and readiness programs to offset the cost, putting missions at risk. [EPA-HQ-OAR-2014-0827-1175 p.2] [[These comments can also be found in EPA-HQ-OAR-2014-0827-1372, p.194.]]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Fuel economy is only one factor truckers must use in making equipment decisions.

There are many factors in a tractor, engine, or trailer that a truck owner must consider when making an equipment purchase. Fuel economy is certainly one of those factors, as it is the greatest expense of the owner-operator, but other needs and requirements of the job matter. Primary among these is reliability and the equipment specifications required by the function served by different types of truck operation in our economy. For example, while lower rolling resistant (LRR) tires can be beneficial for a trucking company operating around the flat plains of Kansas, they can become a safety hazard while operating in the mountainous regions, such as the Tejon Pass in California or the Loveland Pass in Colorado. Additionally, the National Academy of Sciences (NAS) has demonstrated that the fuel efficiency will decrease for a sleeper cab tractor pulling a flatbed trailer if it is equipped with a full-height air deflector because the high roof sleeper increases the frontal area of the truck beyond what the trailer requires.<sup>4</sup> Thus, there are many equipment decisions which affect the purchase of a truck. [EPA-HQ-OAR-2014-0827-1244-A1 p.6]

**Organization:** Pew Charitable Trusts

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014.<sup>4</sup> As travel among heavy duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1334-A1 p.1]

Fuel is the single largest expense to motor carriers – accounting for nearly 40 percent of operating costs, or about \$73,000 annually for a combination trailer that gets about 6.5 miles to the gallon (mpg).<sup>6</sup> These charges are passed on to consumers through higher priced products. The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-1334-A1 p.2]

The first round of truck standards, affecting model year 2014 through 2018 vehicles, is estimated to save a total of \$50 billion in fuel costs and reduce carbon pollution by 270 million metric tons. Finalizing a strong second phase rule will generate \$230 billion dollars in net benefits to the U.S. over the lifetime of vehicles sold between 2021 and 2027.<sup>7</sup> Vehicle owners will save \$170 billion while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons under the regulatory timeframe. Furthermore, a new long-haul truck owner in 2027 will recoup the upfront cost of more efficient technologies less than 2 years through fuel savings. [EPA-HQ-OAR-2014-0827-1334-A1 p.2]

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3 <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>; <https://www.census.gov/prod/2011pubs/acs-15.pdf>;

4 <http://www.trucking.org/article.aspx?uid=70210058-bb81-44df-a565-492f899fc139>

5 [http://www.eia.gov/forecasts/aeo/section\\_deliveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm)

6 <http://atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf>; [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Technology-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf)

7 <http://www.epa.gov/otaq/climate/documents/420f15903.pdf>

**Organization:** Quasar Energy Group

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1335-A1 p.1]

Finalizing a strong second phase rule is expected to save vehicle owners \$170 billion in fuel costs while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons over the lifetime of vehicles sold under the program. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

**Organization:** Sanborn Head

Businesses and consumers across all sectors of the economy rely on trucks to move materials and products. Tractor-trailers and package delivery vans move \$10 trillion worth of freight each year and commuter buses transport 3.5 million people to work every day.<sup>3</sup> Furthermore, U.S. companies spent over \$700 billion dollars on trucking services in 2014. As travel among heavy duty vehicles grows by nearly 50 percent over the next 25 years, America will continue to rely on these trucks to support critical services needs as well as the growing economy.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1257-A1 p.1]

Fuel is the single largest expense to motor carriers — accounting for nearly 40 percent of operating costs, or about \$73,000 annually for a combination trailer that gets about 6.5 miles to the gallon (mpg).<sup>5</sup>



These charges are passed on to consumers through higher priced products. The Consumer Federation of America reports that fuel costs for goods and services delivered by medium-and heavy-duty trucks cost U.S. households an average of \$1,100 in 2010. [EPA-HQ-OAR-2014-0827-1257-A1 p.2]

The first round of truck standards, affecting model year 2014 through 2018 vehicles, is estimated to save a total of \$50 billion in fuel costs and reduce carbon pollution by 270 million metric tons. Finalizing a strong second phase rule will generate \$230 billion dollars in net benefits to the U.S. over the lifetime of vehicles sold between 2021 and 2027.<sup>6</sup> Vehicle owners will save \$170 billion while conserving 1.8 billion barrels of oil and cutting carbon pollution by nearly 1 billion metric tons under the regulatory timeframe. Furthermore, a new long-haul truck owner in 2027 will recoup the upfront cost of more efficient technologies less than 2 years through fuel savings. [EPA-HQ-OAR-2014-0827-1257-A1 p.2]

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3 <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/heavy-duty-truck-standards#.VXho5c9VhBc>;  
<https://www.census.gov/prod/2011pubs/acs-15.pdf>

4 [http://www.eia.gov/forecasts/aeo/section\\_deliveredenergy.cfm](http://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm)

5 <http://atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf>; [http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean\\_vehicles/Truck-Technology-Factsheet.pdf](http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/Truck-Technology-Factsheet.pdf)

6 <http://www.epa.gov/otaq/climate/documents/420f15903.pdf>

**Response:**

Many of the comments here are supportive comments, some of which suggest that the standards should be more stringent to ensure more fuel savings and greater environmental protection. As a specific example, CFA points to the more stringent proposed Alternative 4 as appearing to be similar to proposed program (Alternative 3) in terms of cost effectiveness, but with greater net benefits. As discussed in Section XI of the Preamble, the agencies do not believe the Alternative 4 standards to be feasible overall, and we are consequently unable to accurately estimate costs for them. CFA is correct that the agencies had other factors to consider in setting the final standards, including available technology, feasible reductions of emissions and fuel consumption, costs, lead time, safety, and other relevant factors. For the final standards, we are adopting those elements of the proposed Alternative 4 where we have determined them to be feasible in the lead time provided, resulting in a final program that is more stringent than what was proposed (as discussed in Preamble Sections II-VI). For more responses to comments that generally call for more stringent standards, see Section 8.1.1 of this RTC. Per Navistar's comment about AEO fuel prices, we note that agencies have updated to EIA's 2015 AEO price forecasts, the most recent available at the time that we conducted the analysis presented in the rulemaking documents. The agencies have routinely used the Annual Energy Outlook as a source of estimating future fuel prices since making such estimates is outside our area of expertise. We also consider the projections made in the AEO to be better data than current or recent spot prices since the projections take into consideration estimates of future economic activity. We conclude that the standards continue to have benefits that greatly exceed costs, and, as noted, fairly short payback periods. We conducted sensitivity analyses using the AEO High and Low fuel price cases (RIA Chapter 8.12) and these conclusions still stand.

## 11.4 Maintenance Expenditures

**Organization:** ABC Bus Companies, Inc.

GHG, CO<sub>2</sub>, emission technology's costs seem to be only calculated only on the new purchase cost of vehicles. Total maintenance and life cycle costs are not accounted for. [EPA-HQ-OAR-2014-0827-1430-A2 p.4]

**Response:**

We include maintenance costs for the full life of the vehicle. In the proposal, we included those lifetime costs for tires. In the final rules, we include those costs for many items. Please refer to RIA 7.2.3 for more details regarding the maintenance items included in the final rules and for the full lifetime of vehicles equipped with each technology.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Maintenance costs**

The NPRM requests comment on the estimation of maintenance costs for hybrid electric vehicles. CARB staff supports the inclusion of all maintenance costs across vehicle technologies. Maintenance costs of hybrid buses<sup>80</sup> and small fleets of hybrid delivery vans<sup>81</sup> have been estimated as part of several recent research projects. In addition, changes in electricity expenditures associated with BEVs should also be included in the estimation of fuel costs for advanced technology vehicles. In other words, the costs and savings resulting from changes in electricity consumption, not just savings based on the decreased use of liquid fuels, must be incorporated into the fuel cost savings calculation. [EPA-HQ-OAR-2014-0827-1265-A1 p.183]

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<sup>80</sup> (Callaghan and Lynch, 2005) Callaghan, L. and Lynch, S., “Analysis of electric drive technologies for transit applications: battery-electric, hybrid-electric, and fuel cells. U.S. Department of Transportation,” Final Report: FTA-MA-26-7100-05.1, 1-54.

<sup>81</sup> (Lammert, 2009) Lammert, M, “Twelve-Month evaluation of UPS diesel hybrid electric delivery vans,” NREL Technical Report: NREL/TP-540-44134, 1-38.

**Response:**

We have included many more maintenance items in the final rules than were included in the proposal. For example, we include savings associated with fewer oil changes on hybrid equipped vocational vehicles. Please refer to RIA 7.2.3 for more details.

**Organization:** Daimler Trucks North America LLC

Seventh, the agencies failed to quantify maintenance costs. Indeed the agencies state on 80 FR 40325 and 40445 that they only quantified the cost of tire maintenance. The cost of maintaining hybrid batteries and other such items dwarfs the costs of tires and likely turns the agencies’ cost-benefit analysis on its ear. [EPA-HQ-OAR-2014-0827-1164-A1 p.129]

**Response:**

The final rule analysis includes maintenance costs on batteries included in hybridized vocational vehicles. Please refer to RIA 7.2.3 for more details.

**Organization:** NAFA Fleet Management Association

Fleet managers appreciate the importance of continual improvement in emissions, but many have seen maintenance cost increases triple the rate of inflation since 2007 as a result of government emissions regulations. Many fleets have also seen increases in engine, exhaust, cooling and fuel system repair costs from 2010-2014 related to engine emissions complexity. Complexity further compromises the industry's ability to ensure technician capability is maintained, forcing fleets to maintain higher vehicle counts due to costs, complexity and capability. [NHTSA-2014-0132-0111-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.179-180.]]

NAFA urges the EPA and NHTSA to undertake a more robust sensitivity analysis with respect to maintenance and potential scenarios. The proposal and the Regulatory Impact Analysis do not go far enough in looking at potential maintenance costs. Projected fuel savings assumed by the proposed standards will not offset operational costs in every instance. Fuel costs are only one element of the cost architecture of a vehicle. Other costs include maintenance and repair, depreciation, and costs associated with doing business. [NHTSA-2014-0132-0111-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.180.]]

**Response:**

We have included far more costs associated with maintenance in the final rules than in the proposal. Please refer to RIA 7.2.3 for more details.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

**Warranty, Maintenance, and Downtime Costs**

The proposed rule will force new technologies into the market and with new technologies will come increased warranty costs, maintenance costs, and costs associated with increased downtime. The proposed rule only counts some of the increased maintenance costs associated with tires. In doing so, the agencies are greatly underestimating the overall impact of new technology. The agencies should calculate in the analysis additional warranty, maintenance and downtime costs. In an April 2014 Board Meeting, OOIDA Board Member Lewie Pugh presented to the EPA a 7-foot long printout of everything that had gone wrong with the MaxxForce engine truck that he had purchased in 2011. He said, "When the truck breaks down, the mechanics don't even know what's wrong. They don't know how to work on them. The dealership I go to is packed with trucks with emission problems."<sup>48</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.45][This comment can also be found in section 11.12 of this comment summary]

If an Alternative that forces new technologies is chosen by the agencies, the impact of increased repairs beyond traditional warranty coverage needs to be taken into account. Small business owners and fleets cannot continue to bear the cost of forced technologies and the ensuing repairs. The irony with this situation is that any increased warranty coverage would increase the purchase price of a new truck. Additionally, this will negatively impact the resale value of the truck. For example, the trucks subject to the Phase I standards, such as the MaxxForce engine which caused large amounts of downtime, will be passed along to the new consumer, without an extended warranty, many owner-

operators could be placed out of business. According to the OOIDA Foundations Member Profile Survey, 74 percent of owner-operators purchase used trucks. Any unreliable or problematic truck produced as a consequence of the Phase II standards will eventually be placed on the used market, thus adversely impacting owner-operators who purchase them several years into the future. [EPA-HQ-OAR-2014-0827-1244-A1 p.45-46][This comment can also be found in section 11.12 of this comment summary]

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48 “EPA takes notes on OOIDA concerns.”

**Response:**

In the final rules, relative to the proposal, we have included many more routine maintenance items and, as such, are estimating considerably higher maintenance costs as a result (see final RIA Chapter 7.2.3). We do not believe that the technologies expected for complying with the new standards will result in additional down time. Instead, we believe that maintenance costs at the sort of routine maintenance intervals in today’s fleets will be higher, but not necessarily more frequent (i.e., no additional down time). Further, we do not believe that breakdowns will occur at higher rates due to the new technologies being added. We understand that past criteria pollutant rules lead to technology introductions which had adverse impacts with respect to vehicle breakdowns. However, we believe that the primary culprit was lack of appropriate lead time to enable a smooth implementation of the technologies added at that time. For these new GHG and fuel consumption standards, we believe that the lead time being provided is much more favorable and, perhaps more importantly, the pace of implementation afforded by the phase-in of additional stringency levels should provide sufficient flexibility to enable a smooth implementation of new technologies. This is part of the reason we have not moved forward with Alternative 4 from the proposal which, based on our engineering judgement, carried with it higher risks of insufficient lead time and phase-in flexibility.

**Organization:** Truck Renting and Leasing Association

Indeed, to satisfy the Proposed Standards, new technologies will almost certainly have to be integrated into vehicles, especially heavy-duty equipment. The agencies have stated they expect minimal increases in maintenance costs, yet they have only estimated such costs associated with lower rolling resistance tires; this rule has the potential for higher repair and maintenance costs, vehicle downtime, high replacement vehicle costs, and dissatisfied customers. These impacts should be studied more thoroughly. Higher frequency of maintenance is a particular concern as it will tend to frustrate consumer acceptance of the new regulations while increasing costs across the board. As an example, the 2010 EPA product performance from all manufacturers has generally resulted in high, repetitive maintenance and repair expense, including significant vehicle replacement costs and likely negative impact on resale values. Anecdotally, TRALA members can document increased numbers of maintenance issues and costs on vehicles subject to Phase I of the program, with no one manufacturer being immune. [EPA-HQ-OAR-2014-0827-1140-A1 p.3]

**Response:**

We have included many more maintenance items in the final rules analysis than were included in the proposal. Please refer to RIA 7.2.3 for more details.

## **11.5 Analysis of the Rebound Effect**

### **11.5.1 General Rebound**

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

## Rebound

Also pertinent to the estimate of benefits of the proposed standards are the assumptions made about the rebound effect associated with the standards, and in particular the extent to which better fuel efficiency results in more miles traveled by the regulated vehicles. The agencies maintain the assumptions of 10% rebound for heavy-duty pickups and vans, 15% for vocational vehicles, and 5% for combination trucks using in the Phase 1 rule. Absent further evidence, the agencies' current estimates are reasonable. In particular, the 10% rebound assumption that has been used in the light-duty vehicle fuel economy rulemakings is the best starting point for heavy-duty pickups and vans. With regard to the other vehicle categories, however, it should be noted that the working paper by Energy and Environmental Research Associates that the agencies placed in the docket concludes: "The results suggest that in recent decades, fuel price elasticities for U.S. trucking VMT (combination and single-unit trucks) and fuel consumption (combination trucks) are near zero or not statistically different than zero." [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

This and other relevant work warrant further consideration for the final rule. [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

### *Recommendation: Rebound*

- Consider newly available research on the effects of improved fuel efficiency on heavy-duty vehicle driving behavior to determine whether the rebound values used in the proposal should be retained in the final rule. [EPA-HQ-OAR-2014-0827-1280-A1 p.27]

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Rebound effect**

The NPRM requests comment on the assumptions related to the rebound effect for heavy-duty vehicles. CARB staff believes further research is needed in this area. Emerging research from Winebreak et al. (2015) on fuel price elasticity in the U.S. combination trucking sector suggests fuel price inelasticity of demand for vehicles miles traveled and fuel consumption.<sup>82</sup> This result implies that existing estimates of the rebound effect in the combination trucking sector could be overstated and calls for additional analysis. CARB staff suggests that, when feasible, short-run and long-run rebound effects should be estimated separately as research suggests the response to changes in efficiency varies over time.<sup>83</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.184]

In addition, CARB staff recommends additional research on the indirect and economy-wide portions of the rebound effect. Freight system interactions, fuel surcharges, and changes in capacity may impact the direct rebound effect in the heavy-duty sector, resulting in compensating changes outside of fuel consumption.<sup>84</sup> The price elasticity of energy demand may be preferred over the use of the price elasticity of VMT in the heavy-duty sector. [EPA-HQ-OAR-2014-0827-1265-A1 p.184]

The RIA cites Guerrero (2014), which simulates the California freight network and concludes that the rebound effect could offset 40 to 50 percent of vehicle efficiency emission reductions.<sup>85</sup> CARB staff does not support the findings of Guerrero (2014) in assessing the relationship between fuel saving

technology and the management of vehicle fleets. Guerrero (2014) estimates the rebound effect of long-haul trips only, which is not representative of the entire heavy-duty vehicle fleet. The analysis fails to account for existing market failures that currently are impediments to the adoption of cost-effective fuel saving technology, resulting in potential overestimation of the rebound effect with optimal adoption of fuel saving technology. Guerrero (2014) is based on a commodity flow data and not heavy-duty vehicle activity, which is more representative of the sector and utilized in Winebreak (2015). CARB staff appreciates the use of sensitivity analysis in regards to the rebound effect and suggests additional sensitivity cases to incorporate varying discount rates, and additional estimates of indirect and economy-wide rebound, when feasible. [EPA-HQ-OAR-2014-0827-1265-A1 p.184-185]

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<sup>82</sup> (Winebreak et al., 2015) Winebreak, J. J., Green, E.H, Comer, B., Li, C., Froman, S., and Shelby,M., “Fuel price elasticities in the U.S. combination trucking sector,” Transportation Research Part D: 38,166177.

<sup>83</sup> (Dahl, 2012) Dahl, C.A., “Measuring global gasoline and diesel price and income elasticities,” Energy Policy: 41, 2-13. (De Borger and Mulalic, 2012) De Borger, B., Mulalic, I., “The determinants of fuel use in the trucking industry – volume, fleet characteristics and the rebound effect,” Transportation Policy: 24, 284-295. (Winebreak et al., 2012) Winebreak, J.J, Green, E.H., Comer, B., Froman, S., “Estimating the direct rebound effect for on-road freight transportation,” Energy Policy: 48. 252-259.

<sup>84</sup> (Winebreak et al., 2015) Winebreak, J. J., Green, E.H, Comer, B., Li, C., Froman, S., and Shelby,M., “Fuel price elasticities in the U.S. combination trucking sector,” Transportation Research Part D: 38,166177.

<sup>85</sup> (Guerrero, 2014) Guerrero, S.E., “Modeling fuel saving investments and fleet management in the trucking industry: the impact of shipment performance on GHG emissions,” Transportation Research Part E: 68, 178-196.

**Organization:** Consumer Federation of America (CFA)

Ironically, these positive economic externalities can create concerns from the energy and environmental points of view. When consumers use their savings from lower fuel costs to buy more goods and services, they are likely to indirectly increase their use of energy. However, the increase in consumption due to this dynamic, called the ‘rebound effect,’ is much smaller than the direct reduction in energy consumption, so the net effect is still to reduce overall energy consumption.<sup>27</sup> From the point of view of consumer and macroeconomic analysis, “the rebound effect” represents a positive economic result for consumers. It means that consumer welfare is increasing. How consumers use their increased disposable income is of secondary importance to the fact that they have more income to spend on other goods and services. However, if the goal is to reduce energy consumption, one must subtract the rebound effect from the benefits column. But experience shows that the rebound effect erases only a fraction of the energy savings.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.35]

## 2. Pass-through

A second theoretical explanation that played an important part in the earlier analysis and was addressed by EPA/NHTSA is the question of the pass-through of cost savings to consumers. [EPA-HQ-OAR-2014-0827-1336-A1 p.51]]

As a result of this proposed rulemaking, it is anticipated that trucking firms will experience fuel savings. Fuel savings lower the costs of transportation goods and services. In a competitive market, some of the fuel savings that initially accrue to trucking firms are likely to be passed along as lower transportation costs that, in turn, could result in lower prices for final goods and services. Some of the savings might also be retained by firms for investments or for distributions to firm owners. Again, how much accrues to customers versus firm owners will depend on the relative elasticities of supply and demand. Regardless, the savings will accrue to some segment of consumers: Either owners of trucking firms or the general public, and the effect will be increased spending by consumers in other sectors of the economy, creating jobs in a diverse set of sectors, including retail and service industries.<sup>41</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.51-52]

The pass-through issue also turns up in another key aspect of the overall analysis, the rebound effect. The increase in consumption associated with the rebound effect occurs because consumers have more money to spend. The first effect is through the reduction of the cost of travel, but there is a second effect through the increase in disposable income available for other consumption. [EPA-HQ-OAR-2014-0827-1336-A1 p.52]

Elasticities with respect to fuel price and fuel cost can provide some insight into the magnitude of the HDV VMT rebound effect.... Freight price elasticities measure the percent change in demand for freight in response to a percent change in freight prices, controlling for other variables that may influence freight demand such as GDP, the extent that goods are traded internationally, and road supply and capacity. This type of elasticity is only applicable to the HDV subcategory of freight trucks (i.e., combination tractors and vocational vehicles that transport freight). One desirable attribute of such measures for purposes of this analysis is that they show the response of freight trucking activity to changes to trucking rates, including changes that result from fuel cost savings as well as increases in HDV technology costs. Freight price elasticities, however, are imperfect proxies for the rebound effect in freight trucks for a number of reasons. For example, in order to apply these elasticities we must assume that our proposed rule's impact on fuel and vehicle costs is fully reflected in freight rates. This may not be the case if truck operators adjust their profit margins or other operational practices (e.g., loading practices, truck driver's wages) instead of freight rates. It is not well understood how trucking firms respond to different types of cost changes (e.g., changes to fuel costs versus labor costs).<sup>42</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.52]

These observations make it clear that there is a significant level of pass-through of cost savings. Given the competitiveness of the trucking industry and its importance, we believe it is substantial. EPA/NHTSA conclude that there will be pass-through, but they do not provide an estimate. Their estimate of the rebound effect is moderate – 10% – based on a variety of factors. We have discussed this earlier. Given the very large economic benefits, the magnitude of the rebound effect does not significantly affect the bottom line of the analysis. Without specifying the precise level, it is clear that pass-through is significant and has important macroeconomic benefits. [EPA-HQ-OAR-2014-0827-1336-A1 p.52-53]

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<sup>27</sup> Barker, Terry, Paul Eakins and Tim Foxon, 2007, "The Macro-economic Rebound Effect in the UK Economy," *Energy Policy*, 35; Cambridge Centre for Climate Mitigation Research, 2006, *The Macro-economic Rebound Effect and the UK Economy*, Cambridge Econometrics and Policy Studies Institute, May 15; Goldstein, David, Sierra Martines and Robin Roy, *Are there Rebound Effects from Energy Efficiency? An Empirical Analysis, Internal Consistency and Solutions*, [Electric Policy.com](http://ElectricPolicy.com).; Nadel, Steven, 2012, *The Rebound Effect: Large or Small*, American Council For An Energy Efficient

Economy, August.; Bornstein, Severin, 2013, *A Microeconomic Framework for Evaluating Energy Efficiency Rebound and Some Implications*, Energy Institute at HAAS, May.

<sup>28</sup> Cooper, *Performance Standards*.

<sup>41</sup> EPA/NHTSA, NPRM, p. 40482

<sup>42</sup> EPA/NHTSA, NPRM, p. 40450, 40451.

**Organization:** Daimler Trucks North America LLC

Lastly, we think that the agencies' estimates of the rebound effect appear reasonable. [EPA-HQ-OAR-2014-0827-1164-A1 p.130]

**Organization:** Environmental Defense Fund (EDF)

## **b. Rebound**

*New studies should be used to inform final rebound values*

The agencies have proposed to maintain the same rebound values finalized in the Phase 1 program – 5% for tractor trailers, 15% for vocational and 10% for pickups and vans – stating they had “insufficient evidence to justify revising the rebound effect values that were used in the Phase 1 analysis.” New analyses by Winebrake et. al., however, indicate that these Phase 1 values may be too high. [EPA-HQ-OAR-2014-0827-1312-A1 p.23]

A 2015 paper by Winebrake et. al. looks at fuel price elasticity estimates for single-unit truck activity (vocational trucks), as measured in VMT, and concludes they “cannot reject a null hypothesis that fuel price elasticities for single-unit truck VMT is zero.”<sup>113</sup> The authors state that the elasticities in their paper may be used as a proxy for rebound in certain cases – and, at the very least, to inform the choice of a rebound estimate for the vocational sector. [EPA-HQ-OAR-2014-0827-1312-A1 p.23-24]

Similarly, another 2015 paper by Winebrake et al. looks at fuel price elasticities of combination trucking operations in the U.S. between 1970 and 2012 and concludes that “we are in a period of time where fuel price elasticities for US combination trucking VMT and fuel consumption are near zero.”<sup>114</sup> Again, the authors argue that their results may be used as a proxy for rebound under certain circumstances but at the very least should be used to inform the rebound values chosen for tractor trailers. [EPA-HQ-OAR-2014-0827-1312-A1 p.24]

EDF asks the agencies to consider these two new studies by Winebrake et al. in finalizing rebound values for vocational vehicles and tractor-trailers and, at minimum, include sensitivities reflecting lower rebound values. [EPA-HQ-OAR-2014-0827-1312-A1 p.24]

*EDF supports inclusion of welfare benefits of rebound effect*

To the extent the Agencies retain some positive rebound value, it is important to estimate the beneficial impacts of that rebound effect. As discussed in a 2014 Resources for the Future discussion paper on “The Rebound Effect and Energy Efficiency Policy,” rebound often has a misconceived ‘evil’ connotation because policymakers tend to focus solely on energy minimization (in this case, fuel



consumption reduction) and ignore welfare maximization.<sup>115</sup> However, this does not capture the entire impact of rebound because any time a consumer changes his or her behavior (for example, by buying a more efficient truck), it means that there is some inherent welfare benefit to that consumer (relative to no change in behavior). It is therefore important that “[r]ather than consider[ing] the rebound effect as a deterrent from passing energy efficiency policies, policymakers should include these welfare gains in the tally of benefits of a policy.”<sup>116</sup> For this reason, we support the Agencies’ decision to estimate the benefits of increased travel associated with rebound driving.<sup>117</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.24]

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113 Winebrake et al., Fuel price elasticities for single unit truck operations in the United States. *Transport. Res. Part D*, (2015), available at <http://www.sciencedirect.com/science/article/pii/S1361920915000711>.

114 Winebrake, et al., Fuel price elasticities in the U.S. combination trucking sector, *Transport. Res. Part D*, (2015), available at <http://www.sciencedirect.com/science/article/pii/S1361920915000383>.

115 Gillingham, et al., The Rebound Effect and Energy Efficiency Policy, Resources for the Future Discussion Paper, 2014 RFF DP 14-39, forthcoming in the Review of Environmental Economics and Policy, (in press).

116 Id.

117 Preamble at 40474.

**Organization:** International Council on Clean Transportation (ICCT)

The agencies continue to extensively apply controversially high rebound factors in their assessment based on theoretically sound, but non-empirically validated, evidence. The latest state-of-the-art peer-reviewed research indicates that the rebound effect for combination tractor-trailers and regional delivery and service trucks in the U.S. is not statistically significantly different from zero (Winebrake et al, 2015a, b). As a result we believe that the only scientifically defensible approach to this question is to assume the rebound effect for fuel savings associated with the regulation is zero, unless or until new peer-reviewed work that is empirically based on more comprehensive and more recent U.S. data is published. We recommend that the agencies incorporate the most applicable, state-of-the-art research and assume that the rebound effect from increased fuel efficiency is zero. [EPA-HQ-OAR-2014-0827-1180-A4 p.18]

**Organization:** Mannix, Brian

### **Rebound Effect**

The RIA makes a considerable effort to characterize and quantify the “rebound effect” – the changes in fuel consumption and in other variables that result when more energy-efficient vehicles are used more intensively because the cost of using them has declined.<sup>7</sup> The agencies should be applauded for recognizing the importance of rebound effects, which other agencies have been known to ignore. Markets are elastic, in countless dimensions, and it can be very difficult to anticipate the ways in which their dynamic response to regulatory interventions may differ from the static model that may represent the regulator’s intent. There is an unfortunate tendency in the literature to coin new terms (see “leakage,” and “backfire effect,” in addition to “rebound”) to describe these market responses, as if they

were something new and surprising. The reality is that economists have known for a long time about the complexity and responsiveness of dynamic markets. Generally, unless a regulatory intervention is very carefully designed, the various price elasticities and cross-elasticities will tend to frustrate the attempts of regulators to move markets in a direction they are not willing to go, so that the forecast benefits may not fully materialize. Agencies should be encouraged to use models that fully reflect the elasticity of markets in the real world, and should be prepared to abandon regulatory strategies that, however well intentioned, do not appear to be effective under real-world conditions. [EPA-HQ-OAR-2014-0827-1222-A1 p.4]

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7 RIA, pp. 8-10 to 8-29.

**Organization:** Natural Resources Defense Council (NRDC)

### **VMT Rebound**

The agencies' assumptions for a vehicle-miles-traveled (VMT) rebound factor appear to overestimate the potential for improved efficiency to increase heavy truck mileage. The agencies assume a 5 percent VMT rebound factor for combination tractor-trailers and 15 percent for vocational vehicles. Recent analysis by Winebrake et al suggest that VMT rebound for both combination trucks and single-unit vocational vehicles could be zero.<sup>23</sup> NRDC urges the agencies to review this analysis to ensure the rule is not overestimating the VMT rebound effect. [EPA-HQ-OAR-2014-0827-1220-A1 p.10]

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23 See Winebrake J.J., Green E.H., Comer B., Li C., Froman S., Shelby M. "Fuel price elasticities in the U.S. combination trucking sector," Transportation Research Part D: Transport and Environment, Volume 38, July 01, 2015, Pages 166-177 and Winebrake J.J., Green E.H., Comer B., Li C., Froman S., Shelby M. "Fuel price elasticities for single-unit truck operations in the United States," Transportation Research Part D: Transport and Environment, Volume 38, July 01, 2015, Pages 178-187.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Again, while reducing the weight of the truck and trailer appears to work on paper, the real-world effects are often different. As part of the agencies analysis, they described in detail what is known as a "rebound effect." According to the NPRM, "The "rebound effect" has been defined a number of ways in the literature, and one common definition states that the rebound effect is the increase in demand for an energy service when the cost of the energy service is reduced due to efficiency improvements." The agencies attributed this effect to vehicle miles traveled; however, they did not consider the rebound effect for weight reduction. In the reality of a highly competitive industry, if the weight of the tractor and trailer is reduced then the shipper will simply add weight to the load being hauled, essentially making any proposed or mandated weight reduction ineffective. [EPA-HQ-OAR-2014-0827-1244-A1 p.33-34]

Today, many tractors and trailers are already specified for maximum weight savings based upon the vehicle usage. For example, it is common for an aluminum end dump trailer with aluminum wheels and wide based tires to be loaded to the max in order to take full advantage of the weight savings. It is a common occurrence for such trucks to be loaded while on a scale so that they can be loaded until the total vehicle weight reaches 80,000 lbs. It is imperative that the agencies consider the rebound effect beyond just vehicle miles traveled. [EPA-HQ-OAR-2014-0827-1244-A1 p.34]

It also worth noting that the topic of a “rebound effect” validates that the trucking industry is well aware of methods to conserve fuel, and thereby decrease GHG emissions, and will actively pursue them when it they are appropriate for their operation. [EPA-HQ-OAR-2014-0827-1244-A1 p.34]

**Organization:** Resources for the Future

The comment is based on statistical analysis of truck-level data, in which we estimate the rebound effect for tractor-trailers and vocational trucks, and the effect of economic activity on miles traveled. The estimated rebound effect is substantially larger for tractor trailers than that used by the agencies in the regulatory impact analysis (RIA), but the rebound effect for vocational trucks is similar to that used in the RIA. We find that vehicle miles traveled respond less than proportionately to economic activity. Using these estimates in the RIA would provide a stronger foundation for the analysis. This would reduce the net benefits of the rule, although probably not by a substantial amount. [EPA-HQ-OAR-2014-0827-1200-A1 p.1]

**Overview**

To estimate the benefits of the Phase 1 and proposed Phase 2 greenhouse gas and fuel efficiency standards for medium and heavy-duty trucks, the agencies have included assumptions about the rebound effect on truck miles travelled as a result of the standards. The Agencies acknowledge that there is limited data for analysis of the rebound effect, and little research exists on this issue, especially in the U.S. We are submitting a comment that summarizes the conclusions of our new paper titled “Fuel Costs, Economic Activity, and the Rebound Effect for Heavy Duty Trucks” (Resources for the Future Discussion Paper 15-43, <http://www.rff.org/files/document/file/RFF-DP-15-43.pdf>) [EPA-HQ-OAR-2014-0827-1200-A1 p.1]

We use microdata from the U.S. Census’ Vehicle Inventory and Use Survey (VIUS) to assess the magnitude of the rebound effect on vehicle miles travelled (VMT) in the trucking sector. We use individual truck level data for six waves of the VIUS survey, in which trucks in all fifty states were surveyed every five years from 1977 to 2002. The period of the survey was a time with almost no regulation of fuel economy. [EPA-HQ-OAR-2014-0827-1200-A1 p.1]

The rebound effect is important because although the standards target the rate of emissions per mile travelled, the social benefits depend on how much trucks are driven. As fuel economy improves due to the tighter standards, the cost per mile of driving will decrease and the number of miles driven will tend to increase. The resulting increase in trucking miles traveled is the rebound effect, and it partially offsets the decrease in fuel use and emissions that would occur from the fuel consumption rate alone. The greater is the expected reduction in fuel intensity from the regulation, the larger the effect on cost per mile of driving and the rebound effect. [EPA-HQ-OAR-2014-0827-1200-A1 p.1]

In the trucking sector, the rebound effect in the short run is likely to be different from the long run rebound effect. Because only new trucks are regulated, the cost of driving new trucks is relatively less costly compared to other trucks in the fleet, and fleet managers may shift miles driven from old trucks to new trucks. This type of substitution can temper the rebound effect in the short-term. This effect disappears in the long run, however, as the cost per mile will fall by the same proportion for all trucks. Our analysis, which uses individual truck level data, is able to separate each truck from its competitors allowing us to estimate both short and long run rebound effects. [EPA-HQ-OAR-2014-0827-1200-A1 p.1]

The Agencies have reviewed the available literature and have done some of their own analysis to estimate the magnitude of the rebound effect. Both the relevant studies and the Agencies' own analysis use data on truck VMT aggregated to the state or national level. The aggregate data include assumptions about how trucks in the fleet are driven. In contrast, the VIUS data provide individual truck information including VMT, state registration, miles travelled in and out of state, average miles per gallon and average cargo weight, along with detail about the type of truck, products shipped and its business affiliation. Our analysis is able to use this extensive set of controls for truck characteristics that are likely correlated with fuel economy to improve our estimates of the cost of driving on miles travelled, the key relationship being estimated. [EPA-HQ-OAR-2014-0827-1200-A1 p.2]

In our paper, to fully exploit the advantages of the microdata, we decompose total trucking miles traveled into the product of two components: miles traveled per truck, and the number of trucks operating in the market. We estimate separate equations for each of these two components. The first, miles traveled per truck is estimated as a function of the truck's fuel costs per mile, economic activity, truck, business and geographic characteristics, and a time trend. We believe fuel costs are likely to be endogenous both for reasons of reverse causality and omitted variables. When trucks are driven more miles they are likely to be driven with heavier loads, reducing fuel economy. Additionally, truck owners likely to drive long miles are more likely to purchase more fuel-efficient trucks. Therefore, we instrument cost per mile with the contemporaneous crude oil price. We use gross state product (GSP) as a proxy for economic activity. [EPA-HQ-OAR-2014-0827-1200-A1 p.2]

In the second equation we estimate the number of trucks as a function of the fuel cost per mile economic activity, truck, business and geographic characteristics, and a time trend. As in the truck-level estimation, we instrument for fuel costs per mile and use GSP to proxy for economic activity. [EPA-HQ-OAR-2014-0827-1200-A1 p.2]

### **Implications for long--run rebound effects**

The results for both VMT and truck count equations are shown in Tables 2-5 in the paper. We use the elasticities of VMT and truck counts with respect to the fuel cost variable to infer the rebound effect for changes in fuel economy standards for the two truck types, tractor-trailers and vocational vehicles. Because total truck VMT is the product of miles travelled per truck and the number of trucks operating and we have estimated the both equations in logs, the total rebound effect will be the sum of the two estimated coefficients on cost per mile. Table 6 in the paper provides a detailed summary of the inferred rebound effects with confidence intervals. We reproduce Table 6 here. We show the estimates for both the VMT elasticity and the truck count elasticity with respect to fuel cost per mile and the sum of the two. The truck count elasticities are not statistically different from zero, and therefore the cumulative estimates have relatively large standard errors. [EPA-HQ-OAR-2014-0827-1200-A1 p.2]

**The total VMT elasticity estimate for tractor trailers has a mean that is much larger than the 5% used by the Agencies in the assessment of the Phase 1 standards and the large confidence interval does not include the Agency estimate. In contrast, our estimate of the VMT elasticity for vocational vehicles is only slightly less than the Agencies' and the confidence interval includes their estimate of 15%. [EPA-HQ-OAR-2014-0827-1200-A1 p.2]**

[Table 6, 'Summary of Rebound Effect Estimates', can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1200-A1]

### **Evidence of short-run and long-run differences in rebound effects**

The elasticities presented above and the inferred rebound effects are both long-run estimates. We also estimate a short-run elasticity by allowing the miles travelled by each truck to depend not only on its own cost per mile, but on the cost per mile of its competitors in the fleet. We define competitors as other trucks in the same survey year, truck category, body type and business. Body type is an obvious category for competition: tow trucks will not compete with concrete mixers, nor will delivery vans compete with logging trucks. Business is also necessary, as it separates trucks used, for example, for construction, for-hire transportation, manufacturing, and personal transportation. We have estimated models using other competition definitions and have found them to be generally comparable to our results. [EPA-HQ-OAR-2014-0827-1200-A1 p.3]

**The results for tractor trailers suggest that the short-run impact of fuel economy standards may not lead to much of a net rebound effect, as VMT of relatively fuel efficient new trucks will substitute for VMT of relatively fuel inefficient used trucks as the standards become binding.<sup>1</sup>** In the long run, however, once existing used trucks are scrapped and new truck fuel economy is on average equal to used truck fuel economy, the impact of the standard on total gallons of gasoline consumed is measured by the sum of the log cost per mile and log average competition cost per mile, as the standards influence the cost per mile of all trucks by the same proportion, including truck and truck's competitors. For tractor trailers, the sum of these two coefficients is -0.188, which is statistically indistinguishable from our rebound effect reported in column (3) of Table 2. We do not find evidence that there is a similar short-run effect for vocational trucks. [EPA-HQ-OAR-2014-0827-1200-A1 p.3-4]

### **The effect of economic activity on miles driven**

The benefits of the fuel efficiency standards depend on the difference between outcomes for fuel consumption and emissions with the standards in place compared to business as usual (BAU) with no new standards. In forecasting the BAU and "with standards" cases for the future, an important relationship is one between economic activity and total truck miles driven. In most existing models miles traveled depend on economic activity and operating costs relative to other transportation modes. Either gross domestic product or gross output typically serves as a proxy for economic activity and demand for trucking services in these models. Lower operating costs for trucks relative to other transportation modes cause more shipping via trucks. Furthermore, an increase in economic activity typically increases demand for trucking services, such as transporting goods for retail sale. It may be reasonable to assume that shipments respond proportionately to economic activity—in fact, the analysis by EPA and NHTSA implicitly assumes a proportionate relationship—but we are not aware of direct empirical evidence supporting this assumption. In our study, we estimate the relationship between economic activity and total miles travelled. [EPA-HQ-OAR-2014-0827-1200-A1 p.4]

We use GSP to proxy for economic activity and estimate an elasticity of miles traveled per truck to GSP of 18 percent for both tractor trailers and vocational trucks. The elasticities of truck count with respect to GSP are larger than the VMT elasticities for both tractor trailers and vocational vehicles, and both are significant at 1% levels. [EPA-HQ-OAR-2014-0827-1200-A1 p.4]

The VMT and truck count elasticities with respect to GSP are summarized in the paper in Table 7, which we show below. We compute a cumulative effect by summing the VMT elasticity and the truck count elasticity. The cumulative effect for each group is economically and statistically significant, and the point estimates are both less than one. This result has important implications for estimating expected gasoline consumption and emissions reductions from the fuel efficiency standards. The benefits of the standards depend on forecasted business-as-usual (BAU) total VMT. Cumulative elasticities less than one imply that BAU total VMT will grow less rapidly than economic activity, so that expected gasoline consumption and emissions reductions stemming from fuel economy standards

will be less dramatic than a setting where VMT and truck counts grow in proportion with economic activity. Another noticeable result is that the elasticity for tractor trailers is substantially less than the elasticity for vocational vehicles. Since tractor trailers represent a large fraction of emissions from heavy duty trucks, the fact that this elasticity is relatively small implies even lower expected fuel and emissions savings as a result of the standards. [EPA-HQ-OAR-2014-0827-1200-A1 p.4]

[Table 7, 'Summary of GSP Elasticities', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1200-A1]

### **Robustness checks**

We test the sensitivity of our results to using alternative measures of economic activity, alternative measures of cost per mile, and estimating models of ton miles traveled instead of miles traveled for tractor trailers and vocational vehicles. The results are summarized in Tables 8 – 12 of the paper. [EPA-HQ-OAR-2014-0827-1200-A1 p.5]

### **Summary**

We appreciate the opportunity to submit our comment on the proposed phase 2 greenhouse gas and fuel economy rule for trucks, and hope our analysis is helpful to your review of this issue for the final rule. To summarize, we find that the estimated rebound effect is substantially larger for tractor trailers than that used by the agencies in the regulatory impact analysis (RIA), but the rebound effect for vocational trucks is similar to that used in the RIA. We find that vehicle miles traveled respond less than proportionately to economic activity. We believe that using these estimates in the RIA would provide a stronger foundation for the analysis. It appears that using these estimates would reduce the net benefits of the rule, although probably not by a substantial amount. [EPA-HQ-OAR-2014-0827-1200-A1 p.5]

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1 The substitution results for tractor trailers and vocational vehicles can be found in column 4 of Tables 2 and 4, respectively.

### **Response:**

The “rebound effect” has been defined numerous ways in the energy policy and economics literature. One common definition states that the rebound effect is the increase in demand for an energy service when the cost of the energy service is reduced due to efficiency improvements. In the proposed Phase 2 rulemaking, the Agencies focused on one widely-used metric to estimate the rebound effect associated with all types of more intensive HDV use, the increase in vehicle miles traveled (VMT) that results from improved fuel efficiency. VMT can often provide a reasonable approximation for all types of more intensive HDV use. For simplicity, we refer to this as “the VMT rebound effect” or “direct VMT rebound,” although we acknowledge that it is an approximation to the rebound effect associated with all types of more intensive HDV use.

For the proposal, the agencies used VMT rebound effect values of five percent for combination tractors, 10 percent for heavy duty pickup trucks and vans and 15 percent for vocational vehicles. The agencies acknowledged that there was a limited amount of literature on this topic and that the literature that did exist showed a wide range of HDV rebound effect estimates. At the time of the proposal, the Agencies committed to review and consider revising their VMT rebound estimates by truck class in the Final

Rule, taking into consideration all available data and analysis, including submissions from public commenters and new research on the HDV rebound effect.

Also for the proposal, EPA communicated that it had contracted with Energy and Environmental Research Associates (EERA), to analyze the HDV VMT rebound effect for regulatory assessment purposes. Excerpts of EERA's initial Report to EPA are included in the docket that contain detailed qualitative discussions of the rebound effect as well as data sources that could be used in quantitative analysis. EERA also conducted a follow-on quantitative analyses focused on estimating the impact of fuel prices on HDV VMT and fuel consumption. EPA included a Working Paper in the docket on this effort, and sought comment on this work. EPA also noted in the proposal that EERA's Working Paper had not been available at the time the agencies conducted the analysis of the HDV rebound effect, but the Agencies would consider this work, as well as any other analytical work, to support the Final Rule.

A number of commenters are open to the idea that the Agencies consider newly available research on the effects of improved fuel efficiency on HDV driving behavior to determine whether the VMT rebound values used in the proposal should be retained in the Final Rule. Several environmental NGOs (NRDC, EDF, ACEEE) suggested that the Agencies factor the Winebrake et al. work into the HDV direct rebound estimates used in the final rule. The Winebrake study found no responsiveness of truck travel to diesel fuel prices, suggesting that VMT rebound for vocational trucks and combination trucks could be essentially zero. One industry commenter (Diamler Trucks North America) suggested that Agencies rebound numbers used in the proposal "appear reasonable." One environmental NGO (ICCT) suggested the HDV rebound estimates used in the proposed HDV Rule are overestimates, and suggested using the Winebrake et al. estimates instead.

Resources for the Future (RFF) submitted a comment that summarizes the conclusions of a new RFF Working Paper entitled "Fuel Costs, Economic Activity, and the Rebound Effect for Heavy Duty Trucks" by Leard et al. Leard et al. use microdata from the U.S. Census' Vehicle Inventory and Use Survey (VIUS) to assess the magnitude of the rebound effect on VMT in the trucking sector. The individual truck use data is for six waves of the VIUS survey, in which trucks in all fifty states were surveyed every five years from 1977 to 2002. Instead of using aggregate data, the VIUS data provides individual truck information including VMT, state registration, miles travelled in and out of state, average miles per gallon and average cargo weight, along with detail about the type of truck, products shipped and its business affiliation.

The Leard et al. paper concludes that the total VMT rebound estimate for combination trucks is larger than the five percent used by the Agencies in the proposed standards and also has a larger confidence interval that does not include the Agencies' estimate. When considering the VMT response to lower fuel costs for combination trucks, Leard et al. estimates an 18.5 percent rebound effect. When considering the increase in the number of combination trucks in response to lower travel costs, the Leard et al. estimates a total rebound effect of 29.7 percent. The Leard et al. estimate of the VMT rebound for vocational vehicles is smaller than the Agencies' value used in the Phase 2 proposal and the confidence interval includes their estimate of 15 percent. When considering the VMT response to lower fuel costs for vocational trucks, Leard et al. estimate a 12.2 percent rebound effect. When considering the increase in the number of vocational trucks in response to lower travel costs, the Leard et al. estimates a total rebound effect of 9.3 percent. While the study uses a rich data base and does not appear to have any obvious methodological flaws, the Agencies are concerned that the rebound effects reported by Leard et al. are based upon an older time period, 1977 to 2002, and that truck travel patterns and infrastructure conditions (e.g., congestion on highways) may be quite different that the time period for

which the Phase 2 program is being implemented. We also note that the Leard et al. paper is a Working Paper, and in revising the HD VMT rebound estimates for the final program, the agencies found it more appropriate to give greater consideration to the findings of Winebrake et al. because it is peer-reviewed and published; see discussions in Section IX.E. of the Preamble and in RIA Chapter 8.3.

In the Phase 2 proposal, the agencies cited a study by Guerrero (2014), which simulated the California freight network and concluded that the HDV rebound effect could offset 40 to 50 percent of vehicle efficiency emission reductions. CARB Staff reviewed the Guerrero study and does not support its findings. CARB Staff pointed out that the Guerrero estimates are for long-haul trips only, which is not representative of the entire heavy-duty vehicle fleet. In addition, the CARB Staff points out that the Guerrero study is based on a commodity flow data and not heavy-duty vehicle activity and travel. We are in general agreement with CARB Staff on their assessment of the Guerrero study.

One commenter (Owner-Operator Independent Drivers Association) suggested that the agencies should factor in changes in freight tonnage into the rebound effect as a result of this rulemaking. The commenter suggests that if the weight of combination trucks is reduced as a result of the Rule that the shipper could add weight to the load being hauled. We interpret this comment as suggesting that weight reduction could play a role as a mechanism that actually lowers VMT because more cargo is going on the vehicle, thus saving trips. We are in general agreement with this observation, but we did not include this information to lower our VMT rebound estimates since it is hard to quantify. We hope to consider this topic in future VMT rebound work.

Consumer Federation of America (CFA) pointed out that consumers may use their savings from lower fuel costs as a result of the direct rebound effect to buy more goods and services, which indirectly increases the use of energy. In the energy policy and economics literature, this effect has been labeled the so called “indirect rebound” effect. CFA states that the indirect rebound effect represents a positive economic result for consumers, since consumer welfare increases. However, if the goal of a Rulemaking is to reduce energy consumption, one must subtract the rebound effect from the benefits of the Rule. In a similar comment, EDF referred to an 2014 Resources for the Future discussion paper on “The Rebound Effect and Energy Efficiency Policy,” that states that “[r]ather than consider[ing] the rebound effect as a deterrent from passing energy efficiency policies, policymakers should include these welfare gains in the tally of benefits of a policy.” We agree with these commenters in their assessment of some of the trade-offs that need to be considered when assessing rebound effects.

Plant Oil Powered Diesel Fuel Systems (comment below) asserts that Agencies failed to take into account any indirect rebound effect of overall embedded energy expended to produce new goods entering the marketplace as a result of improved fuel efficiency and the resulting lowered cost of truck transport. The Commenter believes that the estimates of fuel savings and greenhouse gas emissions reductions are lower than what the Agencies estimated for this Final Rulemaking. An addition commenter (CARB Staff) recommended additional research on the indirect and economy-wide portions of the HDV rebound effect. One private citizen suggested that the Agencies should use models that fully reflect the responsiveness of markets in the real world. The Agencies believe that there are no available, credible studies of indirect and economy-wide rebound effects for HDVs that could be used in this Rulemaking. We agree that more work in the area of indirect and economy-wide HDV rebound effects, as well as direct VMT rebound effects, is needed.

### **11.5.2 Response to POP Diesel**



**Organization:** Plant Oil Powered Diesel Fuel Systems

2. The GHG Standards are inconsistent with law for the additional reason that two agencies fail to take into account any indirect rebound effect of overall embedded energy expended to produce new goods entering the marketplace as a result of improved fuel efficiency and the resulting lowered cost of truck transport. [EPA-HQ-OAR-2014-0827-1125-A1 p.4]

## **2. The Failure of the Two Agencies to Consider Indirect Rebound Effects Arising from the Fuel Efficiency Standards Renders the GHG Standards Inconsistent with Law Due to Their Failure to Reduce Overall Energy Consumed and Resulting GHG Emissions**

Energy economist Harry D. Saunders, Ph.D., submits the new declaration that is Exhibit 10 [exhibit 10 can be found on p.58 of docket number EPA-HQ-OAR-2014-0827-1125-A1] explaining in logical detail that the proposed Truck Rule 2 acknowledges the rebound effect that improved fuel efficiency will directly cause increased vehicle miles traveled (VMT's) and, therefore, increased energy expended and greenhouse gases emitted in rebound, but that this Rule fails to consider and quantify the indirect implications of this direct rebound effect. Generally speaking, the indirect rebound effect is the additional energy expended, and greenhouse gases emitted, to produce additional goods that will be put onto the market as a result of the lower vehicle operating costs occasioned by improved fuel efficiency. Dr. Saunders calls this the 'embedded energy' rebound effect. [EPA-HQ-OAR-2014-0827-1125-A1 p.11]

In an addendum appearing after paragraph 58 of his original declaration from 2012, a corrected copy of which is attached to his new declaration at Exhibit 10, he conducted a careful analysis of the 'embedded energy' indirect rebound effect, based on the two agencies' own assumptions about the magnitude of the direct rebound effect and relying on U.S. government databases. In conclusion, he quantified it as being between 117% and 1,408%. In other words, due to the 'embedded energy' indirect rebound effect alone, the Truck Rule will cause between 17% and 13 times more overall energy to be consumed, and presumably resulting GHG's emitted, than if the fuel efficiency standards did not come into effect at all. [EPA-HQ-OAR-2014-0827-1125-A1 p.11-12]

As Dr. Saunders points out in paragraph 11 of his new declaration, the two agencies state at Federal Register Volume 80, page 40450 that improved fuel efficiency may increase truck capacity and loaded weight. Increased vehicle miles traveled are not the same as increased capacity and loaded weight; the latter are in addition to the former. Thereby, the two agencies acknowledge the existence of this indirect rebound, since it would be additional goods entering commerce that would create the demand for and supply this added capacity and weight. The two agencies, while acknowledging increased capacity and loaded weight which mean additional goods entering commerce, fail altogether to account for this indirect rebound effect in their own, quantified estimates. [EPA-HQ-OAR-2014-0827-1125-A1 p.12]

In paragraph 5 of his new declaration, Dr. Saunders responds to a footnote in the Preamble to the proposed Truck Rule 2 questioning the credibility of his analysis. Since he has published 12 peer-reviewed articles on the subject of the rebound effect, Dr. Saunders is in a position to state that his conclusions regarding the two agencies' ignoring of the indirect, 'embedded energy' rebound effect and therefore, their vast underestimating of the total rebound effect caused by the truck fuel efficiency standards do not require peer review. He is simply applying the same conceptual approach that he applied with approval in some of his peer-reviewed articles, but to a new context: truck engine efficiency and resulting energy consumed across the economy. The consideration of overall energy consumed, like lower greenhouse gases in the atmosphere (and not simply GHG's emitting from the tailpipe) is the ostensible target of the Truck Rule 2. The logic of his analysis is unimpeachable. The

data that Dr. Saunders runs through his accepted analytical method, as he also points out in paragraph 5, is U.S. government data that is beyond reproach. Dr. Saunders's new declaration, as well as his original one and its precise quantifying of the 'embedded energy' rebound effect, merit the two agencies' careful review for the inconsistency it demonstrates in their compliance with statutory purposes. [EPA-HQ-OAR-2014-0827-1125-A1 p.12]

## Response

We received comments from POP Diesel which argued that EPA should account for the energy and GHG emissions impact associated with the so-called “indirect” rebound effect (distinct from the “direct” rebound effect). These effects could arise from the decline in fuel costs as a result of the rule, which could make goods and services transported by the U.S. trucking industry less expensive. In turn, less expensive goods and services could result in increased consumption of goods and service in the overall economy. Producing extra goods and services requires that more energy be used. This extra energy use can be thought of as “embedded” in the extra goods and services. Hence the term used in the POP Diesel comment for this type of indirect rebound effect is the “embedded energy” rebound effect.

To support this claim, POP Diesel relies on two affidavits written by Dr. Harry Saunders, in which Dr. Saunders argues that the proposed rulemaking would result in significant indirect rebound and that EPA has not appropriately considered this impact. One of the affidavits is identical to an affidavit submitted to EPA by POP Diesel as part of a 2012 petition to reconsider the Phase I GHG emissions standards and fuel economy standards for medium- and heavy-duty engines and vehicles. EPA responded to this affidavit in our denial of POP Diesel’s petition.<sup>209</sup>

The second affidavit, which is unique to POP Diesel’s comments on this rulemaking, does not present any new data or evidence, but rather presents new analysis of the same (purported) evidence presented in the 2012 affidavit, as well as additional reasons why EPA should accept the conclusions of the 2012 affidavit, the result being that estimates of the indirect rebound effect should be included in the rule’s effect in our economic analysis. The underlying evidentiary and analytical support for Dr. Saunders’ conclusions remain the same as those set forth in the 2012 affidavit. We note further that although EPA voiced many of these same concerns and critiques in denying the reconsideration petition, the new comment addresses none of EPA’s responses. For this reason, our un rebutted concerns with this analysis remain the same as those published in our denial of POP Diesel’s 2012 petition for reconsideration.

In his 2012 affidavit, Dr. Saunders cited only one published study quantifying indirect rebound effects (Druckman et al., 2011). Saunders affidavit para. 16. Although this UK-based study could offer insights into how to estimate indirect rebound effects in some contexts, the method appears inappropriate here for many reasons. First, the U.S. economy, transport system, and consumer behavior is likely to differ from other countries’ (e.g., Americans have different product and service preferences and our products and services have different levels of embedded energy). Similar data and models may not exist to replicate the UK study in a U.S.-context. Second, the study is generally designed to examine consumer behavioral strategies (e.g., lowering thermostats, reducing food waste, and biking instead of using a car) rather than firms’ behavior associated with improving technology. Among other things, the study does not consider business capital expenditures associated with energy savings that could dampen any increase in consumption of additional goods and services (e.g., our rule increases the cost of new vehicles, which offsets the fuel cost savings that trucking firms may pass along to shippers,

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<sup>209</sup> 77 FR 51701-5.

which in turn, would dampen any decrease in product prices that shippers pass along to consumers). Third, the study does not consider the potential for economic restructuring in response to decreased energy consumption (i.e., it does not consider “general equilibrium” effects), which could lead to either lower or higher energy consumption as a result of our rule. Fourth, the authors recognize that there is a major limitation of the study: they have only a very small number of expenditure categories in their model and there is considerable disparity in GHG intensities of commodities within each category (p. 3578). Fifth, the study does not directly explore the market mechanism through which our rule could influence the amount of goods and services consumed since it focuses on energy efficiency improvements that more directly increase consumers’ disposable income rather than on the more complex and indirect pathway where greater heavy duty vehicle fuel efficiency may result in lower-priced goods and services. Finally, the authors do not attempt to quantify the additional benefits to consumers associated with increased consumption of goods and services, which would be important to consider if we were assessing the overall costs and benefits associated with potential indirect rebound effects from our rule.

At the time of our response to POP Diesel’s 2012 petition for consideration, EPA was not aware of any data to indicate that the magnitude of indirect rebound effects, if any, would be significant for this rule. Since the finalization of the Phase I rulemaking, EPA has considered this issue further, but we are aware of no new peer reviewed studies or other research that would alter our assessment of the current state of knowledge about indirect rebound as it relates to fuel economy. Research on indirect rebound effects remains nascent. The magnitude of effects from our rule postulated in the Saunders affidavit still has little support in the literature, still reflects no expert peer review, and in the end remains speculative. It appears highly improbable that all of the GHG emissions benefits of this rule would be negated by putative indirect rebound effects, and the state of the literature on indirect rebound does not provide EPA with a sufficient basis to decide (or think) otherwise.

There remain substantial unanswered questions that the literature on indirect rebound must study further before EPA can consider including such estimates in our economic analysis. As discussed in this proposed rule, all of the fuel costs savings will not necessarily be passed through to the consumer in terms of cheaper goods and services. First, there may be market barriers that impede trucking companies from passing along the fuel cost savings from the rule in the form of lower rates. Second, there are upfront vehicle costs (and potentially transaction or transition costs associated with the adoption of new technologies) that would partially offset some of the fuel cost savings from our rule, thereby limiting the magnitude of the impact on prices of final goods and services. In turn, it is not clear how the fuel savings would be spent and the consequences of the spending on greenhouse gas emissions.

EPA raised these same questions in response to POP Diesel’s 2012 petition for reconsideration. However, the new Saunders affidavit does not consider these questions, but rather argues that it must be the case that increased fuel economy will make the cost of freight transportation service cheaper, and will result in further demand for goods. But the affidavit provides no studies of historical data, of decision-making in the trucking sector, nor any other evidence to support this claim. In the case of the direct rebound effect, the Winebrake et al. papers discussed in detail in the Preamble of this final rulemaking suggest that the effect may not be significantly different from zero. It is therefore feasible that the indirect rebound effect might also not be significantly different from zero. Until the literature on indirect rebound studies these questions more thoroughly, any estimates of the existence and magnitude of an indirect rebound effect remain speculative. At this point in the development of that body of literature, it would be unreasonable for EPA to include any estimate of the indirect rebound effect in our economic analysis.

## 11.6 Impact on Class Shifting, Fleet Turnover, and Sales

### 11.6.1 Impact on Class Shifting & Other Concerns

**Organization:** American Trucking Associations (ATA)

#### **Manufacturers Should not Limit Vehicle Purchasing Options**

OEM's will comply with the rule by selling more efficient engines, tractors, and trailers. Shortfalls in meeting their targets can be supplemented with either early introduction or over-compliance credits. The trucking industry is very diverse and vehicles and trailers are traditionally ordered with equipment tailored for specific applications. As under Phase 1, ATA and its member fleets remain concerned that certain equipment the industry has relied upon by the industry may no longer be manufactured and offered for sale due to their lower overall efficiency numbers. If such a scenario does in fact play out, fleets may be forced to purchase equipment that is, in fact, less efficient since the equipment is no longer properly paired with its specific work application. [EPA-HQ-OAR-2014-0827-1243-A1 p.21]

This scenario is a real concern for the trucking industry. Fleets want to be assured that the vehicles they purchase are best-suited for their needs. Trucking customers are so specific with their truck orders that they would rather wait to get the exact truck they need than take what is available. In a worst-case scenario, a fleet may explore the newer, used truck market or extend their normal trade-in cycles. This situation has occurred recently with the elimination of cab-over tractors. Companies that were employing these tractors, in many cases to comply with vehicle length limitations, have been forced to extend the life of their existing tractors and forego vehicles with advanced emissions controls, or reconfigure to shorter trailers, resulting in more truck trips. Technologies that add additional weight to a truck and/or increase a company's capital costs without optimizing fuel consumption and GHG reductions will reduce the potential benefits of the rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.21]

**Organization:** Diesel Technology Forum

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows:[EPA-HQ-OAR-2014-0827-1171-A2 p.5]

- **That this rule is compatible with the needs and complexities of the diverse marketplace:** Commercial trucks encompass a wide range of types, shape and sizes with primary and secondary manufacturers of commercial vehicles, along with many vehicles customized to meet the needs of a broad range of specific work tasks. Efforts to impose fuel economy standards should not affect vehicle choice or such efforts could have unintended consequences of causing shifts in the marketplace to less productive and more vehicles on the road. [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

#### **Response**

The Phase 2 standards are performance-based, meaning that the industry will have a significant range of technology choices to be considered for compliance. It is important to emphasize here that the agencies are not mandating the use of a specific technology to meet the Phase 2 standards, rather manufacturers would be able to choose the technologies, or combinations of technologies, that are best for them in achieving the standards. The agencies do not believe the new regulation would limit or prohibit any specific product, such as cab over tractors. However, manufactures might choose not to produce less energy efficient tractors in order to meet the new standards (for example, the cab over tractor is

aerodynamically worse than the regular tractor). On the other hand, manufacturers might choose to produce this kind of tractors by using the flexibility program (such as credit trading) built in the new standards because of special market demand (we note that cab over tractor has been phased out in recent years even before the HD Phase 1 rule because of market competition (worse in aerodynamics, less fuel efficiency, and higher operation cost)). Even vehicles with lower fuel consumption should be marketable to consumers, because they will have lower operating costs. For most trucking companies, fuel costs are the highest business cost, outside of driver labor. Indeed, if consumers consider even a few years' worth of fuel savings in deciding what vehicles they will buy, the vehicles with increased fuel economy may be more attractive to them than vehicles with lower fuel economy. As a result, the agencies believe that few, if any, companies will extend the lives of older vehicles instead of buying new ones.

The rule has associated costs, as calculated in the RIA Chapter 8, and summarized in Section IX.D of the Preamble to the final rule, but the fuel savings greatly exceed those expenses. The net benefits calculation indicate that average buyer will experience net benefits, as shown in Section IX.D of the Preamble to the final rule. These benefits are in addition to the benefits that motivate the rule, reduced GHG emissions and improved energy security. To the extent that the comments imply that different assumptions about a specific technology would reduce the benefits of the program, we refer the reader to our extensive technology and cost discussions presented in Chapters 2 and 7 of the RIA and discussed throughout Sections II-VI and Section IX of the Preamble. Similar to our response to Section 11.1.2 above, changes in assumptions for any one technology would not change the overall conclusions of the cost benefit-analysis; i.e., that the benefits of the program far outweigh the costs. However, as shown in this RTC document, where commenters have provided data to support changes in technology assumptions, including cost, we have considered those data in setting our final standards and in our final cost-benefit analysis.

**Organization:** National Automobile Dealers Association (NADA)

The Phase 2 rule must not put dealerships in the position of having to take the delivery of vehicles they may be forced to sell at a loss. Prospective truck customers have very specific needs and will wait to get the exact truck to meet them rather than purchase a less suitable one from stock. Experience with the 2004, 2007, and 2010 truck emissions standards and with the "great recession" left dealerships with unpopular trucks and tractors sitting on lots for months and even years, all the while incurring expensive floorplan interest costs while becoming less desirable. If and when floorplan curtailments of ten percent or more are incurred on vehicles costing upwards of \$150,000, it can put a small truck dealership out of business. [EPA-HQ-OAR-2014-0827-1309-A1 p.4]

At the beginning of a model year, truck OEMs tend to follow an annual plan, in part based on regulatory mandates. First they establish pricing and production schedules for "work ready" trucks. Dealers and some larger customers buy trucks; with customers putting them to work and dealers offering them for sale. As the year progresses, OEMs make changes to their production mix to adjust for compliance with their fuel efficiency and GHG targets. As a practical matter, the only way to "mix shift" is to sell more of something and less of something else. OEMs typically accomplish this by offering financial and other concessions on the vehicles they must sell, so that they become attractive enough to dealerships and prospective customers who otherwise would not order them. [EPA-HQ-OAR-2014-0827-1309-A1 p.4-5]

This complex scenario is made even more complex by the fact that newly ordered and delivered units may have a concession (or concessions) that similar trucks already in dealer stock don't, as OEMs sometimes fail to re-invoice dealers for stock vehicles at the new concession level. Consequently,

inventory becomes older and more difficult to sell and the rule's public policy goals also take a hit. [EPA-HQ-OAR-2014-0827-1309-A1 p.5]

**Organization:** United Parcel Service (UPS)

UPS believes that there is also a danger that premature deployment of technology will actually hurt the environment, especially the carbon footprint of trucking in America. It is important that we get this rule right from the start. The use of immature technologies will also eat up the limited engineering expertise of engine and truck manufacturers. [EPA-HQ-OAR-2014-0827-1262-A1 p.2]

The prime example from the past of such premature deployment is the emissions control after-treatment technology present on diesel trucks today, both medium and heavy. Its cost, difficulty in service and in maintenance, and lack of customization all have discouraged the use of diesel engines and shifted trucking toward the spark-ignited, Otto cycle engine. The latter, is substantially less thermodynamically efficient than the compression ignition engine. The dual-fuel diesel/LNG class 8 tractor that UPS has run in service since 2002, has disappeared from the market, replaced with a spark-ignited LNG engine that is significantly less efficient than its predecessor. This translates directly into enhanced carbon emissions, as compared to a compression engine. We believe a large part of this shift to the spark ignition engine was due to the unavailability of diesel emission after-treatment systems that are tailored to that dual-fuel application. We see the consequences in our fleet's fuel consumption and carbon emissions. [EPA-HQ-OAR-2014-0827-1262-A1 p.2-3]

The situation with medium delivery trucks is even worse. One need only look at the number of such trucks that have shifted away from diesel, to gasoline. Since 2009, UPS alone has shifted 25,000 of its class 6 trucks to gasoline instead of diesel. The maintenance requirements of these emission control systems forced truck owners to operate outside their normal duty cycle for no reason other than to meet the needs of the emissions control system. The added cost and maintenance nightmares have led truck owners to shift to gasoline engines and the low gasoline prices today only aggravate this shift. We believe that the attendant loss in engine efficiency and increase in carbon emissions is equal to or beyond anything the Phase II rule hopes to achieve in carbon reductions. [EPA-HQ-OAR-2014-0827-1262-A1 p.3]

This phenomenon is completely unaddressed by the proposed rule, and indeed what the rule might achieve would only add to the environmental benefits of a shift back to efficient diesel engines. UPS has raised this issue to DOE and our suppliers. In short, we need a better mousetrap to clean diesel emissions more cheaply and conveniently. Our fear is that the engineering talent needed for such an improvement in emissions after-treatment will instead chase the next premature technology, very likely the exhaust heat recovery system that is not commercially available today. Again, as best we can tell, the proposed rule does not attempt to address the problem we describe, and indeed it could not until improved emissions control technology is ready. [EPA-HQ-OAR-2014-0827-1262-A1 p.3]

**Response:**

The agencies disagree with commenters that the new standards will have the same effect as the commenter states for the 2004, 2007, and 2010 standards. Those standards imposed costs without providing financial returns in the form of fuel savings. For the new standards, the fuel savings reduce the net costs of the standards. Moreover, with respect to the delivery vehicles of concern to UPS, the vocational vehicle standards are subcategorized to reflect appropriate duty cycles (there are no comparable subcategories in the 2004, 2007, and 2010 criteria pollutant standard rules), these vehicles can be certified to any of the subcategories (urban/regional/multi-purpose) which the OEM believes best fits in-use driving patterns.

**Organization:** Transfer Flow, Inc.

Necessity is the mother of invention, and as such the idea that regulation drives technological innovation rather than industry meeting demands through application of technology is not only backward, but such an ideological approach lacks the foresight to understand that human nature will find ways to meet needs while remaining compliant when technology fails. Currently, vehicle and equipment manufacturers have been unable to meet all regulatory constraints through the application of technology. By attempting to drive technological innovation through regulatory decree instead of allowing industry to address customer needs through application of current technologies, we find ourselves in the current situation where people have found creative ways to operate within regulatory constraints without purchasing newer lower emission vehicles and equipment. [EPA-HQ-OAR-2014-0827-1922-A1 p.1]

One example of technological failures that have led to creative solutions are exhaust treatment technologies imposed on heavy duty diesel vehicles which have caused reliability to come into question. In addition to reliability issues, the time needed for regeneration cycles that often do not fit well into the operator's schedule lead to frustration and often the regeneration is not allowed to occur when necessary to maintain vehicle performance. We then find ourselves in a situation where a new efficient vehicle is now consuming more fuel per mile than the older inefficient counterpart vehicle because new operational parameters are not followed. If vehicle demands are continued to be ignored and the vehicle is operated further, component failure can result that can result in dire unintended consequences. This was demonstrated as reported by Diesel Net by the September 7th 2011 fire in Washington State where a Cleaire Long Mile filter that was potentially overladen with soot experienced an uncontrolled regeneration resulting in a fire that destroyed over 100 structures including 29 homes. [EPA-HQ-OAR-2014-0827-1922-A1 p.1]

As a result of incidents such as the Cleaire fire, older vehicles which allegedly pollute more due to lack of technologies imposed on newer vehicles have become more desirable in the marketplace. Vehicle and equipment owners now find themselves in the predicament of either having to service an aging fleet or purchase new vehicles that have technology implemented on them that is not reliable and causes complications in their business practices as well as potentially ruinous malfunctions. This has been demonstrated by the downturn in new heavy duty vehicle sales. The regulatory implementation of technology has had the unintended consequence of forcing owners to keep vehicles in service that would have been previously retired. [EPA-HQ-OAR-2014-0827-1922-A1 p.1]

Another way owners are able to meet customer demands while maintaining fleet compliance is through segmentation by purchasing multiple lighter class vehicles or equipment with smaller currently unregulated engines to perform the same function as one heavier class vehicle did previously. Multiple lighter class vehicles or smaller engines consume more fuel to accomplish the same function than one larger engine that previously performed the same task. When viewed from a cradle to grave model the use of multiple smaller pieces of equipment or vehicles to accomplish the same task that was previously accomplished with one vehicle or piece of equipment has exponential ramifications. In this case there are now multiple engines, tires, drivetrains or pieces of equipment to service and maintain in order to perform the same function as was previously performed by one engine, drivetrain and piece of equipment. Highway maintenance, traffic congestion, engine emissions, equipment maintenance and operational costs all increase when this type of problem solving is employed. However, given the current regulatory situation, business owners have no choice but to employ the most cost sensitive solution even though it is more complicated and less desirable. [EPA-HQ-OAR-2014-0827-1922-A1 p.2]

Vehicle manufacturers are able to meet fleet averages by producing light duty vehicles that are now rated to higher payloads using smaller more efficient engines than their predecessors. These vehicles are typically not employed in a vocational work capacity but account for a large percentage of vehicles sold. These lighter vehicles appear to have the same capabilities of older medium duty vehicles. New, heavier, medium duty vehicles that are used in a vocational work capacity largely have gone unchanged in engine options and fuel efficiency. The largest gasoline engines are still offered in these vehicles with the same efficiencies and emission systems that they have had for several years. There have been particulate filters implemented on medium duty diesel vehicles that have caused lower fuel efficiencies and share all the same frustrations and complications that are present on heavy duty diesel vehicles with the same types of devices. [EPA-HQ-OAR-2014-0827-1922-A1 p.2]

Since there are now more vehicles rated to a higher payload that account for a large percentage of vehicle sales, it would appear that there are more fuel efficient medium duty vehicles being purchased into the work force. However, if vehicle sales are broken down by application, we see that newer light duty vehicles, with a higher payload capacity than their predecessors, which appear as medium duty vehicles, are still not largely purchased for vocational work applications. Vehicle manufacturers can now state that they are selling more fuel efficient vehicles into a higher weight class; however those vehicles are largely still employed as they have always been in a non-vocational capacity. For all the attempt to reduce emissions from vehicles that travel the most miles and account for the largest percentage of emissions generated by requiring manufacturers to offer more fuel efficient vehicles, not much has been accomplished other than some creative labeling of vehicles. [EPA-HQ-OAR-2014-0827-1922-A1 p.2]

Once again we see that regulatory overreach has had the opposite effect of its initial intention. If the true intention of the regulation was to drive economic stimulation of the tax base through restructuring business practices, then this is a job well done. Companies have gone from purchasing one large piece of equipment to multiple purchases of smaller pieces of equipment that surpass the cost of the larger purchase and then require higher maintenance cost. Instead of a regulatory approach of a problem looking for a place to happen, perhaps a realistic approach of true problem solving could accomplish the emissions reduction goal. [EPA-HQ-OAR-2014-0827-1922-A1 p.2-3]

**Response:**

In its comment, Transfer Flow questions the agencies' justification for the standards, and also raises concerns regarding the agencies' proposed standards. Transfer Flow claims the proposed standards would have unintended consequence of forcing owners to keep vehicles in service that would have been previously retired because of concerns regarding the technological reliability of the exhaust treatment imposed on HD trucks. If those technologies are not reliable, older vehicles have become more desirable in the marketplace. In addition, Transfer Flow claims that new standards might change the truck owner's choice in purchasing the vehicle. The fleet owner might choose multiple lighter class vehicles or equipment with smaller currently unregulated engines to perform the same function as one heavier class vehicle did previously in the vocational vehicle category.

We agree with Transfer Flow that market forces induce innovation, but we disagree with the claim that regulations do not. Preamble Section IX.A. and RIA Chapter 8.2 discuss some potential explanations for private markets not investing in new technologies that can provide private net benefits. For instance, as discussed there, regulations may help to overcome "network externality" problems associated with new technologies: e.g., in the absence of regulation, repair facilities may not stock low-rolling-resistance tires unless large numbers of vehicles use them, but people may not install them if replacements aren't available in repair facilities. Also as discussed there, there may be first-mover disadvantages to investing in new technologies because of the up-front costs; standards can level the playing field by



spreading the risk across all market participants, rather than concentrating it on a small number of participants. Regulations can help to overcome these problems by providing incentives for market participants to overcome these barriers. We also disagree that “vehicle and equipment manufacturers have been unable to meet all regulatory constraints through the application of technology.” In fact, all HD vehicles being sold now are required to meet regulatory constraints

We do not envision that new standards would have unintended consequences as described by Transfer Flow, where operators would keep HD trucks in the service longer because they perceive the new technology to be unreliable. The new standards will not impose a specific technology for manufacturers to meet the standards but will allow manufacturers to optimize technology packages to meet the new standards. Market and consumers will recognize or determine if one specific exhaust treatment is more reliable, cost effective, and fit their need. The agencies understand the potential impact that fleets delaying purchases could have on the program’s environmental and fuel savings goals, and have taken steps in the design of the program to avoid such disruption. These steps include the following:

- Providing considerable lead time
- Adopting standards that will result in significantly lower operating costs for vehicle owners (unlike the 2007 standard, which increased operating costs)
- Phasing in the standards
- Structuring the program so the industry will have a significant range of technology choices to be considered for compliance, rather than the one or two new technologies the OEMs pursued to comply with EPA’s 2007 criteria pollutant standard
- Allowing manufacturers to use emissions averaging, banking and trading to phase in the technology even further

We do not envision that the regulatory program would cause fleet owners to purchase multiple lighter class vehicles or equipment with smaller currently unregulated engines to perform the same function as one heavier class vehicle did previously. As described at Preamble Section IX. F, we do not envision the new standards would cause the class shifting within the vocational vehicle weight class or within the duty cycles (particularly given that manufacturers can choose essentially without constraint whether to certify as regional, urban, or multi-purpose). Specifically with respect to the commenters concerns about a shift to lower weight vehicles in an effort to circumvent more stringent standards, we note that the Phase 2 vocational vehicle standards are *more stringent* for lower weight classes than for the higher weight class standards. We have designed standards to avoid incentivizing the purchase of truck sizes that have not been optimized for their intended applications. As vocational vehicles include a wide variety of vehicle types, and serve a wide range of functions, the diversity in the vocational vehicle segment can be primarily attributed to the variety of customer needs for specialized vehicle bodies and added equipment, rather than to the chassis. The new standards would lead a small increase in the incremental cost per vehicle. However, these cost increases are consistent across the board for both vocational vehicles and the engines used in the vehicle as shown in Table V-30, Preamble Section V.C.3. The agencies believe that the utility gained from the additional technology packages would outweigh the additional cost for vocational vehicles.

### **11.6.2 Impact on Fleet Turnover and Sales**

**Organization:** Allison Transmission, Inc.

The RIA recognizes the possibility of a pre-buy, but the analysis concentrates only on what is viewed as favorable fuel costs and savings that will be recognized by vehicle owners. Specifically, the agencies “are not projecting a change in fleet turnover characteristics due to this regulation.”<sup>10</sup> Allison recommends a more thorough analysis of the market history to predict behaviors and economic impact due to the technology risks that are inherent in the proposed rule. Based on that analysis, changes in timing or stringency levels may have merit. For example, fuel costs per mile were calculated using EIA’s 2014 Annual Energy Outlook for diesel prices. Yet more recent EIA projections indicate a substantial decline.<sup>11</sup> This is significant since the agencies’ assumptions concerning “pre-buy” are that the value of saving money in future fuel purchases will outweigh the upfront additional costs of new vehicles. [EPA-HQ-OAR-2014-0827-1284-A1 p.11]

More broadly, EPA and NHTSA must analyze other non-fuel costs factors – e.g., concern with regard to the performance of new technology – and their impact on vehicle purchases. The agencies do not appear to have considered this very real and significant factor in the MD/HD market when assessing the feasibility of Alternative 4. As noted above, the NAS has cited “unknown reliability” as a factor in the “profound fluctuations” buying behavior surrounding the transition to 2007 HD standards. [EPA-HQ-OAR-2014-0827-1284-A1 p.11]

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10 RIA at 8-34.

11 Diesel fuel prices were 2.88 in the 3rd quarter of 2014 compared with \$1.60 in the third quarter of 2015. See <http://www.eia.gov/forecasts/steo/tables/pdf/2tab.pdf>. Projections for 2016 are now \$1.86. Id.

**Organization:** Daimler Trucks North America LLC

Sixth, the agencies failed to estimate a pre-buy or the costs associated with one. (See 80 F.R. 40456, stating that the agencies are not accounting for a pre-buy). Although it is true that the Phase 1 standards did not result in a pre-buy and that customers should have incentive to buy the new fuel saving technologies that Phase 2 will push, it remains likely that there will be a pre-buy. Unlike Phase 1, the agencies premise the Phase 2 standards on technologies that are not off-the-shelf and thus 1) are untested by fleets and 2) are in the stage of development during which manufacturers are still finding problems and developing solutions. (See the warranty information as a function of time, which DTNA shared with the agencies in 2014). Moreover, the agencies are pushing technologies that do not have the return on investment demanded by fleets; if the technologies did have such return on investment, then manufacturers would already be selling the technologies in high numbers. In turn, fleets have an incentive to spend their limited capital on the pre-Phase 2 vehicles. This creates a cost for manufacturers such as DTNA: we must increase staffing and production levels to meet pre-buy demand, and we have to decrease them the following year, possibly being forced to lay off staff (although we sincerely hope not). These swings in production cost money, both increasing capacity and scaling it back. The agencies failed to account for such costs. [EPA-HQ-OAR-2014-0827-1164-A1 p.128-129]

**Organization:** Environmental Defense Fund (EDF)

EDF preformed an extensive market analysis of heavy-duty vehicle purchases between 1992 and 2014 matched with the 2007 and 2010 engine standards.<sup>118</sup> Appropriately controlling for macroeconomic trends, our analysis showed that there was smooth growth in vehicle demand prior to, and during, implementation of the 2014 Phase 1 fuel efficiency standards. As further evidence, model year 2014 heavy-duty trucks saw the highest sales since 2005.<sup>119</sup> The results of our analysis support the premise

that fuel savings provide an advantage in the competitive market. Lower freight costs drive higher demand for freight transport and demand for freight transport drives demand for new vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.25][This comment can also be found in section 11.12 of this comment summary]

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118 Rittenhouse and Zaragoza-Watkins, Strategic Response to Environmental Regulation: Evidence from U.S. Heavy-Duty Vehicle Air Pollution Regulations, MIT CEEPR Working Paper, (2015).

119 “Healthy Demand Overall for Trucks in September,” Heavy Duty Trucking, available at <http://www.truckinginfo.com/channel/fleet-management/news/story/2014/10/healthy-demand-overall-for-trucks-in-september.aspx?ref=rel-recommended> (last accessed November 5, 2014).

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

As previously mentioned engine regulations in the past have had adverse economic consequences and contributed to a pre-buy/no-buy boom and bust cycle. This proposal must guard against creating these conditions. Severe market disruptions would not only be bad for workers, they would also be bad for the environment and would undermine the regulation’s foundational goal of reducing harmful greenhouse gas emissions and increasing fuel efficiency. If fleets and other customers pull ahead truck purchases due to concerns about increased cost or unproven technology, the end result is more higher-polluting and less fuel efficient trucks on the road for a longer period of time. [EPA-HQ-OAR-2014-0827-1248-A2 p.4] [This comment can also be found in section 11.12 of this comment summary.]

**Organization:** Odyne Systems LLC

Other factors could influence unit sales. Higher than expected component costs, lower than expected fuel costs or an easing in efficiency and emissions regulations could reduce demand. On the other hand, it may be possible to reach a higher percentage of the annual installed 145,000 unit PTO market if various scenarios including increased regulatory measures, higher fuel costs above \$4 per gallon or component costs lower than projections were to occur. [EPA-HQ-OAR-2014-0827-1239-A1 p.17]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

Prior to promulgating EPA’s 2000 emission standard, the EPA and the OEMs perhaps should have predicated the now famous pre-buys which occurred before the October 2002 deadline. According to five engine manufacturers that were contacted by the Government Accountability Office (GAO), the pre-buys caused a rippling effect on OEMs, which stated that in order to meet the increased demand for the pre-October 2002 MY engines, their companies hired new workers, increased operations, and experienced concurrently increasing sales. However, after the deadline, engine orders dropped and did not level off again until the end of the 2003 fiscal year. The rapid decline in orders forced the manufacturers to both lay off new-hires and to suspend operations at some plants. According to the engine manufacturers’ representatives, such instability resulted in increased costs and a net loss of revenue.<sup>12</sup> In addition, according to the GAO, those manufacturers which produced cleaner engines lost out in the marketplace because their engines faced significant reliability and durability issues. Truckers using these engines paid the ultimate price in dollars and downtime and even reduced fuel mileage. [EPA-HQ-OAR-2014-0827-1244-A1 p.12-13]

As part of the 2000 emission standard, EPA estimated that within the first 15-months, 233,000 new clean engines would be on the road, when in market reality only 148,000 were actually on the road. EPA also estimated that the consent decrees would require 865,000 older trucks to adjust their computers in order to reduce NO<sub>x</sub> emissions. However, GAO found that only 12 percent of that number actually adjusted their computers. Further, a recent market analysis done by the American Truck Dealers in 2012, noted that the EPA grossly underestimated emission system costs to the industry. Looking at the cost estimates of EPA along with the actual increase in cost of the new cleaner engines, the report found that the actual cost was more than \$21,000, while the EPA estimate was \$5,000.<sup>15</sup> All of the facts presented above demonstrate one of the most fundamental problems associated with EPA's estimates and their myopic vision of emission standards, which is, though the agency can mandate cleaner engines, they cannot mandate that people buy them. This is known as "risk aversion," and according to the National Economic Research Associates, is not accounted for in environmental policy evaluations.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.13-14]

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12 GAO, Air Pollution: EPA Could Take Additional Steps to Help Maximize the Benefits of the 2007 Diesel Emission Standards, Government Accountability Office (March 2004), pg. 5.

15 Patrick Caplin and Esteban Plaza-Jennings, A look Back at EPAs Cost and other Impact projections for MY 2004-2010 Heavy-Duty Truck Emissions Standards, (2012).

16 Noah Kaufman, Why is Risk Aversion Unaccounted for in Environmental Policy Evaluations?, NERA Economic Consulting (2014).

**Organization:** Recreational Vehicle Industry Association (RVIA)

The Proposed Rule will have negative impact on motorhome shipments and jobs. RVIA contracted with John Dunham and Associates<sup>31</sup> (Dunham) to assess the economic impact that compliance with the proposed Phase 2 standards could have on the motorhome industry. The methodology for this model is available in Appendix C. In simplistic terms, Dunham's model assumes that some change in price will have an impact on motorhome sales (shipments)<sup>32</sup> and that this impact on sales will in turn impact industry jobs, wages, economic output, government tax revenue, etc. RVIA asked Dunham to estimate the economic impacts for the following four scenarios: [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.12 of this comment summary]

**Scenario 1:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.12 of this comment summary]

**Scenario 2:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.12 of this comment summary]

**Scenario 3:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.12 of this comment summary]

**Scenario 4:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.12 of this comment summary]

The results of Dunham's assessment for 2021MY, 2024MY and 2027MY are found in the following three tables below. Additional details are located in Appendix D. [EPA-HQ-OAR-2014-0827-1261-A1 p.21][This comment can also be found in section 11.3 and 11.12 of this comment summary]

[Charts, economic impacts, can be found on p.21-22 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

In RVIA's view, Scenario 4 represents the most likely outcome. Scenario 4 reflects costs based on an ICM that is more representative of actual practice in the motorhome industry which, as we have already discussed, is distinctly different from other vocational vehicle segments (largely because motorhomes are not purchased for commercial purposes). [EPA-HQ-OAR-2014-0827-1261-A1 p. 22][This comment can also be found in section 11.3 and 11.12 of this comment summary]

Scenario 4 also reflects the fact that the average motorhome buyer, unlike the commercial vehicle fleet manager, likely places little value on future fuel savings when purchasing a motorhome. These are not vehicles purchased for daily driving or commercial purposes. Rather, the purchaser generally focuses on cost, features and other factors. [EPA-HQ-OAR-2014-0827-1261-A1 p. 22] [This comment can also be found in section 11.12 of this comment summary]

Looking at Scenario 4 and 2024MY standards, we estimate that a total of 1,553 jobs would be lost. Of these, 460 would be motorhome manufacturing jobs. This is over 5% of the existing 8,732 motorhome manufacturing jobs that exist today in the thirty-four motorhome manufacturing sites in the United States. With motorhome manufacturing jobs located in a handful of rural communities in a small number of states, applying the proposed standards will have serious negative impact on these communities. The rule would negatively impact not just motorhome manufacturing employees (460 lost jobs) but also motorhome dealers and component part suppliers (144 and 404 lost jobs, respectively). Also negatively impacted would be persons outside the industry who live in these manufacturing communities. Lost wages are estimated at nearly \$118 million. Federal, state and local governments will also have about \$34 million fewer tax dollars to invest in social programs, and infrastructure. [EPA-HQ-OAR-2014-0827-1261-A1 p.22][This comment can also be found in section 11.12 of this comment summary]

Regardless of the scenario and the extent to which our industry and the communities that manufacture motorhomes are affected, the negative impacts for our industry cannot be ignored. We have concrete evidence showing what happens when motorhome shipments decline. It has been only six years since 2009 when nearly two-thirds (64%) of all direct motorhome manufacturing employees lost their jobs.<sup>33</sup> As of 2013, the latest year for which data is available, there are 43% fewer motorhome manufacturer businesses and still 59% fewer motorhome manufacturer employees than pre-recession. [EPA-HQ-OAR-2014-0827-1261-A1 p.22-23][This comment can also be found in section 11.12 of this comment summary]

While the estimated job losses associated with this rule do not approach the numbers experienced just a few years ago during and after the recession, they will still result in much pain and suffering, particularly for a handful of low-income rural communities that are only now just starting to recover from the recession. At the very least, EPA must consider these economic costs and impacts under the

Regulatory Flexibility Act and Executive Orders 12866, 13563 and 12898. [EPA-HQ-OAR-2014-0827-1261-A1 p.23][This comment can also be found in section 11.12 of this comment summary]

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31 John Dunham & Associates (JDA) is an economic specialist in regulatory analysis. JDA generates economic and fiscal impact studies from a national level down to geographic regions, municipalities, marketing areas or Federal and state legislative districts. See <http://guerrillaeconomics.com/>.

<sup>32</sup> According to John Dunham and Associates, the base elasticity for motorhomes is -0.905, suggesting that a 10 percent change in prices will reduce demand by 9 percent (see Appendix C).

<sup>33</sup> Based on U.S. Economic Census data, available at: [www.census.gov/econ](http://www.census.gov/econ).

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Potential Pre-Buy/Low-Buy Concerns

Other issues exacerbate the problems associated with adopting Alternative 4 for medium-duty and heavy-duty vehicles. As the Agencies well know, there is significant elasticity in the demand for the commercial vehicles at issue in this rulemaking. The Agencies only regulate the manufacturing of new engines and vehicles. There is no obligation for customers to buy the new products – and certainly not at the time of implementation of a new regulation. Moreover, experience has shown that adverse economics, globally or affecting key market segments, have resulted in customers delaying vehicle purchases. Similarly, experience has shown that actual or perceived concerns about the cost, performance, durability, serviceability, or overall efficacy of new-tier vehicle technologies have also resulted in customer “pre-buys” of current-tier technologies and/or the delayed purchase of new-tier technologies. Neither manufacturers (who wish to start recovering their investment in new-tier engine and vehicle technologies as soon as possible) or regulators or the public (who wish to realize the benefits of new regulations as soon as possible) want to experience a pre-buy/low-buy response to the Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.56][This comment can also be found in section 1.5 of this comment summary]

Alternative 4 increases the risk for such a potential response since it likely would result in significantly higher per-vehicle cost increases (compared to Alternative 3), and could produce real or perceived concerns for product durability, reliability and maintenance issues. Those possible circumstances – necessarily more likely under Alternative 4 – could induce vehicle and fleet owners to revise their scheduled purchases of new Phase 2 vehicles. In that regard, and as the Agencies expressly acknowledge, Alternative 4 would deprive manufacturers of three-years of learning time and therefore would decrease the “learning-benefit” savings otherwise available under Alternative 3. [EPA-HQ-OAR-2014-0827-1269-A1 p.56][This comment can also be found in section 1.5 of this comment summary]

The net result could be that manufacturers will be unable to recoup their capital investments in the time period projected in the NPRM. Worse, the very marginal GHG emission benefits ascribed to Alternative 4 might not be realized, even if the three-year pull-ahead could be accomplished, if the Alternative 4 standards proved in the market to be perceived as problematic by customers. The higher costs and potential reliability issues associated with Alternative 4 could be enough to cause vehicle and fleet owners to keep their Phase 1 vehicles longer than otherwise. Consequently, Alternative 4 might actually result in higher aggregate GHG emissions than under Alternative 3, not marginally lower emissions.

This is another reason why the Agencies should not implement Alternative 4. [EPA-HQ-OAR-2014-0827-1269-A1 p.56][This comment can also be found in section 1.5 of this comment summary]

**Organization:** Truck Renting and Leasing Association

Because the technology-forcing nature of the Proposed Standards is anticipated to increase costs, pre-buys may also be expected as the natural result of market behavior. Pre-buys may counter some of the goals that the agencies are trying to obtain. Pre-buys, as were seen before the 2007 NOx regulation implementation, can result in unemployment in the truck manufacturing, component supplier, and service support industries.<sup>1</sup> This negatively impacts businesses, the economy, and solvency of the Highway Trust fund – the latter of which in particular remains in dire straits. Environmental benefits are also put in jeopardy as anticipated benefits are not obtained. [EPA-HQ-OAR-2014-0827-1140-A1 p.4]

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<sup>1</sup> See, e.g., “Customer Behavior in Response to the 2007 Heavy-Duty Engine Emission Standards: Implications for the 2010 NOx Standard” (NERA Economic Consulting, Nov. 14, 2008) (available at [http://www.ooida.com/Documents/NERA 2010 NOx Standard Report.pdf](http://www.ooida.com/Documents/NERA_2010_NOx_Standard_Report.pdf)).

**Organization:** Volvo Group

Heavy-duty trucks are commercial vehicles purchased to enhance the profitability of a business. Purchasers must consider the initial cost (including Federal Excise Tax and state tax), operating and maintenance costs, plus any cost of vehicle downtime. Class 8 tractors, in particular, are generally purchased for regional or long-haul operation accumulating 100,000 or more miles annually. Most fleets require payback for efficiency technology in 18-24 months to cover the risk factors (actual efficiency delivered, maintenance and downtime costs, etc.), recoup their investment, and to provide a profit margin within their 4-5 year trade cycle. Fleets are particularly leery of complex new systems with unproven reliability and unknown maintenance cost. Rather than purchase such technology, fleets have delayed new purchases by extending the life of older equipment and/or pre-buying vehicles before such systems were forced into the market. This was amply demonstrated in 2007 when diesel particulate traps were forced into the market by PM emissions targets. Factories ran at full capacity at the end of 2006 only to nearly shut down for long periods in 2007. Production was then further curtailed by the severe recession in 2008. Vehicle manufacturers’ and suppliers’ employees suffered from lay-offs, pay reductions, and lack of work. One major supplier, Caterpillar, dropped out of the on-road engine business. Since 2010, the increased cost and complexity of emissions technology has spawned a booming business in trucks built from glider kits, a completely new truck chassis and body that is up-fitted with a rebuilt engine, driveline and axle, skirting emissions and efficiency regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.18]

In the Phase 1 rule, EPA and NHTSA initiated a phased in approach using averaging, moderate changes in stringency, and a three year period to correct a failure to meet an annual target. This process, which would continue at an accelerated pace in Phase 2, helps to eliminate the need to force major new technology into the market at full volume. However, it introduces another problem - manufacturers must induce customers to purchase technologies in adequate volumes to achieve regulatory targets when the customers have the option not to purchase such technologies if they are not convinced of the merits. History shows a gradual market acceptance as technologies are tested by first users, then, if found to be cost effective, purchased by others in low volumes before becoming generally accepted. Accelerating this dynamic will certainly be challenging and could be very costly if manufacturers are forced to heavily discount new technology. Markets can also be greatly distorted if some manufacturers accrue large credit balances allowing them to delay technology introduction, thereby forcing competitors to compete against lower cost products. This issue will be particularly acute if truck owners do not

perceive adequate payback for technology. Conversely, technology that delivers good payback, reliability, and durability will be adopted without need for regulation. [EPA-HQ-OAR-2014-0827-1290-A1 p.18-19]

**Response:**

Several of the commenters (Daimler Trucks North American (DTNA), EDF, UAW, OOIDA, EMA, Truck Renting and Leasing Association (TRLA), and Volvo) discuss the concern that these standards may lead to “pre-buy,” that is, purchasers buying large numbers of new vehicles before the standards come into effect, in order to avoid the effects of the standards. As a result of pre-buy, sales would drop after the standards are effective. Employment would swing up before the effective date of the standards, and decrease afterward, in what the UAW calls a “boom and bust cycle.” In addition, because of delayed market penetration of the new vehicles, the environmental gains of the standards would be delayed as well. Commenters note standards put in place for criteria pollutants in the 2000s as leading to pre-buy.

The agencies agree with these commenters that pre-buy is an undesirable phenomenon, for environmental reasons as well as for impacts on the industry. The degree to which that concern applies to GHG/fuel economy standards, however, seems much lower than for the criteria pollutant standards of the 2000s. As discussed in Preamble IX.F.2 and RIA Chapter 8.4.2, those criteria pollutant standards differ from these GHG/fuel efficiency standards because the latter, unlike the former, provide fuel savings to users in addition to increased costs. The expectation of fuel savings should mitigate any attempt to avoid purchase of vehicles subject to the standards. Although DTNA and Volvo raise concerns that the return on investment is not as large as fleets demand, we nevertheless project fuel savings that exceed increased costs with payback periods between two and four years. Volvo argues that technologies with “good payback, reliability, and durability will be adopted without need for regulation.” Preamble Section IX.A. and RIA Chapter 8.2 discuss possible reasons that these technologies may not have been adopted in the absence of the standards, even with short payback periods. EDF points to research that it has done showing “smooth growth in vehicle demand prior to, and during implementation” of Phase 1 of the HD program – that is, it does not find evidence of pre-buy in response to the onset of Phase 1. It also notes that HD sales in 2014 were at their highest level since 2005. These observations suggest that pre-buy has not been a significant issue for Phase 1.

DTNA agrees that Phase 1 did not result in pre-buy, but it argues that the technologies expected under Phase 2 are untested, and manufacturers are still finding problems with them. Allison Transmissions and EMA raise concerns with pre-buy specifically in regard to proposed Alternative 4; Volvo expresses concerns related to the speed with which the standards become more stringent. We note that the decision not to finalize proposed Alternative 4 is largely to allow lead time for development and testing of new technologies. At the same time, the standards provide certainty to promote markets for efficiency technologies, as Odyne Systems points out. Odyne Systems and EMA also note that a wide range of factors affects sales; we agree with this observation as well. As one example, it is likely that the high sales EDF notes for 2014 are due heavily to recovery from the Great Recession; the effects of the standards on those sales levels could be positive or negative, and are likely to be small relative to the effects of the recovery.

Allison Transmission asks for an analysis “to predict behaviors and economic impact due to the technology risks,” and points out the use of EIA’s 2014 AEO price forecasts in the NPRM as potentially overstating fuel savings. We have not conducted a quantitative analysis of the effects of the standards on sales because we have not identified in the literature a suitable model or suitable data for making such estimates. We have updated to EIA’s 2015 AEO price forecasts, the most recent available at the time



that we conducted the analysis presented in the rulemaking documents. The standards continue to have benefits that greatly exceed costs, and, as noted, fairly short payback periods.

OVIDA cites risk aversion as a source of pre-buy, and suggests that risk aversion is not considered in environmental policy analysis. Risk aversion means that consumers prefer a certain value to an uncertain value whose expected value is the same as the certain value. It is unclear in OVIDA's statement how risk aversion applies: up-front costs of meeting the standards, even those subject to the criteria pollutant standards of the 2000s, were built into purchase prices and thus not uncertain at the time of purchase. Perhaps they were uncertain before the vehicles went on sale, and may have thus contributed to pre-buy. This argument, however, leaves out an additional aspect of risk aversion especially important for GHG/fuel efficiency standards: future fuel costs are highly uncertain as well, due to fluctuations in world energy prices. Fuel-saving technologies reduce the impacts of those fluctuations and thus would benefit risk-averse buyers. Although OVIDA cites a claim that the agencies have not considered risk aversion in our analysis, Preamble IX.F.2. and RIA Chapter 8.4.2 discuss our recognition that the two factors affected by risk aversion, the up-front costs and future fuel savings, both affect buyer decisions. We have not identified reliable estimates to quantify these effects on vehicle sales, and thus have presented a qualitative argument.

RVIA expresses concern with the negative sales and employment impacts of the standards. To some extent, this comment is overtaken by events, since the final standards provide for (optional) custom chassis standards that differ from those proposed in ways that should address many of the commenter's substantive concerns. In any case, the concern is that the RV industry is at risk to suffer significant negative effects due to the rule, based, in part, on the question of whether RV consumers will factor fuel savings into their purchase decisions. If consumers do not consider fuel savings, then increases in RV price due to complying with the rule could reduce sales, eventually leading to job losses. The RV industry was disproportionately hurt during the Great Recession and has only recently experienced a recovery.<sup>210,211</sup> The maximum adverse effects on sales, in an analysis by John Dunham and Associates for RVIA, are based in part on the assumption that fuel savings do not affect vehicle sales. One of the drivers of the current recovery of sales appears to be low gas prices,<sup>212</sup> which suggests that RV consumers do consider fuel costs in the purchase decision, and thus are likely to put some consideration on fuel savings from new technology. If so, the reduced fuel costs associated with these standards are likely to mitigate any adverse effects on vehicle sales. Section 11.12 of this Response to Comments discusses the employment impacts in detail.

## 11.7 Monetized GHG Impacts

**Organization:** ABC Bus Companies, Inc.

Phase 2 summaries of benefits, costs, emissions, reduced total fuel consumption, carbon footprints, etc., make no reference in the report that we can find that measures the motorcoach industry contribution to

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<sup>210</sup> Quiggle, Ben. "RV sales projected to be stronger in 2016 thanks to low gas prices, steady economy", *The Elkhart Truth*, March 6, 2016. <http://www.elkharttruth.com/news/business/2016/03/03/RV-sales-projected-to-be-stronger-in-2016-thanks-to-low-gas-prices-steady-economy.html>, accessed 3/28/2016.

<sup>211</sup> Morris, Frank. "Ready For A Road Trip? RVs Are Rolling Back Into Fashion," *Morning Edition on NPR*, March 28, 2016. <http://www.npr.org/2016/03/28/468172578/ready-for-a-road-trip-rvs-are-rolling-back-into-fashion>, accessed 3/28/2016.

<sup>212</sup> Quiggle, Ben. "RV sales projected to be stronger in 2016 thanks to low gas prices, steady economy", *The Elkhart Truth*, March 6, 2016. <http://www.elkharttruth.com/news/business/2016/03/03/RV-sales-projected-to-be-stronger-in-2016-thanks-to-low-gas-prices-steady-economy.html>, accessed 3/28/2016.

reduced automobile traffic, emissions, congestion and highway damage, per numbers of passengers moved from point A to point B. In short, one 81 passenger motorcoach could potentially remove 81 cars, pickup trucks, or light duty vehicles from the American roadways. [EPA-HQ-OAR-2014-0827-1430-A2 p.2-3]

**Reductions in fuel consumption, emissions, carbon footprints, etc., on a per motorcoach basis, should be compared against the same consumption and discharge categories of smaller vehicles removed from the roadways.** [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

Page 40294 refers to MOVES forecasts of 1,000 commercial intercity coach buses, 5,000 transit buses, 40,000 school buses, and 90,000 recreational vehicles in MY 2018. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

The average passenger capacity of an intercity coach bus is 56 passengers. Using the 1,000 yearly intercity coach bus figure provided in the report, the potential to remove 56,000 automobiles from the U.S highway system per year exists. The real impact of motorcoach GHG emissions should be offset by the numbers of automobile and light truck vehicles removed from the US highways. Reduced GHG, fuel consumption, and CO<sub>2</sub> figures could be based on 'passenger' MPG instead of 'vehicle' MPG. [EPA-HQ-OAR-2014-0827-1430-A2 p.3]

**Response:**

EPA does not consider impacts on a per-passenger basis as part of its standard-setting process. As a result, EPA does not relate fuel savings (or other impacts) to “cars-off-the-road” in our analysis.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Social cost of non- CO<sub>2</sub> GHGs**

The NPRM requests comment on the inclusion of non- CO<sub>2</sub> GHGs in the estimated benefits of the proposed rulemaking. CARB staff supports the use of directly modeled peer-reviewed estimates of the social cost of all GHGs over the GWP approach but is concerned about consistency if not all GHGs are directly modelled. Currently, there is no proposed research to directly model the social cost of HFC-134a for example, which will result in biased estimation as the GWP-based approximation has been shown to underestimate climate benefits relative to direct modeling. CARB staff suggests that there is a need for additional research on the social cost of non- CO<sub>2</sub> GHGs such as black carbon including harmonization with the social cost of CO<sub>2</sub>. [EPA-HQ-OAR-2014-0827-1265-A1 p.185]

**Response:**

EPA acknowledges this comment and notes that it has used the SC-CO<sub>2</sub> estimates as well as the Marten et al. (2014) social cost of methane (SC-CH<sub>4</sub>) and social cost of N<sub>2</sub>O (SC-N<sub>2</sub>O) estimates to monetize the climate-related impacts of this rulemaking. Regarding the comment that the social cost of carbon underestimates benefits, the EPA recognizes that none of the three integrated assessment models (IAMs) fully incorporates all climate change impacts, either positive or negative; see EPA response to comment EPA-HQ-OAR-2014-0827-1296-A1.

Regarding the comments about GHGs not monetized in the main benefit-cost analysis for the final rulemaking, e.g., HFC-134a, EPA notes that neither the interagency working group nor the EPA have established a methodology for valuing the social cost of HFC-134a or black carbon. EPA strives to identify, quantify, and monetize all relevant impacts from the rulemaking but may not be able to do so in practice due to methodological limitations. EPA recognizes the importance of quantifying and monetizing the benefits of regulations to the extent feasible, and discussing qualitatively any benefits that cannot be quantified. The RIA presents a thorough discussion of the GHG impacts expected from this final rulemaking.

**Organization:** Environmental Defense Fund (EDF)

Finally, in May 2013, the Interagency Working Group on the Social Cost of Carbon (IWG) published an updated assessment that increases the predicted threat that climate change poses and will continue to pose into the future. The IWG's original estimate in 2010 provided four potential values to represent the cost that each metric ton of CO<sub>2</sub> emissions will impose on society for the year 2020: \$7, \$26, \$42, and \$81.<sup>66</sup> The 2013 estimate increases those values to \$12, \$43, \$65, and \$129, respectively.<sup>67</sup> While the Joint Environmental Commenters believe that these updated figures fundamentally underestimate the true cost of carbon emissions, they nonetheless reflect the same trend as seen in the scientific literature: not only does the potential harm from carbon emissions increase with each additional ton released into the atmosphere, but the severity of the predicted harm increases as our understanding of climate change grows. [EPA-HQ-OAR-2014-0827-1312-A1 p.14][This section can also be found in section 9.4 of this comment summary]

**Social cost of carbon and social cost of methane**

Please see separate comments submitted jointly to the docket by EDF, Institute for Policy Integrity, Union of Concerned Scientists and the Natural Resources Defense Council. [EPA-HQ-OAR-2014-0827-1312-A1 p.23][Comments can be found in docket number EPA-HQ-OAR-2014-0827-1296-A1]

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66 Interagency Working Group on the Social Cost of Carbon (IWG), Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (2013), at 2.

67 Id.

**Response:**

EPA acknowledges this comment and notes that it has used the SC-CO<sub>2</sub> estimates as well as the Marten et al. (2014) social cost of methane (SC-CH<sub>4</sub>) and social cost of N<sub>2</sub>O (SC-N<sub>2</sub>O) estimates to monetize the climate-related impacts of this rulemaking. Regarding the comment that the social cost of carbon

underestimates benefits, the EPA recognizes that none of the three integrated assessment models (IAMs) fully incorporates all climate change impacts, either positive or negative; see EPA response to comment EPA-HQ-OAR-2014-0827-1296-A1.

**Organization:** Institute for Policy Integrity

**Institute for Policy Integrity, Excerpt 1:** Our organizations respectfully submit these comments regarding EPA and NHTSA's valuation of the benefits of their greenhouse gas and fuel efficiency standards for medium and heavy-duty vehicles—specifically, the use of the Interagency Working Group's valuation of the Social Cost of Carbon and the consideration of the Social Cost of Methane metric. Our organizations may separately and independently submit other comments regarding the proposed standards themselves. [EPA-HQ-OAR-2014-0827-1296-A1 p.1]

We strongly affirm that the current Social Cost of Carbon (SCC) values are sufficiently robust and accurate to continue to be the basis for regulatory analysis going forward. We further agree with EPA's most recent assessment that the Social Cost of Methane approach is methodologically sound and should be applied to value methane emissions. As demonstrated below, if anything, current values are significant underestimates of the SCC and the Social Cost of Methane. As economic and scientific research continues to develop in the future, the values should be revised, and we also offer recommendations for that future revision. [EPA-HQ-OAR-2014-0827-1296-A1 p.1]

Our comments are summarized in six sections: [EPA-HQ-OAR-2014-0827-1296-A1 p.1]

1. Introduction: The SCC is an important policy tool.
2. The Interagency Working Group's (IWG) analytic process was science-based, open, and transparent.
3. The SCC is an important and accepted tool for regulatory policy-making, based on well-established law and fundamental economics.
4. Recommendations on further refinements to the SCC.
5. Support for the Social Cost of Methane methodology, and recommendations on refinements.
6. Conclusion: Recommendations on the use of the SCC and Social Cost of Methane in regulatory impact analyses. [EPA-HQ-OAR-2014-0827-1296-A1 p.1]

### **1. Introduction: The SCC is an important policy tool.**

The SCC estimates the economic cost of climate impacts—specifically the additional economic harm caused by one additional metric ton of carbon dioxide (CO<sub>2</sub>) emissions. SCC calculations are important for evaluating the costs of activities that produce greenhouse gas emissions and contribute to climate change, such as burning fossil fuels to produce energy. The SCC is also important for evaluating the benefits of policies that would reduce the amount of those emissions going into the atmosphere. For example, in order to properly evaluate standards that reduce the use of carbon-intensive energy or that improve energy efficiency—like the proposed standards—it is important to understand the benefits they will provide, including the benefit of reducing carbon pollution and the harm it causes. [EPA-HQ-OAR-2014-0827-1296-A1 p.2]

As with all economic impact analyses, the exercise can only provide a partial accounting of the costs of climate change (those most easily monetized) and inevitably involves incorporating elements of uncertainty. However, accounting for the economic harms caused by climate change is a critical component of sound benefit-cost analyses of regulations that directly or indirectly limit greenhouse gases. This endeavor is important because benefit-cost analysis is a central tool of regulatory policy in

the United States, first institutionalized in a 1981 executive order by President Ronald Reagan. The executive order currently in effect provides that agencies: [EPA-HQ-OAR-2014-0827-1296-A1 p.2]

- “[P]ropose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify);...
- “[S]elect, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity);...
- “In applying these principles, each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. Where appropriate and permitted by law, each agency may consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts.”<sup>1</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.2]

Benefit-cost analysis has long been a staple of agency rulemakings, usually conducted as part of the regulatory impact analysis associated with proposed rules. Even though the analysis is generally not able to encompass all of the effects of a policy, and it is challenging to translate impacts on health, mortality, and welfare into dollar values, benefit-cost analysis is an important economic tool to help inform decision-makers about the societal benefits of different policy choices. Of course, benefit-cost analysis cannot be the sole criterion for making regulatory decisions, especially in cases where there are overriding public health, equity, or safety imperatives.<sup>2</sup> And in a few instances, legal protections prohibit the consideration of benefit-cost analysis. [EPA-HQ-OAR-2014-0827-1296-A1 p.2]

Without an SCC estimate, regulators would by default be using a value of zero for the benefits of reducing carbon pollution, implying that carbon pollution has no costs. That, sadly, is not the case, as evidenced by the large body of research outlining the sobering health, environmental, and economic impacts of rising temperatures, extreme weather, intensifying smog, and other climate impacts. If anything, most evidence points to the fact that current numbers significantly underestimate the SCC. It would be arbitrary for a federal agency to weigh the societal benefits and costs of a rule with significant carbon pollution effects but to assign no value at all to the considerable benefits of reducing carbon pollution.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.2-3]

**Response:**

EPA acknowledges this comment and notes that it has used the SC-CO<sub>2</sub> estimates as well as the Marten et al. (2014) social cost of methane (SC-CH<sub>4</sub>) and social cost of N<sub>2</sub>O (SC-N<sub>2</sub>O) estimates to monetize the climate-related impacts of this rulemaking. Regarding the comment that the social cost of carbon underestimates benefits, the EPA recognizes that none of the three integrated assessment models (IAMs) fully incorporates all climate change impacts, either positive or negative; see EPA response to comment EPA-HQ-OAR-2014-0827-1296-A1.

Regarding EPA’s response to sections 2 through 6 of the letter submitted by Institute for Policy Integrity, see responses below to comment excerpts from EPA-HQ-OAR-2014-0827-1296-A1.

**Organization:** Institute for Policy Integrity

**Institute for Policy Integrity, Excerpt 2**

**2. The IWG’s analytic process was science--based, open, and transparent.**

To facilitate accounting for the costs of climate impacts and the benefits of reducing carbon pollution in regulatory proceedings undertaken by different agencies, the United States government assembled an Interagency Working Group (IWG) to develop an estimate of a social cost of carbon that can be utilized in rulemakings and other pertinent settings across the federal government.<sup>4</sup> The IWG's estimates—first released in 2010 and updated in 2013 and 2015—have been used in numerous benefit-cost analyses related to federal rulemakings.<sup>5</sup> The IWG recently released an updated set of SCC estimates, centered at approximately \$40 per metric ton of CO<sub>2</sub> for emissions in the year 2015, in 2015 dollars at a 3% discount rate.<sup>6</sup> The 2015 SCC estimates are higher than those from 2010, reflecting the growing understanding of the costs that climate impacts will impose on society. [EPA-HQ-OAR-2014-0827-1296-A1 p.3-4]

The increase in the SCC estimate is important because it reflects the growing scientific and economic research on the risks and costs of climate change, but is still very likely an underestimate of the economic cost of carbon emissions. The increase also reflects the costs of climate change that we are already experiencing, such as those associated with sea level rise and rising temperatures. Climate change is making coastal flooding, drought, and impacts from extreme weather worse. A rapidly increasing body of evidence has linked ever more recent events directly to climate change.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.4]

The analytic work of the IWG has been transparent. The 2010 Technical Support Document (TSD) set out in detail the IWG's decision-making process with respect to how it assessed and employed the models.<sup>8</sup> Furthermore, the Government Accountability Office (GAO) found that “the working group's processes and methods reflected the following three principles: *Used consensus--based decision making, Relied on existing academic literature and models, and Took steps to disclose limitations and incorporate new information.*”<sup>9</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.4]

Because the 2013 IWG made no changes to the input assumptions and procedures for deriving its SCC estimates, the 2013 TSD discussed only how the three Integrated Assessment Models (IAMs) used in the analysis were updated in the academic literature over the three-year interim period by the independent researchers who have developed these models. The 2013 TSD also established that the increase in the SCC estimate from 2010 to 2013 resulted solely from updates to the three underlying IAMs.<sup>10</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.4]

The 2015 TSD update provided detailed responses<sup>11</sup> to public comments collected through an opportunity for public participation initiated by the Office of Management and Budget (OMB).<sup>12</sup> Additionally, the comment period on these proposed standards are yet another opportunity for continued dialogue about areas requiring further study. Such repeated comment processes and updates demonstrate that the IWG's SCC estimates were developed—and are being used—transparently. Given their strong grounding in the best science available, nothing should prevent the current, continued use of this well-established estimate. As economic and scientific research continues to develop, future revisions will be able to further refine existing estimates based on the latest peer-reviewed literature and the latest updates to the quality of the overall modeling exercise. [EPA-HQ-OAR-2014-0827-1296-A1 p.4-5]

**Response:**

The EPA acknowledges this comment and agrees that the process was science-based, open, and transparent.

**Organization:** Institute for Policy Integrity

### **Institute for Policy Integrity, Excerpt 3**

#### **3. The SCC is an important and accepted tool for regulatory policy-making based on well-established law and fundamental economics.**

The legal and analytic basis for using the SCC is clear and well established. *As a matter of law and economics, uncertainty in benefits estimates does not mean they should be excluded from regulatory impact analyses.* No benefit or cost estimates are certain. Further, the courts have explicitly rejected the argument that uncertainty in assessing the costs of climate impacts provided a basis for ignoring them in assessing the benefits and costs of regulations, and executive orders dating back as far as the Reagan administration have all issued guidelines specifying explicit consideration of benefits even if the precise size of the benefit is uncertain. [EPA-HQ-OAR-2014-0827-1296-A1 p.5]

In 2008, the U.S. Court of Appeals for the Ninth Circuit determined that agencies could not assign a zero dollar value to the social costs of the impacts of climate change. It determined that *failing* to count SCC benefits would be illegal. In this case, the National Highway Traffic Safety Administration (NHTSA) had decided not to count any avoided climate damages in issuing fuel economy standards. The court concluded: “NHTSA’s reasoning is arbitrary and capricious for several reasons. First while the record shows that there is a *range of values*, the value of carbon emission reductions is certainly *not zero* (emphasis added).”<sup>13</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.5]

Like the Court of Appeals, executive orders dating back to 1981 have also required agencies to assess benefits and costs even when significant uncertainty exists. Every president since (and including) Ronald Reagan has issued directives requiring that agencies conduct cost-benefit analyses of proposed regulations where permitted by statute.<sup>14</sup> Specifically, agencies are directed to “take into account benefits and costs, both quantitative and qualitative. . . and use the *best available techniques* to quantify anticipated present and future benefits and costs as accurately as possible.”<sup>15</sup> The IWG’s use of Integrated Assessment Models (IAMs) reflects the best available, peer-reviewed science to tally the benefits and costs of specific regulations with impacts on carbon dioxide emissions. While we address ways for improvement in the next section, current IAMs include benefits and costs that have been quantified to date. [EPA-HQ-OAR-2014-0827-1296-A1 p.5]

The bottom line is that the IWG has properly and lawfully used the best available techniques to quantify the benefits of carbon emission reductions, basing its analysis on the peer-reviewed literature. When agencies use the IWG’s estimates of the SCC to calculate the benefits of a rulemaking, they have taken, and will continue to take, comment on the SCC and the process used to derive that value. That is what the law—and good policy—requires. [EPA-HQ-OAR-2014-0827-1296-A1 p.5]

#### **Response:**

The EPA agrees with this comment.

**Organization:** Institute for Policy Integrity

### **Institute for Policy Integrity, Excerpt 4**

*The IWG Correctly Used a Global SCC Value.*

To design the economically efficient policies necessary to forestall severe and potentially catastrophic climate change, all countries must use a global SCC value. Given that the United States and many other significant players in the international climate negotiations have already applied a global SCC framework in evaluating their own climate policies, the continued use of the global value in U.S. regulatory decisions may be strategically important as the United States seeks to set an example for other countries, harmonize regulatory systems, and take the lead in ongoing international negotiations. Binding legal obligations, basic ethical responsibilities, and practical considerations further counsel in favor of the United States using a global SCC value. [EPA-HQ-OAR-2014-0827-1296-A1 p.6]

To avoid a global “tragedy of the commons” and an economically inefficient degradation of the world’s climate resources, all countries should set policy according to a global SCC value. The climate and clean air are global common resources, meaning they are free and available to all countries, but any one country’s use—i.e., pollution—imposes harms on the polluting country as well as the rest of the world. Because greenhouse gases do not stay within geographic borders but rather mix in the atmosphere and affect climate worldwide, each ton of carbon pollution emitted by the United States not only creates domestic harms, but also imposes additional and large externalities on the rest of the world, including disproportionate harms to some of the least-developed nations. Conversely, each ton of carbon pollution abated in another country will benefit the United States along with the rest of the world. [EPA-HQ-OAR-2014-0827-1296-A1 p.6]

If all countries set their greenhouse gas emission levels based on only their domestic costs and benefits, ignoring the large global externalities, the collective result would be substantially suboptimal climate protections and significantly increased risks of severe harms to all nations, including to the United States. “[E]ach pursuing [only its] own best interest. . . in a commons brings ruin to all.”<sup>16</sup> By contrast, a global SCC value would require each country to account for the full damages of its greenhouse gas pollution and so to collectively select the efficient level of worldwide emissions reductions needed to secure the planet’s common climate resources. [EPA-HQ-OAR-2014-0827-1296-A1 p.6]

Thus, well-established economic principles demonstrate that the United States stands to benefit greatly if all countries apply a global SCC value in their regulatory decisions. A rational tactical option in the effort to secure that economically efficient outcome is for the United States to continue using a global SCC value itself. The United States is engaged in a repeated strategic game of international negotiations and regulatory coordination, in which several significant players—including the United States—have already adopted a global SCC framework.<sup>17</sup> For the United States to now depart from this implicit collaborative dynamic by reverting to a domestic-only SCC estimate could undermine the country’s long-term interests in future climate negotiations and could jeopardize emissions reductions underway in other countries, which are already benefiting the United States.<sup>18</sup> A domestic-only SCC value could be construed as a signal that the United States does not recognize or care about the effects of its policy choices on other countries, and signal that it would be acceptable for other countries to ignore the harms they cause the United States. Further, a sudden about-face could undermine the United States’ credibility in negotiations. The United States has recently reasserted its desire to take a lead in both bilateral and international climate negotiations.<sup>19</sup> To set an example for the rest of the world, to advance its own long-term climate interests, and to secure greater cooperation toward reducing global emissions, strategic factors support the continued use a global SCC value in U.S. regulatory decisions. [EPA-HQ-OAR-2014-0827-1296-A1 p.6-7]

Though the Constitution balances the delegation of foreign affairs power between the executive and legislative branches, “[t]he key to presidential leadership is the negotiation function. Everyone agrees that the President has the exclusive power of official communication with foreign governments.”<sup>20</sup> The development and analysis of U.S. climate regulations are essential parts of the dialogue between the



United States and foreign countries about climate change. Using a global SCC value communicates a strong signal that the United States wishes to engage in reciprocal actions to mitigate the global threat of climate change. The President is responsible for developing and executing the negotiation strategy to achieve the United States' long-term climate interests. Currently, the President has instructed federal agencies to use a global SCC value as one important step that encourages other countries to take reciprocal actions that also account for global externalities. The President's constitutional powers to negotiate international agreements would be seriously impaired if federal agencies were forced to stop relying on a global SCC value.<sup>21</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.7]

In fact, the United States has already begun to harmonize with other countries its policies on climate change and on the valuation of regulatory benefits. The recent U.S.-China agreement is but the latest example. For instance, the United States has entered into a joint Regulatory Cooperation Council with Canada, which has adopted a work plan that commits the two countries to synchronizing "aggressive" greenhouse gas reductions, especially in the transportation sector.<sup>22</sup> A separate Regulatory Cooperation Council with Mexico calls generally for improving and harmonizing policy "by strengthening the analytic basis of regulations,"<sup>23</sup> and its work plan acknowledges the transboundary nature of environmental risks.<sup>24</sup> Mexico and Canada have both adopted greenhouse gas standards for vehicles that harmonize with the U.S. standards<sup>25</sup> and that calculate benefits according to a global SCC value.<sup>26</sup> Canada has also used the IWG's global SCC value in developing carbon dioxide standards for its coal-fired power plants, estimating \$5.6 billion (Canadian dollars) worth of global climate benefits.<sup>27</sup> The direct U.S. share of the net benefits from that Canadian regulation will likely total in the hundreds of millions of dollars.<sup>28</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.7-8]

Further efforts at regulatory harmonization are currently underway. For example, the United States is now negotiating a Transatlantic Trade and Investment Partnership with the European Union, and a key element is regulatory coordination.<sup>29</sup> The European Union has already adopted an Emissions Trading Scheme (ETS) to cap its greenhouse gas emissions, and its Aviation Directive is just one of the climate policies that could be shaped by these negotiations.<sup>30</sup> The European Commission has indicated its willingness to further reduce its ETS cap if other major emitters make proportional commitments<sup>31</sup>—a result that will only occur if countries consider more than their own domestic costs and benefits from reducing greenhouse gas emissions. Moreover, several individual European nations—including the United Kingdom,<sup>32</sup> France,<sup>33</sup> Germany,<sup>34</sup> and Norway<sup>35</sup>—have adopted a global SCC value for use in their regulatory analyses. Some other European countries, such as Sweden, have adopted carbon taxes that implicitly operate as a high SCC that accounts for global externalities.<sup>36</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.8-9]

As further evidence of how the United States' use of a global SCC value is already influencing other international actors to follow suit, the International Monetary Fund (IMF) applies in its policy reviews an SCC estimate based on the IWG number.<sup>37</sup> Given the potential influence of the IMF on the environmental policies of developing countries,<sup>38</sup> the pull that the IWG's global estimate has at the IMF could be very advantageous to the United States, by motivating industrializing countries to use similar numbers in the future. [EPA-HQ-OAR-2014-0827-1296-A1 p.9]

In addition to this compelling strategic argument—namely, that it is rational for the United States and other countries to continue their reciprocal use of a global SCC value to achieve the economically efficient outcome on climate change (and avoid catastrophic climate impacts)—legal obligations further prescribe using a global SCC value. A basic ethical responsibility to prevent transboundary environmental harms has been enshrined in customary international law.<sup>39</sup> For the United States to knowingly set pollution levels in light of only domestic harms, willfully ignoring that its pollution directly imposes environmental risks—including catastrophic risks—on other countries, would violate

norms of comity among countries. The United States would be knowingly causing foreseeable harm to other countries, without compensation or just cause. Given that the nations most at risk from climate change are often the poorest countries in the world, such a policy would also violate basic and widely shared ethical beliefs about fairness and distributive justice. Indeed, taking a global approach to measuring climate benefits is consistent with the ideals of transboundary responsibility and justice that the United States commits to in other foreign affairs.<sup>40</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.9]

Binding international agreements also require consideration and mitigation of transboundary environmental harms. Notably, the United Nations Framework Convention on Climate Change—to which the United States is a party—declares that countries’ “policies and measures to deal with climate change should be cost-effective so as to ensure *global benefits* at the lowest possible cost.”<sup>41</sup> The Convention further commits parties to evaluating global climate effects in their policy decisions, by “employ[ing] appropriate methods, for example *impact assessments*. . . with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change.”<sup>42</sup> The unmistakable implication of the Convention is that parties—including the United States—must account for global economic, public health, and environmental effects in their impact assessments. [EPA-HQ-OAR-2014-0827-1296-A1 p.9-10]

Similar obligations exist in domestic U.S. law as well. For example, the U.S. National Environmental Policy Act recognizes “the worldwide and long-range character of environmental problems”<sup>43</sup> and requires federal agencies to include reasonably foreseeable transboundary effects in their environmental impact statements.<sup>44</sup> While some individual statutes under which federal agencies will craft climate policies may be silent on the issue of considering extraterritorial benefits, arguably the most important statute for U.S. climate policy—the Clean Air Act—requires the control of air emissions that affect other countries and so encourages a global assessment of greenhouse gas effects. Specifically, Section 115 of the Clean Air Act directs EPA and the states to mitigate U.S. emissions that endanger foreign health and welfare.<sup>45</sup> The global perspective on climate costs and benefits required by that provision should inform all regulatory actions developed under the Clean Air Act, and may provide useful guidance under other statutes as well.<sup>46</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.10]

Presidential orders on regulatory analysis also support use of a global SCC value. In 2012, President Obama issued Executive Order 13,609 on promoting international regulatory cooperation.<sup>47</sup> The Order built on his previous Executive Order 13,563, which in turn had affirmed its 1993 predecessor, Executive Order 12,866, in requiring benefit-cost analysis of significant federal regulations.<sup>48</sup> Though White House guidance published in 2003 on regulatory impact analysis under E.O. 12,866 assumed that most analyses would focus on domestic costs and benefits, it ultimately deferred to the discretion of regulatory agencies on whether to evaluate “effects beyond the borders of the United States.”<sup>49</sup> More importantly, since the publication of that guidance, President Obama has issued his own supplemental orders on regulatory analysis, including E.O. 13,609, which clarified the importance of international cooperation to achieve U.S. regulatory goals. This 2012 order explicitly recognizes that significant regulations can have “significant international impacts,”<sup>50</sup> and it calls on federal agencies to work toward “best practices for international regulatory cooperation with respect to regulatory development.”<sup>51</sup> By employing a global SCC value in U.S. regulatory development, and by encouraging other countries to follow that best practice and account for the significant international impacts of their own climate policies, federal agencies will advance the mission of this presidential order on regulatory harmonization. [EPA-HQ-OAR-2014-0827-1296-A1 p.10-11]

Finally, two practical considerations counsel in favor of a global SCC value. First, unlike some other significant international environmental impacts, no methodological limitations block the quantitative

estimation of a global SCC value. In recent regulatory impact analyses for major environmental rules, EPA has qualitatively considered important transnational impacts that could not be quantified. For example, in the Mercury and Air Toxics Standards, EPA concluded that a reduction of mercury emissions from U.S. power plants would generate health benefits for foreign consumers of fish, both from U.S. exports and from fish sourced in foreign countries. EPA did not quantify these foreign health benefits, however, due to complexities in the scientific modeling.<sup>52</sup> Similarly, in the analysis of the Cross-State Air Pollution Rule, EPA noted—though could not quantify—the “substantial health and environmental benefits that are likely to occur for Canadians” as U.S. states reduce their emissions of particulate matter and ozone—pollutants that can drift long distances across geographic borders.<sup>53</sup> Yet where foreign costs or benefits are important and quantifiable, other federal agencies frequently include those calculations.<sup>54</sup> Given that sophisticated models already exist to quantify the global SCC, the global estimate is appropriate to use. [EPA-HQ-OAR-2014-0827-1296-A1 p.11]

Second, a global SCC value is in the national interest because harms experienced by other countries could significantly impact the United States. Climate damages in one country could generate large spillover effects to which the United States is especially vulnerable. The mesh of the global economy is woven tightly, and disruptions in one place can have consequences around the world. As seen historically, economic disruptions in one country can cause financial crises that reverberate globally at a breakneck pace.<sup>55</sup> In a similar vein, national security analysts in government and academia increasingly emphasize that the geopolitical instability associated with climatic disruptions abroad poses a serious threat to the United States.<sup>56</sup> Due to its unique place among countries—both as the largest global economy with trade- and investment-dependent links throughout the world, and as a military superpower—the United States is particularly vulnerable to international spillover effects. [EPA-HQ-OAR-2014-0827-1296-A1 p.11-12]

The 2010 TSD included a rigorous examination of global versus domestic SCC estimates.<sup>57</sup> Consistent with the above discussion, the 2010 IWG reached the conclusion to estimate a global SCC value, citing both the global impacts of climate change and the global action needed to mitigate climate change. The IWG restated these arguments in the 2013 TSD, and refers back explicitly to its discussion in the 2010 TSD.<sup>58</sup> EPA and NHTSA should continue using a global SCC estimate in their regulatory impact analyses. [EPA-HQ-OAR-2014-0827-1296-A1 p.12]

**Response:**

EPA agrees that a focus on global SC-GHG estimates in RIAs is appropriate and has applied global SC-CO<sub>2</sub>, SC-CH<sub>4</sub>, and SC-N<sub>2</sub>O estimates to the analysis of the benefits in the final rulemaking. In particular, EPA agrees with the commenter’s discussion of the global nature of GHG emissions—that each ton of GHGs emitted by the United States creates damages within the country and abroad—and with the commenter’s conclusion that “each ton of carbon pollution abated in another country will benefit the United States along with the rest of the world.” As noted by the commenter, the global economy is tightly interconnected and the United States is especially vulnerable to international spillover effects. The impacts of climate change that occur beyond the borders of the United States will affect the interests of U.S. citizens and U.S. national security interests. EPA agrees with the commenter’s interpretation, as described in this excerpt, of recent reports on geopolitical instability associated with climatic disruptions abroad and the threat such disruptions may pose to the United States. For example, the National Research Council Climate and Social Stress assessment concluded that it is prudent to expect that some climate events “will produce consequences that exceed the capacity of the affected societies or global systems to manage and that have global security implications serious

enough to compel international response.”<sup>213</sup> As discussed in Section I.A of the Preamble, the NRC National Security Implications assessment recommends that, due to climate change, the United States should be preparing for increased needs for humanitarian aid; responding to the effects of climate change in geopolitical hotspots, including possible mass migrations; and addressing changing security needs in the Arctic as sea ice retreats. Section I.A of the Preamble discusses other scientific assessments about the impacts of climate change and presents additional examples of climate change impacts within the United States.

**Organization:** Institute for Policy Integrity

### **Institute for Policy Integrity, Excerpt 5**

#### **4. Recommendations on further refinements to the SCC.**<sup>59</sup>

The IWG process uses assumptions that accord with economic and scientific theory. Economic models, and the scientific analyses they draw from, are of course improving continuously. Future updates to the SCC should build on these and go further. As further refinements better account for climate change impacts not yet incorporated into the modeling, all indications are that the estimated benefits of curbing carbon pollution will rise substantially over current estimates. [EPA-HQ-OAR-2014-0827-1296-A1 p.12]

#### ***The IWG appropriately used consumption discount rates rather than returns on capital.***

With respect to the **discount rate**, the IWG conducted sensitivity analysis of the results to three constant consumption discount rates: 2.5%, 3%, and 5%; for each of the discount rates, the TSDs reported the various moments and percentiles<sup>60</sup> of the SCC estimates. [EPA-HQ-OAR-2014-0827-1296-A1 p.12]

The discount rate is one of the most important inputs in models of climate damages, with plausible assumptions easily leading to differences of an order of magnitude in the SCC. The climate impacts of present emissions will unfold over hundreds of years. When used over very long periods of time, discounting penalizes future generations heavily due to compounding effects. For example, at a rate of 1%, \$1 million 300 years hence equals over \$50,000 today; at 5% it equals less than 50 cents.<sup>61</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.12]

The discount rate changed by a factor of five, whereas the discounted value changed by more than five orders of magnitude. Depending on the link between climate risk and economic growth risk, even a rate of 1% may be too high.<sup>62</sup> Uncertainty around the correct discount rate pushes the rate lower still.<sup>63</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.13]

The IWG correctly excluded a 7% discount rate, a typical private sector rate of return on capital, for several reasons. First, typical financial decisions, such as how much to save in a bank account or invest in stocks, focus on private decisions and utilize private rates of return. Private market participants typically have short time horizons. However, here we are concerned with social discount rates because

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<sup>213</sup> National Research Council. (2013). Climate and Social Stress: Implications for Security Analysis. Committee on Assessing the Impacts of Climate Change on Social and Political Stresses, J.D. Steinbruner, P.C. Stern, and J.L. Husbands, Eds. Board on Environmental Change and Society, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. See page 20. Available at [http://www.nap.edu/download.php?record\\_id=14682#](http://www.nap.edu/download.php?record_id=14682#).

emissions mitigation is a public good, where individual emissions choices affect public well-being broadly. Rather than evaluating an optimal outcome from the narrow perspective of investors alone, economic theory would require that we make the optimal choices based on societal preferences (and social discount rates). Second, climate change is expected to affect primarily consumption, not traditional capital investments.<sup>64</sup> OMB guidelines note that in this circumstance, consumption discount rates are appropriate.<sup>65</sup> Third, 7% is considered much too high for reasons of discount rate uncertainty and intergenerational concerns (further discussed below). [EPA-HQ-OAR-2014-0827-1296-A1 p.13]

*The IWG correctly adopted as one of its discount rates a value reflecting long-term interest rate uncertainty, and—as a primary extension to current results—should go further by directly implementing a declining discount rate.* [EPA-HQ-OAR-2014-0827-1296-A1 p.13]

The IWG was correct in choosing as one of its discount rates an estimate based upon declining discount rates (2.5%). Since the IWG undertook its initial analysis, a consensus has emerged among leading climate economists that a declining discount rate should be used for climate damages to reflect long-term uncertainty in interest rates. Arrow *et.al.* (2013) presents several arguments that strongly support the use of declining discount rates for long-term benefit-cost analysis.<sup>66</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.13]

Perhaps the best reason is the simple fact that there is considerable uncertainty around which interest rate to use: uncertainty in the rate points directly to the need to use a declining rate, as the impact of the uncertainty grows exponentially over time. The uncertainty about future discount rates could stem from a number of reasons particularly salient to climate damages, including uncertainties in future economic growth, consumption, and the interest rate reaped by investments. [EPA-HQ-OAR-2014-0827-1296-A1 p.14]

A possible declining interest rate schedule for consideration by the IWG is the one proposed by Weitzman (2001).<sup>67</sup> It is derived from a broad survey of top economists and the profession at large in a climate change context and explicitly incorporates arguments around interest rate uncertainty. Arrow *et.al.* (2013, 2014), Cropper *et.al.* (2014), and Gollier and Weitzman (2010), among others, similarly argue for a declining interest rate schedule and lay out the fundamental logic.<sup>68</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.14]

Moreover, the United States would not be alone in using a declining discount rate. It is standard practice for the United Kingdom and French governments, among others.<sup>69</sup> The U.K. schedule explicitly subtracts out an estimated time preference.<sup>70</sup> France's schedule is roughly similar to the United Kingdom's. Importantly, all of these discount rate schedules yield lower present values than the constant 2.5% Newell-Pizer rate, suggesting that even the lowest discount rate evaluated by the IWG is too high.<sup>71</sup> The consensus of leading economists is that a declining discount rate schedule should be used, consistent with the approach of other countries like the United Kingdom. Adopting such a schedule would increase the SCC substantially from the administration's central estimate, suggesting that even the high end of the range presented by the administration is likely too low. [EPA-HQ-OAR-2014-0827-1296-A1 p.14]

#### **Response:**

The EPA acknowledges this comment and notes that the discount rates have not changed in the final analysis.

Regarding the commenters' recommendation that the interagency working group (IWG) use a declining discount rate for the social cost of carbon (SC-CO<sub>2</sub>): EPA agrees that this is an important area of emerging research and will share these recommendations with the IWG. However, no widely-accepted declining discount rate schedule has yet been developed. Some key technical issues warrant careful consideration before adopting a declining discount rate schedule, such as determining how to update the discount rate schedule as uncertainty is resolved over time and ensuring that the use of declining discount rates does not lead to the possibility of time-inconsistent choices. A workshop sponsored by the federal government resulted in a paper in *Science* authored by thirteen prominent economists who concluded that a declining discount rate would be appropriate to analyze impacts that occur far into the future (Arrow et al., 2014). However, additional research and analysis is still needed to develop a methodology for implementing a declining discount rate and to understand the implications of applying these theoretical lessons in practice. The EPA will continue to follow and evaluate the latest science on the use of declining discount rates in intergenerational discounting.

In addition, EPA and other members of the U.S. Interagency Working Group on the social cost of carbon are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies' review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> and SC-N<sub>2</sub>O estimates. Going forward, the EPA will evaluate its approach to estimating the SC-GHGs based upon any feedback received from the Academies' panel.

**Organization:** Institute for Policy Integrity

#### **Institute for Policy Integrity, Excerpt 6**

*The IWG's choice of three IAMs was fully justified but should still be revisited in its next iteration.*

In its calculations of the SCC, the IWG relied on the three Integrated Assessment Models (IAMs) available at the time, all with a long record of peer-reviewed publications that link physical and economic effects: the Dynamic Integrated Model of Climate and the Economy (DICE),<sup>72</sup> the Climate Framework for Uncertainty, Negotiation, and Distribution (FUND),<sup>73</sup> and Policy Analysis of the Greenhouse Effect (PAGE).<sup>74</sup> The government's first SCC estimates, published in 2010, used the then-current versions of the models; the recent update employed revised, peer-reviewed versions of the models but maintained the underlying assumptions of the 2010 IWG analysis. As stated by the 2010 IWG, "the main objective of [the 2010 IWG modeling] process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures."<sup>75</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.14-15]

DICE, FUND, and PAGE are well-established, peer-reviewed models. They represent the state-of-the-art IAMs. Each of these models has been developed over decades of research, and has been subject to rigorous peer review, documented in the published literature. However, updates to the SCC should also consider other models that are similarly peer reviewed and based on the state of the art of climate-economic modeling. One such model is Climate and Regional Economics of Development (CRED); another is the World Bank's Environmental Impact and Sustainability Applied General Equilibrium (ENVISAGE) model. [EPA-HQ-OAR-2014-0827-1296-A1 p.15]

CRED borrows its fundamental structure from William Nordhaus's DICE and RICE models but also offers significant changes. For one, it uses updated damage functions and Marginal Abatement Cost Curves (MACC). Moreover, it uses different global equity weights, and uses additional state-of-the-art methodologies.<sup>76</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.15]

ENVISAGE represents a broader modeling effort by the World Bank, where perhaps the largest contribution is a more detailed sectoral breakdown, using 57 different sectors.<sup>77</sup> This level of analysis allows for a more detailed view of agriculture as well as food and energy sectors that are particularly important to any climate-economy modeling. [EPA-HQ-OAR-2014-0827-1296-A1 p.15]

Moreover, the broader policy and research community at large ought to consider creating the right incentive structure within the economic and scientific community to engage many more researchers on working with the core IAMs. Doing so could speed up the process of capturing the latest research on climate damages. [EPA-HQ-OAR-2014-0827-1296-A1 p.15]

No model fully captures the costs of climate impacts to society. In fact, virtually all uncertainties and current omissions point to a higher SCC value. That makes it essential to use the established IWG process, which provides for updating the SCC estimates every two to three years in order to capture the advances in physical and social sciences that have been incorporated into the models during the intervening period, in order to revisit both the choice of models and the key inputs used.<sup>78</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.15]

#### **Response:**

The EPA acknowledges the commenters' recommendations for potential opportunities to improve the social cost of carbon (SC-CO<sub>2</sub>) estimates and has considered each one in the context of this rulemaking, which uses the Marten et al. SC-CH<sub>4</sub> estimates. EPA recognizes the importance of the estimates to be as complete as possible and continues to engage in research on modeling and valuation of climate impacts. In addition, EPA and other members of the U.S. Interagency Working Group on the SC-CO<sub>2</sub> are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies' review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> estimates. Going forward, the EPA will evaluate its approach to estimating the SC-CO<sub>2</sub> and SC-CH<sub>4</sub> based upon any feedback received from the Academies' panel.

After careful evaluation of the full range of comments and associated technical issues described in this RTC, EPA has determined that it will continue to use the Marten et al. SC-CH<sub>4</sub> estimates in the final rulemaking analysis. In particular, the Marten et al. SC-CH<sub>4</sub> estimates represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental emissions changes into regulatory analysis. Therefore, EPA has presented the Marten et al. SC-CH<sub>4</sub> estimates in this rulemaking. EPA will continue to consider these comments and will share the recommendations with the IWG as it moves forward with the Academies process.

In addition, regarding model selection: EPA agrees that the selection of the three IAMs—DICE, FUND, and PAGE—was the most appropriate for the purpose of estimating the SC-CO<sub>2</sub>. EPA and all of the other IWG members made this determination when they began developing the SC-CO<sub>2</sub> estimates in 2009-2010. DICE, FUND, and PAGE are the most widely used and widely cited models in the

economic literature that link physical impacts to economic damages for the purposes of estimating the SC-CO<sub>2</sub>. Moving forward, EPA will continue to follow and evaluate the latest peer reviewed literature applying IAMs. As previously noted, EPA and all of the other IWG members are seeking external expert advice on the technical merits and challenges of using additional models (e.g., CRED, ENVISAGE) to estimate the SC-CO<sub>2</sub> and/or removing existing models from the ensemble (DICE, FUND, and PAGE) used to estimate the SC-CO<sub>2</sub>.

Finally, EPA agrees that it is important to update the SC-CO<sub>2</sub> periodically to incorporate improvements in the understanding of greenhouse gas emissions impacts. EPA will also share with the IWG the commenters' recommendation that the "broader policy and research community at large...consider creating the right incentive structure within the economic and scientific community to engage many more researchers on working with the core IAMs."

**Organization:** Institute for Policy Integrity

### **Institute for Policy Integrity, Excerpt 7**

***The IWG should update its socio-economic assumptions to reflect the latest Shared Socioeconomic Pathways (SSPs).***

One key input is the use of socio-economic scenarios reflected in the choice of economic growth rates and emissions trajectories. Current IWG socio-economic and emissions scenarios were chosen from the Stanford Energy Modeling Forum exercise, EMF-22, and consist of projections for income/consumption, population, and emissions (CO<sub>2</sub> and non- CO<sub>2</sub>). The IWG selected five sets of trajectories, four of which represent business as usual (BAU) trajectories (MiniCAM, MESSAGE, IMAGE, and MERGE models) and a fifth that represents a CO<sub>2</sub> emissions pathway with CO<sub>2</sub> concentrations stabilizing at 550 ppm. Given the possibility of increases in emissions above those expressed by Business As Usual Scenarios, a high- CO<sub>2</sub> emissions pathway should also be considered. The assumptions used in calculating the SCC should be updated regularly to reflect the latest thinking around possible scenarios, reflecting the latest Shared Socio-economic Pathways (SSPs).<sup>79</sup> These SSPs represent the latest, consistent pathways, feeding, for example, into the latest IPCC report. [EPA-HQ-OAR-2014-0827-1296-A1 p.16]

***The current inclusion of CO<sub>2</sub> fertilization benefits likely overstates its effects.***

The models do not reflect recent research on agricultural changes, which suggest the CO<sub>2</sub> fertilization is overestimated, particularly in the FUND model, and that much, if not all, of the fertilization benefits may be cancelled out by negative impacts on agriculture (e.g., extreme heat, pests, and weeds).<sup>80</sup> If the agency is not able to adequately model all agricultural impacts it should, at a minimum, remove CO<sub>2</sub> fertilization benefits. [EPA-HQ-OAR-2014-0827-1296-A1 p.16]

***The specific functional form assumptions in IAMs ought to be re-evaluated.***

Climate damages in IAMs are assumed to affect levels of economic output rather than economic growth rates. Similarly, standard modeling assumptions assume multiplicative damage functions— i.e. substitutability across economic sectors—rather than additive functions—i.e. limited substitutability across sectors. IAMs ought to probe the impacts of both assumptions. Recent literature supports the conclusion that climate change will effect economic growth rates.<sup>81</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.16]



Similarly, models ought to better capture the impacts of wildly heterogeneous climate damages. Each of the models used to calculate the SCC assume one representative household, going as far as to consider damages by relatively large regions. Such averaging ignores the enormously diverse effects of damages. It similarly contributes to not fully capturing the effects of extreme outcomes and tail risks. Instead, models ought to attempt to capture a much broader array of damages and climate impacts.<sup>82</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.16-17]

*The IWG used solid economic tools to address uncertainty and ought to go further in capturing the full extent of its implications.* [EPA-HQ-OAR-2014-0827-1296-A1 p.17]

The IWG was rigorous in addressing **uncertainty**. First, it conducted Monte Carlo simulations over the IAMs specifying different possible outcomes for climate sensitivity (represented by a Roe and Baker Distribution).<sup>83</sup> It also used five different emissions growth scenarios and three discount rates. Second, the IWG reported the various moments and percentiles<sup>84</sup> of the resulting SCC estimates. Third, the IWG put in place an updating process, e.g., the 2013 revision, which updates the models as new information becomes available.<sup>85</sup> As such, the IWG used the various tools that economists have developed over time to address the uncertainty inherent in estimating the economic cost of pollution: reporting various measures of uncertainty, using Monte Carlo simulations, and updating estimates as evolving research advances our knowledge of climate change. [EPA-HQ-OAR-2014-0827-1296-A1 p.17]

The Monte Carlo framework took a step toward addressing what is the most concerning aspect of climate change, the potential for **catastrophic damages**, i.e., low probability/high damage events. These damages come from: uncertainty in the underlying parameters in IAMs,<sup>86</sup> including the climate sensitivity parameter; climate tipping points<sup>87</sup>—thresholds that, when crossed, cause rapid, often irreversible changes in ecosystem characteristics; and “black swan” events—which refer to unknown unknowns.<sup>88</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.17]

The analysis used a right-skewed distribution of temperature (as captured in the Roe Baker climate sensitivity parameter) and an increasing, strictly convex damage function;<sup>89</sup> this correctly results in right-skewed distributions of damage and SCC estimates. By using the mean values of these estimates instead of the median, IWG estimates partially captured the effects of small probability, higher damages from high-level warming events.<sup>90</sup> To reflect uncertainty in estimates resulting from the right-skewed distribution of SCC estimates, the IWG reported the SCC value for the 95th percentile from the central 3% discount rate distribution.<sup>91</sup> This is done to reflect the estimation uncertainty in terms of the possibility of higher-than-expected economic impacts from climate change. [EPA-HQ-OAR-2014-0827-1296-A1 p.17-18]

While the IAMs take different approaches to explicitly modeling tipping points, which to a great extent is lacking in current versions of FUND and DICE, the IWG improved (but in no way fixed) the representation of uncertain catastrophic damages with the Monte Carlo analysis. Still, black swan events go completely unaddressed in the IWG modeling framework, and therefore the SCC estimates do not reflect the value of preventing the occurrence of catastrophic events.<sup>92</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.18]

In addition to choosing an appropriate discount rate and sensitivity analyses around different SSPs, another important parameter to which the SCC estimates are sensitive is Equilibrium Climate Sensitivity (ECS)—how the climate system responds to a constant radiative forcing, which is typically expressed as the temperature response to a doubling of CO<sub>2</sub> concentration in the atmosphere.<sup>93</sup> In its current iteration, the IWG conducted extensive sensitivity analyses over a range of equilibrium climate sensitivity estimates.<sup>94</sup> The assumptions are clearly stated in the TSD. In addition to its sensitivity analysis, the

IWG conducted a Monte Carlo simulation over the climate sensitivity parameter and the other random variables specified within the three IAMs.<sup>95</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.18]

The range for the Equilibrium Climate Sensitivity (ECS) is derived from a combination of methods that constrain the values from measurements in addition to models. These include measured ranges from paleoclimate records, observed comparisons with current climate, as well as responses to recent climate forcings. The currently agreed “likely” range for the ECS (from both the IPCC TAR and AR5) is 1.5-4.5 degrees Celsius. Physical constraints make it “extremely unlikely” that the ECS is less than 1 degree Celsius and “very unlikely” greater than 6 degrees Celsius.<sup>96</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.18]

A host of analyses points to the costs of such uncertainty—both for values that go outside the “likely” range and for uncertainty within it: in short, the optimal SCC tends to increase with increased uncertainty, sometimes dramatically so.<sup>97</sup> While the current treatment of uncertainty around climate sensitivity by the IWG highlights a range of possible uncertainties, a reconsideration of the assumptions feeding into the SCC ought to take the latest advances highlighting the potentially higher costs of deep-seated uncertainty into account. Additionally, the IWG should consider whether it relies too heavily on its 95th percentile estimates as a catchall to cover for limitations in its treatment of uncertainty and catastrophic damages. [EPA-HQ-OAR-2014-0827-1296-A1 p.19]

#### **Response:**

The EPA acknowledges the commenters’ recommendations for potential opportunities for the IWG to update the scenarios for the SC-CO<sub>2</sub> and has considered it in the context of this rulemaking, which uses the Marten et al. SC-CH<sub>4</sub> estimates. EPA has acknowledged that the projection of the scenarios beyond 2100 has greater uncertainty than shorter-term projections and will continue to monitor the literature, including the development of extended RCP/SSP scenarios, for ways to improve the estimated trajectories and improve internal consistency. EPA and other members of the IWG on the SC-CO<sub>2</sub> are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies’ review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> estimates. Going forward, the EPA will evaluate its approach to estimating the SC- CO<sub>2</sub> and SC-CH<sub>4</sub> based upon any feedback received from the Academies’ panel.

Regarding the remaining comments (i.e., treatment of CO<sub>2</sub> fertilization benefits, the recommendation to re-evaluate the functional form assumptions in the IAMs, treatment of uncertainty): As noted in the OMB Response to Comments on SC-CO<sub>2</sub>, to date, the interagency working group (IWG) has accepted the models as currently constituted, and omitted any damages or beneficial effects that the model developers themselves do not include.<sup>214</sup> The IWG recognizes that none of the three IAMs fully incorporates all climate change impacts, either positive or negative. Some of the effects referenced by commenters (e.g., “catastrophic” effects, disease, and CO<sub>2</sub> fertilization) are explicitly modeled in the damage functions of one or more of the current models (although the treatment may not be complete), and the model developers continue to update their models as new research becomes available. In fact, the IWG undertook the 2013 SC-CO<sub>2</sub> revision because of updates to the models, which include new or

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<sup>214</sup> OMB’s Response to Comments on SC-CO<sub>2</sub> is available at <https://www.whitehouse.gov/sites/default/files/omb/inforg/scc-response-to-comments-final-july-2015.pdf>

enhanced representation of certain impacts, such as sea level rise damages. In addition, some of the categories mentioned by commenters are currently speculative or cannot be incorporated into the damage function for lack of appropriate data. Using an ensemble of three different models was intended to, at least partially, address the fact that no single model includes all of the impacts. EPA recognizes that there may be effects that none of the three selected models addresses (e.g., impacts from ocean acidification) or that are likely not fully captured (e.g. catastrophic effects).

EPA also recognizes that the impacts of climate change on agriculture is an area of active research and that methodological and data challenges persist. As a result there is uncertainty as to the magnitude of these impacts and the role of interactions between changes in the climate and other factors, such as CO<sub>2</sub> fertilization, temperature, precipitation, ozone, pests, etc. Additionally, these effects are likely to vary widely across regions and crops. However, with high confidence the IPCC (2013) stated in its Fifth Assessment Report (AR5) that "[b]ased on many studies covering a wide range of regions and crops, negative impacts of climate change on crop yields have been more common than positive impacts." As noted above, the IWG's approach to date has been to rely on the damage functions included in the three IAMs by their developers.

EPA recognizes that it is important to update the SC-CO<sub>2</sub> periodically to incorporate improvements in the understanding of greenhouse gas emissions impacts and will continue to follow and evaluate the latest science on impact categories that are omitted or not fully addressed in the IAMs. EPA and other members of the U.S. Interagency Working Group on the social cost of carbon are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies' review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> estimates. Going forward, the EPA will evaluate its approach to estimating the SC- CO<sub>2</sub> and SC-CH<sub>4</sub> based upon any feedback received from the Academies' panel.

In addition, EPA notes that in two of the IAMs (DICE and FUND), climate damages do affect the realized rate of economic growth in the models. However, EPA recognizes that the magnitude and pathway by which climate change may affect economic growth rates is an active area research.

After careful evaluation of the full range of comments and associated technical issues described in this Response to Comments, EPA has determined that it will continue to use the Marten et al. SC-CH<sub>4</sub> estimates in the final rulemaking analysis. In particular, the Marten et al. SC-CH<sub>4</sub> estimates represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental emissions changes into regulatory analysis. Therefore, EPA has presented the Marten et al. SC-CH<sub>4</sub> estimates in this rulemaking. EPA will continue to consider these comments, including the commenters' question about use of the 95th percentile estimate, and will share the recommendations with the IWG as it moves forward with the Academies process.

**Organization:** Institute for Policy Integrity

**Institute for Policy Integrity, Excerpt 8**

**5. Support for the Social Cost of Methane methodology, and recommendations on continued improvements.**

The agencies expect the heavy-duty truck standards to decrease methane emissions because of reduced refueling, the use of less methane-intensive auxiliary power units in lieu of diesel engines during idling, and upstream emission reductions as overall fuel demand falls.<sup>98</sup> EPA also proposes a methane cap for engines and standards for natural gas vehicles.<sup>99</sup> (EPA considers, if natural gas vehicles displace diesel vehicles, whether the resulting greenhouse gas impacts would be positive or negative, but make no conclusion other than the impact would be minor; however, clearly this could have a substantial impact on the net methane emissions of the rule.<sup>100</sup>) The agencies estimate that the standards could reduce up to 232,000 metric tons of methane per year (which is up to 5.8 million metric tons of carbon dioxide-equivalent per year, according to the agencies' low global warming potential estimate of 25, or approximately between 8.4 million and 20.4 million metric tons using the latest IPCC values for methane's relative global warming potential).<sup>101</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.19]

EPA and NHTSA do not, however, include a monetary estimate of these methane reductions in their net benefits calculations. Instead, EPA conducts a sensitivity analysis that examines two different methodologies: (1) converting methane reductions to carbon dioxide-equivalent units using relative global warming potentials, or (2) directly estimating the Social Cost of Methane using a methodology based on the same techniques the Interagency Working Group developed to estimate the SCC. EPA indicates that it plans use the Social Cost of Methane approach in the rule's final regulatory impact analysis, pending favorable review of a recent analysis conducted by Marten *et al.*<sup>102</sup> That review has now, in fact, been completed, and EPA is already using the Social Cost of Methane approach in other proposed rulemakings.<sup>103</sup> In the final heavy-duty truck rule, EPA and NHTSA should both use the Social Cost of Methane metric—to more accurately reflect the true benefits of the standards and to enhance the rigor and defensibility of the final rule.<sup>104</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.19-20]

The Interagency Working Group on the Social Cost of Carbon has, to date, focused exclusively on carbon dioxide. The SCC can be roughly adjusted to approximate the costs of other greenhouse gases by multiplying by the relative global warming potential of those gases. Scientists, however, have long argued that the full social costs of specific, non-carbon dioxide gases like methane should be assessed through separate models and methodologies, which would more accurately account for varying atmospheric life spans, among other differences.<sup>105</sup> At least a dozen published studies, dating back to 1993, have estimated the social cost of non-carbon dioxide greenhouse gases, including methane.<sup>106</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.20]

EPA proposes to use Social Cost of Methane estimates based on one of the most recent peer-reviewed articles: Marten *et al.*<sup>107</sup> Marten *et al.* takes a reasonable (although conservative) approach to estimating the Social Cost of Methane and currently constitutes “the best available science” to inform agency regulation.<sup>108</sup> Specifically, Marten *et al.* builds on the methodology used by the Interagency Working Group to develop the SCC. The study maintains the same three integrated assessment models, five socioeconomic-emissions scenarios, equilibrium climate sensitivity distribution, three constant discount rates, and aggregation approach that were agreed upon by the Interagency Working Group. Consequently, many of the key assumptions underlying the Social Cost of Methane estimates have already gone through a transparent, consensus-driven, publically reviewed, regularly updated process, since they were borrowed from the Interagency Working Group's thoroughly vetted methodology. [EPA-HQ-OAR-2014-0827-1296-A1 p.20]

Yet while sharing that carefully built framework with the SCC estimates, Marten *et al.*'s Social Cost of Methane estimates directly account for the quicker time horizon of methane's effects compared to carbon dioxide, include the indirect effects of methane on radiative forcing, and reflect the complex, nonlinear linkages along the pathway from methane emissions to monetized damages. Marten *et al.* was not only published in a peer reviewed economics journal, but EPA undertook additional internal and

peer review of the approach.<sup>109</sup> Marten *et al.*'s estimates thus are reasonable and appropriate measurements of the Social Cost of Methane. [EPA-HQ-OAR-2014-0827-1296-A1 p.20]

In fact, Marten *et al.*'s estimates are conservative and very likely underestimate the true Social Cost of Methane. To start, as the authors note, because their methodology followed the Interagency Working Group's approach, all limitations that apply to inputs and modelling assumptions for the SCC also apply to the Social Cost of Methane. As discussed above, omitted damages, socio-economic assumptions, the treatment of uncertainty and catastrophic damages, and so forth all suggest the Social Cost of Methane is underestimated, just as the SCC is. [EPA-HQ-OAR-2014-0827-1296-A1 p.20]

Additionally, the integrated assessment models shared by both the Social Cost of Methane and the SCC include some features better suited to assessing carbon dioxide effects than methane effects, and so likely underestimate the costs of methane. For example, a countervailing benefit of carbon dioxide emissions—enhanced fertilization in the agricultural sector—is included in the underlying models used to develop both the SCC and Social Cost of Methane, yet does not apply to methane emissions.<sup>110</sup> Similarly, the damage functions used by the integrated assessment models assume some level of adaptation to climate change over time, but because methane is a much faster-acting climate pollutant than carbon dioxide, there is less opportunity for technological advancement or political progress to adapt to the climate damages imposed by methane emissions. Methane also has indirect but significant effects, via its contribution to surface ozone levels, on global health and agriculture, and such effects need to be included either in the Social Cost of Methane or elsewhere in the cost-benefit analysis, but currently are not.<sup>111</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.20-21]

Overall, the Marten *et al.* methodology provides reasonable, direct estimates that reflect updated evidence and provide consistency with the Government's accepted methodology for estimating the SCC. The agencies should use these Social Cost of Methane estimates in the final heavy-duty truck rule. Doing so would increase the total net present value of the rule's greenhouse gas benefits by about \$1.5 billion to \$12 billion (2012\$), or approximately 4 to 7 percent, depending on discount rate.<sup>112</sup> [EPA-HQ-OAR-2014-0827-1296-A1 p.21]

At the same time, the agencies should work toward the future refinement of these Social Cost of Methane estimates. Because the Social Cost of Methane and the SCC share many assumptions and methods, it may make sense for the Interagency Working Group to review and update both metrics. In any case, any future improvements made to the SCC methodology should also be incorporated into and adjusted for the Social Cost of Methane estimates. [EPA-HQ-OAR-2014-0827-1296-A1 p.21]

If the agencies for some reason decline to follow the Marten *et al.* approach, they could still use the global warming potential adjustment as a less accurate, lower-bound estimate. However, instead of the outdated multiplier of 25 for methane, the agencies should utilize the latest global warming potential estimates for methane issued by the IPCC: 85 to 87 times greater than carbon dioxide after 20 years and 30 to 36 times greater than carbon dioxide after 100 years (after making the recommended adjustment for fossil methane).<sup>113</sup> Given the short life of methane, the agencies should at least conduct sensitivity analysis over the entire global warming potential range, instead of merely utilizing the lower 100-year timescale range. Again, though, the Social Cost of Methane approach is the more reasonable and preferred way to value this rule's important methane reductions. [EPA-HQ-OAR-2014-0827-1296-A1 p.21-22]

**Response:**

EPA acknowledges this comment and notes that the recommendation about using a global warming potential adjustment is no longer relevant because EPA has used the Marten et al. (2014) social cost of methane (SC-CH<sub>4</sub>) and social cost of N<sub>2</sub>O (SC-N<sub>2</sub>O) estimates to monetize the climate-related impacts of this rulemaking. EPA has included those estimates in the main benefits analysis. EPA agrees that the Marten et al. methodology provides reasonable, direct estimates that reflect updated evidence and provide consistency with the interagency working group's (IWG) SC-CO<sub>2</sub> estimates.

EPA recognizes the importance of the SC-GHG estimates to be as complete as possible and continues to engage in research on modeling and valuation of climate impacts, which would support improvements to SC-CH<sub>4</sub>, SC-N<sub>2</sub>O, and SC-CO<sub>2</sub> estimates. EPA will share with the interagency working group (IWG) the commenters' recommendation to consider reviewing and updating both SC-CO<sub>2</sub> and the SC-CH<sub>4</sub>. EPA will continue to follow and evaluate the latest science on impact categories that are omitted or not fully addressed in the IAMs. As previously noted, EPA and the other IWG members are seeking external expert advice on the technical merits and challenges of potential approaches to update the damage functions in future revisions to the SC-CO<sub>2</sub> estimates, which would likely inform updates to the SC-CH<sub>4</sub> estimates. See response to Institute for Policy Integrity, Excerpt 7, in RTC Section 11.8, for complete discussion.

**Organization:** Institute for Policy Integrity

#### **Institute for Policy Integrity, Excerpt 9**

#### **6. Conclusion: Recommendations on the use of the SCC and Social Cost of Methane in regulatory impact analyses.**

EPA and NHTSA should continue to use the latest IWG estimates of the SCC, and should start using the Social Cost of Methane estimates. The current estimates are biased downwards: more can and should be done to improve the estimates and to ensure, through regular updates, that they reflect the latest science and economics. However, the necessary process of improving the ability of the SCC and Social Cost of Methane to fully reflect the costs of climate impacts to society cannot hold up agency rulemaking efforts. The values provide an important, if conservative, estimate of the costs of climate change and the benefits of reducing carbon pollution. To ignore these costs would be detrimental to human health and well-being and contrary to law and Presidential directives to agencies to evaluate the cost of pollution to society when considering standards to abate that pollution. In the context of agency rulemakings, the SCC and Social Cost of Methane provide the best available means to factor those costs into benefit-cost analyses. [EPA-HQ-OAR-2014-0827-1296-A1 p.22]

In using the estimates in their regulatory impact analyses, however, EPA and NHTSA should also include a qualitative assessment of all significant climate effects that are not currently quantified in the monetized estimate. The IWG acknowledged its incomplete treatment of both catastrophic and non-catastrophic damages, and instructed agencies that "These caveats. . . are necessary to consider when interpreting and applying the SCC estimates."<sup>114</sup> Those instructions are consistent with Executive Orders on regulatory analysis, which tell agencies to "assess. . . qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider."<sup>115</sup> Before the IWG published its first estimates in 2010, some agencies included a detailed chart of unquantified climate effects in their regulatory impact analyses.<sup>116</sup> However, most recent rulemakings only reference unquantified benefits from non- CO<sub>2</sub> gases and from co-pollutants, and list none of the significant, unquantified climate effects from carbon dioxide.<sup>117</sup> In the final greenhouse gas and fuel efficiency standards and the final regulatory impact analyses, EPA and NHTSA should detail all significant,

unquantified climate effects, as consistent with administration-wide policy, the IWG's instructions, past agency practices, and best economic practices. [EPA-HQ-OAR-2014-0827-1296-A1 p.22-23]

We also suggest that EPA and NHTSA encourage the IWG to regularly update the SCC and Social Cost of Methane, as new economic and scientific consensus emerges. Such updates are in line with the stated intentions of the IWG, which committed to "updating these estimates as the science and economic understanding of climate change... improves." [EPA-HQ-OAR-2014-0827-1296-A1 p.23]

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1 Exec. Order No. 13,563 §§ 1(b)-(c), 76 Fed. Reg. 3,821 (Jan. 18, 2011); *see also infra* on how this and subsequent orders, including Exec. Order No. 13,609, inform the use of a global SCC value.

2 President Clinton issued Executive Order 12,866 in 1993, establishing new guidance for benefit-cost analysis and explicitly directing agencies to consider, in addition to costs and benefits for which quantitative estimates are possible, "qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider." Exec. Order No. 12,866 § 1(a), 58 Fed. Reg. 51,735 (Sept. 30, 1993).

3 *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1199 (9th Cir. 2008) (holding unlawful NHTSA's fuel economy standards for passenger vehicles when NHTSA ascribed a value of "zero" to the benefits of mitigating carbon dioxide, reasoning that "NHTSA assigned no value to *the most significant benefit* of more stringent CAFE standards: reduction in carbon emissions" (emphasis added)).

4 The IWG involved a large number of agencies, including the Council of Economic Advisers, Council on Environmental Quality, Department of Agriculture, Department of Commerce, Department of Transportation, Environmental Protection Agency, National Economic Council, Office of Energy and Climate Change, Office of Management and Budget, Office of Science and Technology Policy, and the Department of the Treasury. *See* INTERAGENCY WORKING GROUP ON THE SOCIAL COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12,866 (2010) [hereinafter "2010 TSD"], *available at* <http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf>.

5 The SCC has been used in numerous notice-and-comment rulemakings by various agencies since it was published in 2010, and each of these occasions has provided opportunity for public comment on the SCC. *See, e.g.*, Energy Conservation Program: Energy Conservation Standards for Residential Clothes Washers, 77 Fed. Reg. 32,381 (May 31, 2012); Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers, 77 Fed. Reg. 31,964 (May 30, 2012); Energy Conservation Program: Energy Conservation for Battery Chargers and External Power Supplies, 77 Fed. Reg. 18,478 (Mar. 27, 2012); Energy Conservation Program: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens, 77 Fed. Reg. 8526 (Feb. 14, 2012); Energy Conservation Program: Energy Conservation Standards for Distribution Transformers, 77 Fed. Reg. 7282 (Feb. 10, 2012); Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment, 77 Fed. Reg. 2356 (Jan. 17, 2012); 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74,854 (Dec. 1, 2011); Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 76 Fed. Reg. 52,738 (Aug. 23, 2011); Energy Conservation Program: Energy

Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps, 76 Fed. Reg. 37,549 (June 27, 2011); Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers and Room Air Conditioners, 76 Fed. Reg. 22,324 (Apr. 21, 2011); Energy Conservation Program: Energy Conservation Standards for Fluorescent Lamp Ballasts, 76 Fed. Reg. 20,090 (Apr. 11, 2011); National Emission Standards for Hazardous Air Pollutants: Mercury Emissions from Mercury Cell Chlor-Alkali Plants, 76 Fed. Reg. 13,852 (Mar. 14, 2011); Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 75 Fed. Reg. 74,152 (Nov. 30, 2010); Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Sewage Sludge Incineration Units, 75 Fed. Reg. 63,260 (Oct. 14, 2010); Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers, 75 Fed. Reg. 59,470 (Sept. 27, 2010); Federal Implementation Plans to Reduce Interstate Transport of Fine Particulate Matter and Ozone, 75 Fed. Reg. 45,210 (Aug. 2, 2010). The undersigned organizations have provided comment on the SCC in a number of these proceedings.

6 INTERAGENCY WORKING GROUP ON THE SOCIAL COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12,866 (2015); *see also* INTERAGENCY WORKING GROUP ON THE SOCIAL COST OF CARBON, TECHNICAL SUPPORT DOCUMENT: TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12,866 (2013) [hereinafter “2013 TSD”], *available at* <http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf>.

7 *See generally* Thomas C. Peterson et al. eds., *Explaining Extreme Events of 2012 from a Climate Perspective*, 94 BULL. AMER. METEOR. SOC. S1-74 (2013), and IPCC, *Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (2012). On the scientific research connecting weather and other climate-related events to climate change, see Peter A. Stott et al., “Attribution of Weather and Climate-Related Events.” In *Climate Science for Serving Society*, edited by Ghassem R. Asrar and James W. Hurrell. Netherlands: Springer s307-37 (2013).

8 *See generally* 2010 TSD, *supra* note 4.

9 GAO, REGULATORY IMPACT ANALYSIS: Development of Social Cost of Carbon Estimates, GAO-14-663 (2014).

10 The 2010 and 2013 IWGs did very little to adjust the three IAMs. The main adjustment by IWG was to DICE to ensure that the IAM had an exogenous growth path that matched FUND and PAGE for the purposes of modeling various socio-economic and emission scenarios. *Id.* at 24.

11 OMB & Interagency Working Group, Response to Comments on Social Cost of Carbon (July 2015).

12 OMB, Notice of Availability and Request for Comments, Technical Support Documents: Social Cost of Carbon for Regulatory Impact Analysis, 78 Fed. Reg. 70,586 (Nov. 26, 2013).

13 *Ctr. for Biological Diversity v. Nat’l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1200 (9th Cir. 2008) (emphases added).

14 Stuart Shapiro, *The Evolution of Cost--? Benefit Analysis in U.S. Regulatory Decision making*, in HANDBOOK ON THE POLITICS OF REGULATION 385-392 (David Levi-Faur ed., 2011).



15 Exec. Order No. 13,563 §§ 1(a)-(c), 76 Fed. Reg. 3,821 (Jan. 18, 2011) (emphasis added).

16 Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

17 See *infra* notes 26 and 32 to 35, and accompanying text, detailing use of a global SCC value by Canada, Mexico, the United Kingdom, France, Germany, and Norway.

18 See ROBERT AXELROD, THE EVOLUTION OF COOPERATION 10-11 (1984) (on repeated prisoner's dilemma games).

19 EXEC. OFFICE OF THE PRES., THE PRESIDENT'S CLIMATE ACTION PLAN 17-21 (2013).

20 Phillip R. Trimble, *The President's Foreign Affairs Power*, 83 AM. J. OF INTL. L. 750, 755 (1989).

21 See David Remnick, *The Obama Tapes*, NEW YORKER, Jan. 23, 2014, *available at*

<http://www.newyorker.com/online/blogs/newsdesk/2014/01/the-obama-tapes.html> (quoting interview with President Obama: “[M]y goal has been to make sure that the United States can genuinely assert leadership in this issue internationally, that we are considered part of the solution rather than part of the problem. And if we are at the table in that conversation with some credibility, then it gives us the opportunity to challenge and engage the Chinese and the Indians, as long as we take into account the fact that they’ve still got, between the two of them, over a billion people in dire poverty. . . . This is why I’m putting a big priority on our carbon action plan here. It’s not because I’m ignorant of the fact that these emerging countries are going to be a bigger problem than us. It’s because it’s very hard for me to get in that conversation if we’re making no effort.”).

22 UNITED STATES-CANADA REGULATORY COOPERATION COUNCIL, JOINT ACTION PLAN, at 16 (2011), *available at* [http://www.whitehouse.gov/sites/default/files/omb/oira/irc/us-canada\\_rcc\\_joint\\_action\\_plan.pdf](http://www.whitehouse.gov/sites/default/files/omb/oira/irc/us-canada_rcc_joint_action_plan.pdf).

23 UNITED STATES-MEXICO HIGH-LEVEL REGULATORY COOPERATION COUNCIL, WORK PLAN at 3 (2012), *available at* <http://www.whitehouse.gov/sites/default/files/omb/oira/irc/united-states-mexico-high-level-regulatory-cooperation-council-work-plan.pdf>.

24 *Id.* at 11 (noting that oil drilling activities in the Gulf of Mexico conducted by either country “present risks for both countries, and both countries would benefit from a common set of drilling standards”).

25 See INT’L COUNCIL ON CLEAN TRANSP., MEXICO LIGHT-DUTY VEHICLE CO<sub>2</sub> AND FUEL ECONOMY STANDARDS 4 (Policy Update, July 2013), *available at* [http://www.theicct.org/sites/default/files/publications/ICCTupdate\\_Mexico\\_LDVstandards\\_july2013.pdf](http://www.theicct.org/sites/default/files/publications/ICCTupdate_Mexico_LDVstandards_july2013.pdf) (noting that Mexico’s standards were based on the U.S. and Canadian standards).

26 See Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations, SOR/2013-24, 147 Can. Gazette pt. II, 450, 544 (Can.), *available at* <http://canadagazette.gc.ca/rp-pr/p2/2013/2013-03-13/html/sor-dors24-eng.html> (“The SCC is used in the modelling of the cost-benefit analysis . . . It represents an estimate of the economic value of avoided climate change damages *at the global level*. . . . The values used by Environment Canada are based on the extensive work of the U.S. Interagency

Working Group on the Social Cost of Carbon.”) (emphasis added); Instituto Nacional de Ecología, Mexico, Regulatory Impact Analysis on *PROY-NOM-163- SEMARNAT-ENER-SCFI-2012, Emisiones de bióxido de carbono (CO<sub>2</sub>) provenientes del escape y su equivalencia en términos de rendimiento de combustible, aplicable a vehículos automotores nuevos de peso bruto vehicular de hasta 3857 kilogramos* (July 5, 2012), available at <http://207.248.177.30/mir/formatos/defaultView.aspx?SubmitID=273026> (“[S]e obtienen beneficios ambientales por la reducción del consumo de combustible, los cuales se reflejan en beneficios a la salud de la población en el caso de contaminantes criterio, y en *beneficios globales para las emisiones evitadas de CO<sub>2</sub>*.”) (emphasis added).

27 Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations, SOR/2012-167, 146 Can. Gazette pt. II, 1951, 2000, 2044 (Can.), available at <http://www.gazette.gc.ca/rp-pr/p2/2012/2012-09-12/html/sor-dors167-eng.html>.

28 \$5.6 billion in Canadian dollars is worth \$5.0 billion in U.S. dollars (using February 2014 conversion rates). Seven to twenty-three percent of \$5 billion is between \$350 million and \$1.15 billion. See 2010 TSD, *supra* note 4, at 11 (provisionally calculating the direct U.S. share of a global SCC value at between 7-23%, though ultimately recommending “that using the global (rather than domestic) value ... is the appropriate approach,” for reasons consistent with these comments).

29 See EUR. COMM’N, TRANSATLANTIC TRADE AND INVESTMENT PARTNERSHIP: THE REGULATORY PART (2013).

30 See SIERRA CLUB, THE TRANSATLANTIC FREE TRADE AGREEMENT: WHAT’S AT STAKE FOR COMMUNITIES AND THE ENVIRONMENT at 9-10 (2013).

31 Eur. Comm’n, Working with International Partners, <http://www.e.europa.eu/clima/policies/international> (“The EU is offering to step up its 2020 reduction targets to 30% if other major economies commit.”).

32 ECONOMICS GROUP, DEFRA, U.K., THE SOCIAL COST OF CARBON AND THE SHADOW PRICE OF CARBON: WHAT THEY ARE, AND HOW TO USE THEM IN ECONOMIC APPRAISAL IN THE UK 1 (2007); see also Ministry of Finance, Norway, Cost-Benefit Analysis: Carbon Price Paths, available at <http://www.regjeringen.no/en/dep/fin/Documents-and-publications/official-norwegian-reports-/2012/nou-2012-16-2/10.html?id=713585> (“The United Kingdom has changed its method for the valuation of greenhouse gas emissions. Prior to 2009, the estimated global social cost of carbon was used, but one [sic] has now switched over to pricing in line with the necessary marginal cost of meeting long-term domestic emission reduction targets in conformity with the EU Climate and Energy Package.”).

33 See Balázs Égert, *France’s Environmental Policies: Internalising Global and Local Externalities* 8-10 (OECD Economics Department Working Papers No. 859, 2011), available at <http://dx.doi.org/10.1787/5kgdnp0n9d8v-en> (discussing global impacts and France’s history of calculating the SCC); Oskar Lecuyer & Philippe Quirion, funded by the European Union’s Seventh Framework Programme, *Choosing Efficient Combinations of Policy Instruments for Low-Carbon Development and Innovation to Achieve Europe’s 2050 Climate Targets—Country Report: France* at 8 (2013) (noting the prospects for a carbon tax in 2014-15, and explaining that “A 2009 stakeholder and expert group led by the ‘Conseil d’analyse stratégique’ (a public body in charge of expertise and stakeholder dialogue) set the optimal level of the carbon tax (the social cost of carbon) at € 32/tCO<sub>2</sub> in 2010, and rising to € 100 in 2030 and € 200 in 2050.”).

34 Testimony of Howard Shelanski, OIRA Admin., before the H. Comm. on Oversight & Gov't Reform's Subcomm. on Energy Policy, Healthcare, and Entitlements, July 18, 2013, at 3 (explaining that the global SCC value estimated by the IWG is consistent with values used by Germany and the United Kingdom).

35 See Ministry of Finance, *supra* note 32 (explaining that, for projects not already covered by a binding emission limitation, the carbon price should “be based on the marginal social cost of carbon,” meaning “the global cost of emitting one additional tonne of CO<sub>2</sub>e”). Note that Norway has joined the E.U.'s trading scheme.

36 Henrik Hammar, Thomas Sterner & S. Åkerfeldt, *Sweden's CO<sub>2</sub> Tax and Taxation Reform Experiences*, in REDUCING INEQUALITIES: A SUSTAINABLE DEVELOPMENT CHALLENGE (Genevey, R. et al. eds., 2013).

37 *E.g.*, Benedict Clements et al., International Monetary Fund, *Energy Subsidy Reforms: Lessons and Implications* 9 (IMF Policy Paper, Jan. 28, 2013).

38 See Natsu Taylor Saito, *Decolonization, Development, and Denial*, 6 FL. A & M U. L. REV. 1, 16 (2010) (quoting former IMF counsel as saying “today it is common to find these institutions [IMF and World Bank] requiring their borrowing member countries to accept and adhere to prescribed policies on environmental protection”).

39 See PHILIPPE SANDS, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 241 (2d ed. 2003) (noting that “the responsibility not to cause damage to the environment of other states or of areas beyond national jurisdiction has been accepted as an obligation by all states[;] . . . there can be no questions but that Principle 21 [of the Stockholm Declaration on the Human Environment] reflects a rule of customary international law”).

40 See Paul Baer & Ambuj Sagar, *Ethics, Rights and Responsibilities*, in CLIMATE CHANGE SCIENCE AND POLICY (Stephen Schneider et al., eds., 2009).

41 United Nations Framework Convention on Climate Change, May 9, 1992, S. Treat Doc. No. 102-38, 1771 U.N.T.S. 107, Article 3(3) (emphasis added); *see also id.* at Article 3(1) (“The Parties should protect the climate system for the *benefit of present and future generations of humankind*, on the basis of *equity* and in accordance with their common but *differentiated responsibilities* and respective capabilities.”) (emphasis added); *id.* at Article 4(2)(a) (committing developed countries to adopt policies that account for “the need for equitable and appropriate contributions by each of these Parties to the global effort”).

42 *Id.* at Article 4(1)(f) (emphasis added); *see also id.* at Article 3(2) (requiring parties to give “full consideration” to those developing countries “particularly vulnerable to the adverse effects of climate change”). *See also* North American Agreement on Environmental Cooperation (1993), 32 I.L.M. 1480, art. 10(7) (committing the United States to the development of principles for transboundary environmental impact assessments).

43 42 U.S.C. § 4332(2)(F).

44 COUNCIL ON ENVIRONMENTAL QUALITY, GUIDANCE ON NEPA ANALYSIS FOR TRANSBOUNDARY IMPACTS (1997), *available at* <http://www.gc.noaa.gov/documents/transguide.pdf>; *see also* CEQ, DRAFT NEPA GUIDANCE ON

CONSIDERATION OF THE EFFECTS OF CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS at 2 (2010), available at

<http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf> (defining climate change as a “global problem”); *see also* Exec. Order No. 12,114, *Environmental Effects Abroad of Major Federal Actions*, 44 Fed. Reg. 1957 §§ 1-1, 2-1 (Jan. 4, 1979) (applying to “major Federal actions... having significant effects on the environment outside the geographical borders of the United States,” and enabling agency officials “to be informed of pertinent environmental considerations and to take such considerations into account ... in making decisions regarding such actions”).

45 42 U.S.C. § 7415.

46 For details on the applicability of Section 115, see Petition from the Institute for Policy Integrity, to EPA, for Rulemakings and Call for Information under Section 115, Title VI, Section 111, and Title II of the Clean Air Act to Regulate Greenhouse Gas Emissions (Feb. 19, 2013); *see also* Nathan Richardson, *EPA and Global Carbon: Unnecessary Risk*, COMMON RESOURCES, Feb. 28, 2013 (explaining how Section 115 authorizes use of a global SCC value when regulating under other Clean Air Act provisions).

47 77 Fed. Reg. 26,413 (May 4, 2012).

48 *Id.* § 1 (explaining the order intends to “promot[e] the goals of Executive Order 13563”); *see also* Exec. Order No. 13,563, *Improving Regulation and Regulatory Review*, § 1(b), 76 Fed. Reg. 3821 (Jan. 18, 2011) (reaffirming Exec. Order No. 12,866, 58 Fed. Reg. 51,741 (Sept. 30, 1993) and requiring benefit-cost analysis).

49 OMB, CIRCULAR A-4, at 15 (2003). In sharp contrast to the Circular’s ultimate deferral to agencies on the issue of considering transboundary efficiency effects, the Circular makes very clear that international transfers and distributional effects should be assessed as costs and benefits to the United States: “Benefit and cost estimates should reflect real resource use. Transfer payments are monetary payments from one group to another that do not affect total resources available to society. . . . However, transfers from the United States to other nations *should* be included as costs, and transfers from other nations to the United States as benefits, as long as the analysis is conducted from the United States perspective.” *Id.* at 38 (emphasis original). In other words, even if federal agencies use a global SCC value to assess efficiency effects relating to their climate policies, that global valuation will not prevent the agencies from also counting international transfers or distributional effects that benefit the United States as benefits. *See* Comments from the Institute for Policy Integrity, to EPA, on Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards, at 12-13 (Nov. 27, 2009) (explaining that, depending on the relevant statutory mandate, agencies may calculate a monopsony benefit to the United States even while using a global SCC value).

50 77 Fed. Reg. at 26,414, § 3(b).

51 77 Fed. Reg. at 26,413, § 2(a)(ii)(B) (defining the goals of the regulatory working group).

52 EPA, REGULATORY IMPACT ANALYSIS FOR THE FINAL MERCURY AND AIR TOXICS STANDARDS at 65 (2011) (“Reductions in domestic fish tissue concentrations can also impact the health of foreign consumers... [and] reductions in U.S. power plant emissions will result in a lowering of the global burden of elemental mercury ....”).

53 Federal Implementation Plans to Reduce Interstate Transport of Fine Particulate Matter and Ozone, 75 Fed. Reg. 45,209, 45,351 (Aug. 2, 2010).

54 *E.g.*, Unique Device Identification System, 78 Fed. Reg. 58,786 (Sept. 24, 2013) (“[I]n our final regulatory impact analysis we include an estimate of the costs to foreign labelers.”); Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption, 78 Fed. Reg. 3504 (Jan. 16, 2013) (including costs to foreign farms); U.S. Customs and Border Protection Regulatory Agenda, RIN 1651-AA96 Definition of Form I-94 to Include Electronic Format (2013) (preliminarily estimating net benefits to foreign travelers and carriers).

55 Steven L. Schwarz, *Systemic Risk*, 97 GEO. L.J. 193, 249 (2008) (observing that financial collapse in one country is inevitably felt beyond that country’s borders).

56 *See, e.g.*, Department of Defense, Climate Change Adaptation Roadmap (2014); CNA Military Board, National Security and the Accelerating Risks of Climate Change (2014).

57 2010 TSD, *supra* note 4, at 10-11.

58 2013 TSD, *supra* note 6, at 14-15.

59 The following section relies heavily on Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014), on Gernot Wagner & Martin L. Weitzman, *Climate Shock*, Princeton University Press (2015), on Frank J. Convery & Gernot Wagner, *Reflections—Managing Uncertain Climates: Some Guidance for Policy Makers and Researchers* (forthcoming in REVIEW OF ENVIRONMENTAL ECONOMICS AND POLICY) as well as on several papers cited in footnotes throughout.

60 The moments of a distribution (of SCC estimates in this case) are, loosely speaking, the various values that describe the distribution’s shape: what value is the distribution centered around (mean); how wide is the distribution (the variance); whether the distribution is lopsided (skewness); and whether it is tall and skinny or short and fat (kurtosis). A percentile is a statistical measure of the value (the SCC value in this case) below which a specified percentage of (SCC) observations falls. The 1st percentile indicates the SCC value above which (the other) 99% of observed SCC values fall. The 99th percentile indicates the SCC value below which 99% of all observed SCC values fall.

61 Dallas Burtraw & Thomas Sterner, *Climate Change Abatement: Not “Stern” Enough?* (Resources for the Future Policy Commentary Series, Apr. 4, 2009), available at [http://www.rff.org/Publications/WPC/Pages/09\\_04\\_06\\_Climate\\_Change\\_Abatment.aspx](http://www.rff.org/Publications/WPC/Pages/09_04_06_Climate_Change_Abatment.aspx).

62 “If climate risk dominates economic growth risk because there are enough potential scenarios with catastrophic damages, then the appropriate discount rate for emissions investments is lower than the risk-free rate and the current price of carbon dioxide emissions should be higher. In those scenarios, the “beta” of climate risk is a large negative value and emissions mitigation investments provide insurance benefits. If, on the other hand, growth risk is always dominant because catastrophic damages are essentially impossible and minor climate damages are more likely to occur when growth is strong, times are good, and marginal utility is low, then the “beta” of climate risk is positive, the discount rate should be higher than the risk-free rate, and the price of carbon dioxide emissions should be lower.” Robert B. Litterman, *What Is the Right Price for Carbon Emissions?*, REGULATION, Summer 2013, at 38, 41, available at <http://www.cato.org/sites/cato.org/files/serials/files/regulation/2013/6/regulation-v36n2-1-1.pdf>

63 See following subsection.

64 “There are two rationales for discounting future benefits—one based on consumption and the other on investment. The consumption rate of discount reflects the rate at which society is willing to trade consumption in the future for consumption today. Basically, we discount the consumption of future generations because we assume future generations will be wealthier than we are and that the utility people receive from consumption declines as their level of consumption increases. . . . The investment approach says that, as long as the rate of return to investment is positive, we need to invest less than a dollar today to obtain a dollar of benefits in the future. Under the investment approach, the discount rate is the rate of return on investment. If there were no distortions or inefficiencies in markets, the consumption rate of discount would equal the rate of return on investment. There are, however, many reasons why the two may differ. As a result, using a consumption rather than investment approach will often lead to very different discount rates.” Maureen Cropper, *How Should Benefits and Costs Be Discounted in an Intergenerational Context?*, 183 RESOURCES 30, 33.

65 See CIRCULAR A-4, *supra* note 49, at 33.

66 The arguments here are primarily based on: Kenneth J. Arrow et al., *Determining Benefits and Costs for Future Generations*, 341 SCIENCE 349 (2013); Kenneth J. Arrow et al., *Should Governments Use a Declining Discount Rate in Project Analysis?*, REV ENVIRON ECON POLICY 8 (2014); Richard G. Newell & William A. Pizer, *Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?*, 46 J. ENVTL. ECON. & MGMT. 52 (2003); Maureen L. Cropper et al., *Declining Discount Rates*, AMERICAN ECONOMIC REVIEW: PAPERS AND PROCEEDINGS (2014); S.K. Rose, D. Turner, G. Blanford, J. Bistline, F. de la Chesnaye, and T. Wilson. *Understanding the Social Cost of Carbon: A Technical Assessment*. EPRI Report #3002004657 (2014).

67 Martin L. Weitzman, *Gamma Discounting*, 91 AM. ECON. REV. 260, 270 (2001). Weitzman’s schedule is as follows:

|           |            |             |              |            |
|-----------|------------|-------------|--------------|------------|
| 1-5 years | 6-25 years | 26-75 years | 76-300 years | 300+ years |
| 4%        | 3%         | 2%          | 1%           | 0%         |

68 Arrow et al. (2013, 2014), Cropper et al. (2014), *supra* note 66. Christian Gollier & Martin L. Weitzman, *How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?* 107 ECONOMICS LETTERS 3 (2010).

69 *Id.*

70 Joseph Lowe, H.M. Treasury, U.K., *Intergenerational Wealth Transfers and Social Discounting: Supplementary Green Book Guidance 5* (2008), available at [http://www.hm-treasury.gov.uk/d/4\(5\).pdf](http://www.hm-treasury.gov.uk/d/4(5).pdf). The U.K. declining discount rate schedule that subtracts out a time preference value is as follows:

|            |             |              |               |               |            |
|------------|-------------|--------------|---------------|---------------|------------|
| 0-30 years | 31-75 years | 76-125 years | 126-200 years | 201-300 years | 301+ years |
| 3.00%      | 2.57%       | 2.14%        | 1.71%         | 1.29%         | 0.86%      |

71 Using the IWG’s 2010 SCC model, Johnson and Hope find that the U.K. and Weitzman schedules yield SCCs of \$55 and \$175 per ton of CO<sub>2</sub>, respectively, compared to \$35 at a 2.5% discount rate. Laurie T. Johnson & Chris Hope, *The Social Cost of Carbon in U.S. Regulatory Impact Analyses: An Introduction and Critique*, 2 J. ENVTL. STUD. & SCI. 205, 214 (2012).

72 William D. Nordhaus, *Estimates of the social cost of carbon: concepts and results from the DICE--2013R model and alternative approaches*, 1 JOURNAL OF THE ASSOCIATION OF ENVIRONMENTAL AND RESOURCE ECONOMISTS 1 (2014).

73 David Anthoff & Richard S.J. Tol, THE CLIMATE FRAMEWORK FOR UNCERTAINTY, NEGOTIATION AND DISTRIBUTION (FUND), TECHNICAL DESCRIPTION, VERSION 3.6 (2012), available at <http://www.fund-model.org/versions>.

74 Chris Hope, *The Marginal Impact of CO<sub>2</sub> from PAGE2002: An Integrated Assessment Model Incorporating the IPCC's Five Reasons for Concern*, 6 INTEGRATED ASSESSMENT J. 19 (2006).

75 2010 TSD, *supra* note 4, at 1.

76 Frank Ackerman, Elizabeth A. Stanton & Ramón Bueno, *CRED: A New Model of Climate and Development*, 85 ECOLOGICAL ECONOMICS 166 (2013).

77 World Bank, ENVISAGE, <http://go.worldbank.org/8DTXIDMRM0> (last visited Feb. 4, 2014).

78 2010 TSD, *supra* note 4, at 1-3 (“The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts . . . . Specifically, we have set a preliminary goal of revisiting the SCC values within two years or at such time as substantially updated models become available, and to continue to support research in this area.”).

79 Kristie L. Ebi et al., *A New Scenario Framework for Climate Change Research: Background, Process, and Future Directions*, 122 CLIMATIC CHANGE 363, 368 (2014).

80 FRANK ACKERMAN & ELIZABETH A. STANTON, CLIMATE ECONOMICS: THE STATE OF THE ART 45-56 (2013); Wolfram Schlenker et al., *Will U.S. Agriculture Really Benefit From Global Warming? Accounting for Irrigation in the Hedonic Approach*, 95 AM. ECON. REV. 395, 395-406 (2005). See also: Fisher, Anthony C., W. Michael Hanemann, Michael J. Roberts, and Wolfram Schlenker. 2012. 'The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather: Comment.' *American Economic Review*, 102(7): 3749-60. DOI: 10.1257/aer.102.7.3749

81 See Melissa Dell et al., *Temperature shocks and economic growth: Evidence from the last half century*, 4 AMERICAN ECONOMIC JOURNAL: MACROECONOMICS 66-95 (2012); R. Bansal & M. Ochoa *Temperature, aggregate risk, and expected returns* (National Bureau of Economic Research No. w17575, 2011); E.J. Moyer et al., *Climate impacts on economic growth as drivers of uncertainty in the social cost of carbon* (University of Chicago Coase-Sandor Institute for Law & Economics Research Paper 652, 2013); S. Dietz & N. Stern, *Endogenous Growth, Convexity of Damage and Climate Risk: How Nordhaus' Framework Supports Deep Cuts in Carbon Emissions*, 125 THE ECONOMIC JOURNAL 574-620 (2015); F.C. Moore & D.B. Diaz *Temperature impacts on economic growth warrant stringent mitigation policy*, NATURE CLIMATE CHANGE (2015).

82 See, for example, National Science Foundation-funded work by Per Krusell and Anthony A. Smith on “A Global Economy-Climate Model with High Regional Resolution” using 19,000 agents (each covering a 1 x 1° area of land).

83 See *infra* note 95.

84 *See supra* note 60.

85 The federal government has committed to continuing to update SCC estimates to account for new information. The IWG stated in its 2010 TSD that “[i]t is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. Specifically, we have set a preliminary goal of revisiting the SCC values within two years or at such time as substantially updated models become available, and to continue to support research in this area. In the meantime, we will continue to explore the issues raised in this document and consider public comments as part of the ongoing interagency process.” 2010 TSD, *supra* note 4, at 3.

86 In this case, parameters are the various characteristic that describe the underlying climate and economic systems.

87 *See generally* Timothy M. Lenton et al., *Tipping Elements in the Earth’s Climate System*, 105 PNAS 1786 (2008).

88 Standard decision theory under uncertainty addresses “known unknowns,” which are unknowns for which we can specify a probability distribution function. In the cases of “unknown unknowns,” i.e., ‘black swan’ events, we cannot specify a probability distribution function, raising a host of additional questions. *See, e.g.*, Richard J. Zeckhauser, *Investing in the Unknown and Unknowable*, CAPITALISM & SOCIETY vol. 1, iss. 2, art. 5 (2006).

89 An increasing, strictly convex climate damage function implies a damage function that is strictly increasing in temperature at an increasing rate.

90 The point here is that we miss the big picture if we ignore the “tails” (the upper-most values in the case of the right-skewed SCC), and as a result come to the wrong conclusions. An everyday analogy is airplane safety regulation: safety is protected by guarding against the low-probability but highly dangerous events. With climate change we do not have the luxury of knowing with certainty how damaging the extremes could be or whether they will be triggered by greenhouse gases accumulating in the atmosphere; all we know is that there is a very real possibility they could occur and could be devastating.

91 This approach partially captures catastrophic damages via tipping points through the PAGE model.

92 *See, e.g.*, Peter Howard, *Omitted Damages: What’s Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014), and van den Bergh, J. C. J. M., and W. J. W. Botzen, *A lower bound to the social cost of CO<sub>2</sub> emissions*, 4 NATURE CLIMATE CHANGE 4 (2014).

93 *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS—SUMMARY FOR POLICYMAKERS 14 (2013).

94 Specifying the climate sensitivity parameter as a random variable has a basis in PAGE02, which species a probability distribution function for the parameter. The IWG calibrated the Roe and Baker distribution, a right-skewed distribution, to characterize the probability distribution function of this parameter. The 2010 TSD explains the IWG’s choice of the Roe and Baker distribution. The right-skewed nature of the climate sensitivity parameter’s probability distribution function is independent of the IWG’s choice of the Roe and Baker distribution. Rather, this skewness results from the IPCC’s finding that values of the climate sensitivity parameter above 4.5 degree Celsius cannot be excluded. As



a result, all of the probability distribution functions fit by the IWG for the climate sensitivity parameter were skewed to the right (see Figure 2 in the 2010 TSD), including Roe and Baker. *See* 2010 TSD, *supra* note 4, at 14, fig. 2.

95 A Monte Carlo simulation will run an integrated assessment model thousands of times, each time randomly picking the value of uncertain parameters from a probability distribution function, i.e. a function that assigns a probability to each possible parameter value. In the case of the SCC, the IWG ran 10,000 Monte Carlo simulations for each of the three IAMs and five socio-economic scenarios, randomizing the value of climate sensitivity, i.e., the change in average global temperature associated with a doubling of CO<sub>2</sub>, and all other uncertain parameters in the IAMs by the original authors. For each randomly drawn set of values, the IAM estimated the associated damages, with the final SCC estimate equaling the average value across all 10,000 runs, five socio-economic scenarios, and then across all three models. Therefore, each SCC estimate is calculated using 150,000 runs.

96 IPCC, *supra* note 93, at 14.

97 *E.g.*, Robert S. Pindyck, *Uncertain Outcomes and Climate Change Policy*, 63 J. ENVTL. ECON. & MGMT. 289 (2012); Martin L. Weitzman, *GHG Targets as Insurance Against Catastrophic Climate Damages*, 14 J. PUB. ECON. THEORY 221 (2012); Robert S. Pindyck, *The Climate Policy Dilemma*, 7 REV. ENVTL. ECON. & POL'Y 219 (2013); Gernot Wagner & Richard J. Zeckhauser, *Confronting Deep Uncertainty on Climate Sensitivity: When Good News is Bad News*, ('Beyond IPCC' Presentation, October 17, 2014).

98 80 Fed. Reg. 40,138, 40,404-05 (July 13, 2015).

99 *Id.* at 40,175, 40,208, 40,510.

100 *Id.* at 40,510.

101 *Id.* at 40,404-05. Note that the agencies seem to only count domestic upstream emissions, and thus may significantly undercount upstream effects. For latest IPCC values, *compare* IPCC Working Group I, Fifth Assessment Report, Climate Change 2013: The Physical Science Basis, Chapter 8: Anthropogenic and Natural Radiative Forcing (2014) at 633, 711-712, 714 (Table 8.7), *available at* [https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5\\_Chapter08\\_FINAL.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf) (and see the adjustment identified in note B).

102 Marten, A.L., E.A. Kopits, C.W. Griffiths, S.C. Newbold & A. Wolverson (2014). Incremental CH<sub>4</sub> and N<sub>2</sub>O Mitigation Benefits Consistent with the U.S. Government's SC-CO<sub>2</sub> Estimates, Climate Policy, DOI: 10.1080/14693062.2014.912981.

103 *See* 80 Fed. Reg. 52,099, 52,145 (Aug. 27, 2015).

104 *See Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1202 (9th Cir. 2008) (finding NHTSA's decision to assign zero value to carbon reductions to be arbitrary and capricious).

105 *See* Disa Thureson & Chris Hope, *Is Weitzman Right? The Social Cost of Greenhouse Gases in an IAM World* 21 (Örebro University-Swedish Business School Working Paper 3/2012).

106 See, e.g., Marten et al at 7 (describing eleven prior studies estimating the social cost or global damage potential associated with methane).

107 Alex L. Marten et al., *Incremental CH<sub>4</sub> and N<sub>2</sub>O Mitigation Benefits Consistent With the US Government's SC--? CO<sub>2</sub> Estimates*, *Climate Policy* (2014).

108 See Executive Order 13,563, 76 Fed. Reg. 3821 (January 18, 2011).

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<http://www3.epa.gov/climatechange/pdfs/social%20cost%20methane%20white%20paper%20application%20and%20peer%20review.pdf>

110 Interagency Working Group on the Social Cost of Carbon, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis*, 12 (February 2010), available at <https://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf> (“Impacts other than temperature change also vary across gases in ways that are not captured by GWP. For instance . . . damages from methane emissions are not offset by the positive effect of CO<sub>2</sub> fertilization.”). Martin et al (2015) state that “A comparison across models further highlights the importance of CO<sub>2</sub> fertilization impacts on the global damage potential. CO<sub>2</sub> emissions, and the resulting increase in atmospheric concentration, have the potential to increase yields in the agriculture and forestry sector. This characteristic is not shared by other GHG emissions. Accordingly, the FUND model, which explicitly captures this effect, exerts downward pressure on the SC- CO<sub>2</sub> that is not present for the SC-CH<sub>4</sub> and SC-N<sub>2</sub>O , allowing for the possibility of substantially higher global damage potential estimates. The results based on the FUND model presented in this article exhibit this effect; however, the CO<sub>2</sub> fertilization effect is not explicitly modelled in DICE and PAGE and therefore they are found to produce lower estimates of the global damage potential. For example, using the 3% discount rate, the global damage potential for CH<sub>4</sub> as estimated by FUND ranges between 58 and 88 depending on the scenario, whereas it ranges from 19 to 28 for DICE and PAGE. As the DICE and PAGE models only consider two natural system impacts, temperature and sea level, if they do implicitly include potential CO<sub>2</sub> fertilization benefits, they are included by using the temperature anomaly as a proxy for the increasing atmospheric CO<sub>2</sub> concentration. Fertilization benefits would therefore be allowed to falsely accrue to perturbations of other GHG emissions besides CO<sub>2</sub>. It is not clear the degree to which these models try to incorporate CO<sub>2</sub> fertilization effects and therefore the degree to which this issue is of concern.”

111 A study by Sarofim et al. (2015) finds that reductions in surface ozone levels from the mitigation of methane emissions would provide additional global health benefits from avoided cardiopulmonary deaths equal to 60 to 140% of climate benefits identified by Marten. Similarly, Shindell (2014) finds that the impact of methane on agriculture, via changes in surface ozone, are valued at \$22 and \$27 per ton, for 5% and 3% discounting respectively, in addition to his study's estimates for climate and climate-health related damages.

112 80 Fed. Reg. 40138, 40461; see also Draft Regulatory Impact Analysis at Table 8-14. The estimated non- CO<sub>2</sub> GHG total net benefits using the GWP approach would increase by about \$760 million to \$11 billion (2012\$), depending on discount rate, or approximately 3 percent. U.S. EPA, Draft Regulatory Impact Analysis, Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 at 8-41 (June 2015).

113 IPCC Working Group I, Fifth Assessment Report, *Climate Change 2013: The Physical Science Basis*, Chapter 8: Anthropogenic and Natural Radiative Forcing (2014) at 633, 711-712, 714 (Table

8.7), available at [https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5\\_Chapter08\\_FINAL.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf) (see the adjustment identified in note B for fossil methane).

114 2010 TSD, *supra* note 4, at 29.

115 Exec. Order No. 12,866 § 1(a); *see also* OMB, Circular A-4.

116 *E.g.*, EPA, 420-D-09-001, DRAFT REGULATORY IMPACT ANALYSIS: CHANGES TO RENEWABLE FUEL STANDARD PROGRAM 690 tbl. 5.3-4 (2009).

117 *Compare* EPA, Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants, EPA-452/R-14-002, at tbl. ES-5 (2014) (listing multiple unquantified effects from co-pollutants, but marking “global climate impacts from CO<sub>2</sub>” as fully monetized) *with* Peter Howard, *Omitted Damages: What’s Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014) (detailing the many significant effects not quantified in the SCC).

### **Response:**

The EPA acknowledges this comments and agrees with the recommendation to use the Marten et al. approach in the final rulemaking analysis. Regarding the recommendations to improve the estimates, see response to Institute for Policy Integrity, Excerpt 7, in RTC Section 11.8, for complete discussion.

Regarding the recommendations to include a qualitative assessment of impacts omitted from the SC-CO<sub>2</sub> and SC-CH<sub>4</sub> estimates: EPA notes that it is not possible at this time to provide a precise list of each model’s treatment (i.e., included, excluded) of climate impacts. EPA further notes that the table referenced by the commenter,<sup>215</sup> which was published in a May 2009 draft regulatory impact analysis that was issued prior to the interagency working group’s development of the 2010 SC-CO<sub>2</sub> estimates, itemizes some of the impacts omitted from only one model. Subsequent to the publication of this draft RIA, the interagency working group (IWG) developed SC-CO<sub>2</sub> estimates based on an ensemble of three models. The IWG’s 2010 SC-CO<sub>2</sub> Technical Support Document presents a robust discussion of this key analytical issue, e.g., how each model estimates climate impacts, the known parameters and assumptions underlying those models, and the implications of incomplete treatment of impacts (catastrophic and non-catastrophic) for the SC-CO<sub>2</sub> and SC-CH<sub>4</sub> estimates. Moreover, the discussion in the SC-CO<sub>2</sub> TSD underscores the difficulty in accurately distilling the treatment of impacts in table-form for all three models. Most notably, the use of aggregate damage functions—which consolidate information about impacts from multiple studies—in two of the models, which were not addressed in the table referenced by the commenter, poses a challenge in listing included impacts. For example, within the broad agricultural impacts category, some of the sub-grouped impacts are not explicitly modeled but are highly correlated to other subcategories that are explicitly modeled. Therefore, EPA continues to determine that it is more appropriate to rely on the qualitative discussion in the TSDs about uncertainty. EPA has also updated the RIA Section 4.3 discussion to reference several publications that identify and discuss some of the important, unquantified climate effects.

EPA agrees that it is important to update the SC-CO<sub>2</sub> and SC-CH<sub>4</sub> periodically to incorporate improvements in the understanding of greenhouse gas emissions impacts and will continue to follow

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<sup>215</sup> EPA, 420-D-09-001, DRAFT REGULATORY IMPACT ANALYSIS: CHANGES TO RENEWABLE FUEL STANDARD PROGRAM 690 tbl. 5.3-4 (2009).

and evaluate the latest science on impact categories that are omitted or not fully addressed in the IAMs. As previously noted, EPA and the other IWG members are seeking external expert advice on the technical merits and challenges of potential approaches to update the damage functions in future revisions to the SC-CO<sub>2</sub> estimates, which would likely inform updates to the SC-CH<sub>4</sub> estimates. Finally, the RIA also continues to discuss climate change impacts, specifically an overview of the 2009 Endangerment Finding and climate science assessments released since then (see RIA, Chapter 4).

Regarding the recommendation for regular updates, see response to Institute for Policy Integrity, Excerpt 8, in RTC Section 11.8.

**Organization:** Mannix, Brian

### **Social Cost of Carbon**

The goal of the President's Climate Action Plan is to reduce emissions of greenhouse gases. The proposed Phase 2 standards will primarily reduce emissions of carbon dioxide, although some other greenhouse gases are also covered, and are converted to their "carbon equivalent" for purposes of the analysis. The RIA uses a Social Cost of Carbon (SCC, or SC-CO<sub>2</sub>) to assign benefits to the estimates of reduced emissions. There are numerous complexities and controversies surrounding the estimation of the SCC. Nonetheless, as we have argued elsewhere, it is correct, in principle, for agencies to use a uniform SCC in evaluating programs designed to reduce carbon emissions.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.5]

In doing a sensitivity analysis, the RIA uses multiple estimates of the SCC – including one that is intended to explore the "fat tails" of the probability distribution. "The fourth value is the 95th percentile of the SC-CO<sub>2</sub> from all three models at a 3 percent discount rate. It is included to represent higher-than-expected impacts from temperature change further out in the tails of the SC-CO<sub>2</sub> distribution (representing less likely, but potentially catastrophic, outcomes)."<sup>9</sup> Note, however, that only the hot tail is considered. We know from the geological record that very large climate risks exist on the cold side. A major glacial advance, which has happened dozens of times in the past, would wipe out much of North America and northern Europe. The RIA's use of only one tail of the distribution is an indication of bias in the analysis. [EPA-HQ-OAR-2014-0827-1222-A1 p.5]

There is another flaw in the SCC used to calculate the climate benefits of the standards: the agencies are using an estimate that is global. That is, the SCC mostly (an estimated 80% to 93%) represents benefits that accrue to other countries, rather than to the United States. This is a useful exercise to go through as part of an international conversation on climate change and what to do about it. It is not, however, suitable for estimating the benefits of a unilateral domestic rulemaking.<sup>10</sup> Imposing costs on U.S. businesses and consumers in order to deliver benefits to other countries cannot be characterized as a "big step to grow our economy."<sup>11</sup> Nor is it clear that delivering foreign aid is consistent with the statutory authorities on which the agencies rely in this rulemaking. A domestic SCC would be a sounder basis for evaluating the benefits of the standards. [EPA-HQ-OAR-2014-0827-1222-A1 p.5-6]

### **Response:**

The comments regarding the aggregation of the SC-CO<sub>2</sub> estimates and general application in a rulemaking context mirror those submitted to the Office of Management and Budget's separate comment solicitation on the SC-CO<sub>2</sub> (78 FR 70586; November 26, 2013). As a member of the interagency working group (IWG) on SC-CO<sub>2</sub>, EPA has carefully examined and evaluated comments submitted to OMB's separate solicitation. EPA has also carefully examined and evaluated all comments

received regarding SC-CO<sub>2</sub> through this rulemaking process and determined that the IWG responses to the comments on the OMB solicitation address the comments on the aggregation of SC-CO<sub>2</sub> estimates and use of the estimates in this RIA. Specifically, EPA concurs with the IWG's response to these comments and hereby incorporates them by reference.<sup>216</sup>

In addition, EPA and other members of the U.S. Interagency Working Group on the SC-CO<sub>2</sub> are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies' review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> estimates. Going forward, the EPA will evaluate its approach to estimating the SC-CO<sub>2</sub>, SC-CH<sub>4</sub>, and SC-N<sub>2</sub>O based upon any feedback received from the Academies' panel.

After careful evaluation of the full range of comments and associated technical issues described in this RTC, EPA has determined that it will continue to use the SC-GHG estimates in the final rulemaking analysis. In particular, the current SC-CO<sub>2</sub> estimates and the Marten et al. SC-CH<sub>4</sub> and SC-N<sub>2</sub>O estimates represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental emissions changes into regulatory analysis. Therefore, EPA has presented these estimates in this rulemaking. EPA will continue to consider these comments and will share the recommendations with the IWG as it moves forward with the Academies process.

The remainder of this section elaborates on these comments in the context of this rulemaking.

EPA acknowledges the commenter's endorsement of federal agencies in principle using harmonized SC-CO<sub>2</sub> estimates to evaluate programs designed to reduce carbon emissions. EPA has determined using the current SC-CO<sub>2</sub> figures to estimate the value to society of marginal reductions in CO<sub>2</sub> emissions in Regulatory Impact Analysis under Executive Order 12866 is appropriate both in principle and in practice.

EPA disagrees with the commenter's statement that use of the 95<sup>th</sup> percentile SC-CO<sub>2</sub> estimates introduces bias to the analysis. As the 2010 TSD discusses, the SC-CO<sub>2</sub> estimates derived from the three integrated assessment models have several significant limitations that could lead to a substantial underestimation of the SC-CO<sub>2</sub>. These limitations include the incomplete treatment and monetization of non-catastrophic damages, the incomplete treatment of potential "catastrophic" damages, and uncertainty in extrapolation of damages to high temperatures. The IPCC Fourth Assessment Report, which was the most current IPCC assessment available at the time of the IWG's 2009-2010 review, discussed these limitations and concluded that it was "very likely that [SCC] underestimates" climate change damages. Based on the current scientific understanding of climate change and its impacts, and on the limitations of the IAMs in quantifying and monetizing the full array of potential "catastrophic" and non-catastrophic damages, EPA and the other members of the IWG concluded that the distribution of SCC estimates may be biased downwards. Since then, the peer-reviewed literature has continued to support this conclusion. For example, the IPCC Fifth Assessment report observed that SC-CO<sub>2</sub> estimates continue to omit various impacts that would likely increase damages. The 95<sup>th</sup> percentile

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<sup>216</sup> Referred to as the "OMB Response to Comments on SC-CO<sub>2</sub>." In particular, see pgs 25 to 28, 30-32 at <https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf>.

estimate was included in the recommended range for regulatory impact analysis to address these concerns.

In addition, as acknowledged in the 2010 TSD, the SC-CO<sub>2</sub> estimates derived from the three IAMs did not take into consideration the possibility of risk aversion. That is, individuals may have a higher willingness-to-pay to reduce the likelihood of low-probability, high-impact damages than they do to reduce the likelihood of higher-probability, lower-impact damages with the same expected cost. The inclusion of the 95<sup>th</sup> percentile estimate in the SC-CO<sub>2</sub> values was also motivated by this concern. In contrast, EPA is not aware of systematic upward biases in the estimates comparable to the downward biases discussed above. For this reason, while EPA and other members of the IWG have been fully transparent regarding the entire range of uncertainty reflected in the probability distributions, EPA did not include a 5<sup>th</sup> percentile estimate in the selected range for regulatory impact analysis.

EPA disagrees with the commenter's statement that application of a global SC-CO<sub>2</sub> to calculate the benefits of domestic rulemaking is not appropriate. As discussed in the 2010 SC-CO<sub>2</sub> Technical Support Document (TSD), the IWG determined that a global measure of SC-CO<sub>2</sub> is appropriate in this context because emissions of most greenhouse gases contribute to damages around the world and the world's economies are now highly interconnected.<sup>217</sup> To reflect the global nature of the problem, the SC-CO<sub>2</sub> incorporates the full damages caused by CO<sub>2</sub> emissions and other governments are expected to consider the global consequences of their greenhouse gas emissions when setting their own domestic policies.

Carbon dioxide is a global pollutant with global consequences. Carbon dioxide, in addition to methane, N<sub>2</sub>O and other GHG emissions, contributes to warming of the atmosphere, which over time leads to increased air and ocean temperatures, changes in precipitation patterns, melting and thawing of global glaciers and ice, increasingly severe weather events, such as hurricanes of greater intensity, and sea level rise, among other impacts. Pursuant to Clean Air Act section 202(a), the EPA Administrator found that GHGs in the atmosphere threaten the public health and welfare of current and future generations. In particular, the Administrator found that the mix of six greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, and SF<sub>6</sub>) is "global in nature because the greenhouse gas emissions emitted from the United States (or from any other region of the world) become globally well mixed, such that it would not be meaningful to define the air pollution as the greenhouse gas concentrations over the United as somehow being distinct from the greenhouse gas concentrations over other regions of the world" (74 FR 66517; December 15, 2009). Any pollutant with an atmospheric lifetime of greater than one or two years becomes well-mixed globally. One attribute of a well-mixed substance is that the location of emission has little impact on the consequences of those emissions, such that a ton of methane emitted in the US will have just as much an impact on global temperatures as a ton of methane emitted in Australia.

As stated in the OMB Response to Comments on SC-CO<sub>2</sub>, if all countries acted independently to set policies based only on the domestic costs and benefits of carbon emissions, it would lead to an economically inefficient level of emissions reductions which could be harmful to all countries, including the United States, because each country would be underestimating the full value of its own reductions. The same applies to methane emissions because methane is, as discussed in the previous paragraph, a well-mixed global pollutant with global consequences. This is a classic public goods problem because each country's reductions benefit everyone else and no country can be excluded from enjoying the benefits of other countries' reductions, even if it provides no reductions itself. In this situation, the only

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<sup>217</sup> 2010 SC-CO<sub>2</sub> TSD available in the docket and at <https://www.whitehouse.gov/sites/default/files/omb/foreg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf>

way to achieve an economically efficient level of emissions reductions is for countries to cooperate in providing mutually beneficial reductions beyond the level that would be justified only by their own domestic benefits. By adopting a global estimate of the SC-CO<sub>2</sub> or the SC-CH<sub>4</sub> or the SC- N<sub>2</sub>O , the U.S. government can signal its leadership in this effort. In reference to the public good nature of mitigation and its role in foreign relations, thirteen prominent academics noted that these "are compelling reasons to focus on a global [SC-CO<sub>2</sub>]" in a recent article on the SC-CO<sub>2</sub> (Pizer et al., 2014). In addition, there is no bright line between domestic and global damages from greenhouse gas emissions, such as CO<sub>2</sub>, methane, and N<sub>2</sub>O. Adverse impacts on other countries can have spillover effects on the United States, particularly in the areas of national security, international trade, public health and humanitarian concerns.

GHG emissions in the United States will have impacts abroad, some of which may, in turn, affect the United States. For this reason, a purely domestic measure is likely to understate actual impacts to the United States. Also, as stated above, the EPA and the other members of IWG believes that accounting for global benefits can encourage reciprocal action by other nations, leading ultimately to international cooperation that increases both global and U.S. net benefits relative to what could be achieved if each nation considered only its own domestic costs and benefits when determining its climate policies. As a party to the United Nations Framework Convention on Climate Change, the United States is actively engaging with the international community to find solutions and promote global cooperation on climate change. As of May 2016, over 170 nations have signed the Paris Agreement on climate change, signifying worldwide commitment to reduce GHG emissions.

Further, as explained in the 2010 TSD, from a technical perspective, the development of a domestic SC-CO<sub>2</sub> was greatly complicated by the relatively few region- or country-specific estimates of the SC-CO<sub>2</sub> in the literature, and impacts beyond our borders have spillover effects on the United States, particularly in the areas of national security, international trade, and public health. As a result, it was only possible to include an "approximate, provisional, and highly speculative" range of 7 to 23 percent for the share of domestic benefits in the 2010 TSD. This range was based on two strands of evidence: direct domestic estimates resulting from the FUND model, and an alternative approach under which the fraction of GDP lost due to climate change is assumed to be similar across countries.

Regarding the commenter's criticism that the SCC does not consider the risks of cooling, there are no credible projections of future temperatures over the next century that include any appreciable probability that temperatures will decline. This is because the elevated concentrations of greenhouse gases already in the atmosphere are projected to lead to future warming even in the absence of future increases in concentrations until the Earth system returns to a radiative balance: future emissions of greenhouse gases (and in particular carbon dioxide due to its long lifetime) will lead to even more warming.

Finally, EPA notes that the commenter has not provided any basis for his assertion that an estimated 80 to 93 percent of the SC-CO<sub>2</sub> represents benefits that accrue to other countries. This figure is not presented in the Gayer and Viscusi paper referenced by the commenter.

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8 Brian Mannix & Susan E. Dudley, "Public Comment on the Interagency Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order No. 12866." The George Washington University Regulatory Studies Center, Washington, DC. February 26, 2014.  
[https://regulatorystudies.columbian.gwu.edu/sites/regulatorystudies.columbian.gwu.edu/files/downloads/OMB\\_2013-0007\\_SCC.pdf](https://regulatorystudies.columbian.gwu.edu/sites/regulatorystudies.columbian.gwu.edu/files/downloads/OMB_2013-0007_SCC.pdf)

9 RIA, p. 8-37.

10 Gayer and Viscusi note that “imposing a global perspective on benefits will increase the apparent desirability of the policy but will overstate the actual benefits to the American people.”

See Ted Gayer and Kip Viscusi, “Determining the Proper Scope of Climate Change Benefits.” The George Washington University Regulatory Studies Center, Washington, DC. June 4, 2014.  
[http://regulatorystudies.columbian.gwu.edu/sites/regulatorystudies.columbian.gwu.edu/files/downloads/Gayer-Viscusi\\_Determining%20the%20Proper%20Scope%20of%20Climate%20Change%20Benefits.pdf](http://regulatorystudies.columbian.gwu.edu/sites/regulatorystudies.columbian.gwu.edu/files/downloads/Gayer-Viscusi_Determining%20the%20Proper%20Scope%20of%20Climate%20Change%20Benefits.pdf)

11 Remarks by the President on Fuel Efficiency Standards for Medium and Heavy-Duty Vehicles, February 18, 2014.

**Organization:** Michaels and Knappenberger

It is clearly inappropriate to relate unmeasurable and unverifiable impacts to economic gains. The EPA, nevertheless, does this through using the social cost of carbon (SCC), attributing \$100 billion of economic savings through the alleviation of future climate change. [EPA-HQ-OAR-2014-0827-1206-A1 p.1]

EPA’s determination of the SCC is discordant with the best scientific literature on the equilibrium climate sensitivity and the fertilization effect of carbon dioxide—two critically important parameters for establishing the net externality of carbon dioxide emissions. It is based upon the output of Integrated Assessment Models (IAMs) which have little utility because of their great uncertainties. They provide no reliable guidance as to the sign, much less the magnitude of the social cost of carbon. Additionally, as run by the Interagency Working Group (IWG), whose results were incorporated by the EPA in this proposal, the IAMs produce illogical results that indicate a misleading disconnection between climate changes and the SCC value. Additionally, new research strongly suggests that the scientific research on the SCC is biased in favor of high SCC values, and that when this bias is accounted for, the SCC value used by the EPA is inflated. [EPA-HQ-OAR-2014-0827-1206-A1 p.1-2]

Considering the improprieties surrounding the determination of the SCC by the current Administration, their determination should never be used federal rulemakings. It is better not to use any value for the SCC in cost/benefit analyses, than to include one which is clearly improper, inaccurate and misleading. [EPA-HQ-OAR-2014-0827-1206-A1 p.2]

The combination of a lack of measurable climate impacts with the lack of logical cost estimates renders this proposed regulation unjustifiable. Consequently, we suggest that it should be withdrawn. [EPA-HQ-OAR-2014-0827-1206-A1 p.2]

And perhaps most remarkable of all, is that although the climate risks were not “formally estimated,” the EPA determines that the climate impacts resulting from the proposed regulation will lead to “net economic benefits exceeding \$100 billion making this a highly beneficial rule” (Federal Register, Vol. 80, No. 133, pg 40169). [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

Things that one can neither measure nor detect cannot be assigned any discrete cost. [EPA-HQ-OAR-2014-0827-1206-A1 p.6]



This occurs throughout the EPA's ill-advised application of the ill-suited and ill-determined social cost of carbon (Federal Register, Vol. 80, No. 133, pg 40456). [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

#### *Comments on the Social Cost of Carbon*

The EPA incorporates the social cost of carbon (SCC) value determined through a process conducted by the federal Interagency Working Group (IWG) that was initially established in 2010 and subsequently revised on several occasions. The EPA uses the SCC value established by the IWG in its May 2013 update. Therefore, our comments largely reflect the contents of the IWG 2013 SCC justifications and the EPA's reliance upon them. We note that recently, in July 2015, the IWG, through the Office of Management and Budget (OMB) has reaffirmed the 2013 SCC value, and offered responses to criticism of that determination. However, the IWG (2015) response is inadequate to alleviate the concerns that we express in this set of comments. [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

The IWG continues to ignore a large amount of relevant science such that the current SCC value (as incorporated by the EPA in this rulemaking) should be considered invalid and discarded. It is better not to include any value for the SCC in federal cost/benefit analyses such as this one, than to include one which is knowingly inaccurate and thus potentially misleading. [EPA-HQ-OAR-2014-0827-1206-A1 p.6]

#### *Domestic vs. Global Costs*

During the public comment period associated with new regulations such as this one which incorporate the SCC, a clear distinction should be made between domestic costs/benefits and foreign cost/benefits—and numerical calculations of each provided in all cost/benefits analyses included in the proposal (to be included in the main body of the proposal). In this way, the public can readily judge for itself (rather than have to defer on the judgement of the IWG) the value of the regulation. As it currently stands, the public likely has little idea as to how large a percentage of the benefits of the proposed EPA regulations on domestic activities are conferred upon foreign nations under the guise of the SCC. We recommend reporting the results of the domestic SCC calculation in the main body of the proposed regulation. As it stands presently, the situation is clearly not as “transparent” as it should be. [EPA-HQ-OAR-2014-0827-1206-A1 p.7]

#### *Equilibrium Climate Sensitivity*

In May 2013, the Interagency Working Group (IWG) produced an updated SCC value by incorporating updates to the underlying three Integrated Assessment Models (IAMs) used in its initial 2010 SCC determination. But, at that time, the IWG did not update the equilibrium climate sensitivity (ECS) employed in the IAMs. This was not done, despite there having been, since January 1, 2011, at least 14 new studies and 20 experiments (involving more than 45 researchers) examining the ECS, each lowering the best estimate and tightening the error distribution about that estimate. Instead, the IWG wrote in its 2013 report: “It does not revisit other interagency modeling decisions (e.g., with regard to the discount rate, reference case socioeconomic and emission scenarios, or equilibrium climate sensitivity).” [EPA-HQ-OAR-2014-0827-1206-A1 p.7]

This decision was reaffirmed by the IWG in July 2015. But, through its reaffirmation, the IWG has again refused to give credence to and recognize the importance of what is now becoming mainstream science—that the most likely value of the equilibrium climate sensitivity is lower than that used by the IWG and that the estimate is much better constrained. This situation has profound implications for the

determination of the SCC and yet continues to be summarily dismissed by the IWG. [EPA-HQ-OAR-2014-0827-1206-A1 p.7]

The earth's equilibrium climate sensitivity is defined in the Interagency Working Group on Social Cost of Carbon 2010 (hereafter, IWG2010) report as "the long-term increase in the annual global-average surface temperature from a doubling of atmospheric CO<sub>2</sub> concentration relative to pre-industrial levels (or stabilization at a concentration of approximately 550 parts per million (ppm))" and is recognized as "a key input parameter" for the integrated assessment models used to determine the social cost of carbon. [EPA-HQ-OAR-2014-0827-1206-A1 p.7]

The IWG2010 report has an entire section (Section III.D) dedicated to describing how an estimate of the equilibrium climate sensitivity and the scientific uncertainties surrounding its actual value are developed and incorporated in the IWG's analysis. The IWG2010, in fact, developed its own probability density function (pdf) for the ECS and used it in each of the three IAMs, superseding the ECS pdfs used by the original IAMs developers. The IWG's intent was to develop an ECS pdf which most closely matched the description of the ECS as given in the Fourth Assessment Report of the United Nation's Intergovernmental panel on Climate Change which was published in 2007. [EPA-HQ-OAR-2014-0827-1206-A1 p.7]

The functional form adopted by the IWG2010 was a calibrated version of Roe and Baker (2007) distribution. It was described in the IWG2010 report in the following Table and Figure (from the IWG2010 report): [EPA-HQ-OAR-2014-0827-1206-A1 p.8]

[Table 1, 'Summary Statistics for Four Calibrated Climate Sensitivity Distributions', and Figure 2, 'Estimates of the Probability Density Function for Equilibrium Climate Sensitivity', can be found on p.8 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

The calibrated Roe and Baker functional form used by the IWG2010 is *no longer scientifically defensible*; nor was it at the time of the publication of the IWG 2013 SCC update, nor at the time of the July 2015 update. [EPA-HQ-OAR-2014-0827-1206-A1 p.8]

The figure below vividly illustrates this fact, as it compares the best estimate and 90% confidence range of the earth's ECS as used by the IWG2010/2013/2015 (calibrated Roe and Baker) against findings in the scientific literature published since January 1, 2011. [EPA-HQ-OAR-2014-0827-1206-A1 p.8]

Whereas the IWG2010/2013/2015 ECS distribution has a median value of 3.0°C and 5th and 95th percentile values of 1.72°C and 7.14°C, respectively, the corresponding values averaged from the recent scientific literature are 2.0°C (median), 1.1°C (5th percentile), and 3.5°C (95th percentile). [EPA-HQ-OAR-2014-0827-1206-A1 p.9]

These differences will have large and significant impacts on the SCC determination. [EPA-HQ-OAR-2014-0827-1206-A1 p.9]

[Figure, 'Equilibrium Climate Sensitivity', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

The IWG2010 report noted that, concerning the low end of the ECS distribution, its determination reflected a greater degree of certainty that a low ECS value could be excluded than did the IPCC. From the IWG2010 (p. 14): [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

“Finally, we note the IPCC judgment that the equilibrium climate sensitivity “is very likely larger than 1.5°C.” Although the calibrated Roe & Baker distribution, for which the probability of equilibrium climate sensitivity being greater than 1.5°C is almost 99 percent, is not inconsistent with the IPCC definition of “very likely” as “greater than 90 percent probability,” it reflects a greater degree of certainty about very low values of ECS than was expressed by the IPCC.” [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

In other words, the IWG used its judgment that the lower bound of the ECS distribution was higher than the IPCC 2007 assessment indicated. However, the collection of the recent literature on the ECS shows the IWG’s judgment to be in error. As can be seen in the chart above, the large majority of the findings on ECS in the recent literature indicate that the lower bound (i.e., 5th percentile) of the ECS distribution is lower than the IPCC 2007 assessment. And, the average value of the 5th percentile in the recent literature (1.1°C) is 0.62°C less than that used by the IWG—a sizeable and important difference which will influence the SCC determination. [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

In fact, the abundance of literature supporting a lower climate sensitivity was at least partially reflected in the new IPCC assessment report issued in 2013. In that report, the IPCC reported: [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

Equilibrium climate sensitivity is *likely* in the range 1.5°C to 4.5°C (*high confidence*), *extremely unlikely* less than 1°C (*high confidence*), and *very unlikely* greater than 6°C (*medium confidence*). The lower temperature limit of the assessed *likely* range is thus less than the 2°C in the AR4...[EPA-HQ-OAR-2014-0827-1206-A1 p.10]

Clearly, the IWG’s assessment of the low end of the probability density function that best describes the current level of scientific understanding of the climate sensitivity is incorrect and indefensible. [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

But even more influential in the SCC determination is the upper bound (i.e., 95th percentile) of the ECS probability distribution. [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

The IWG2010 notes (p.14) that the calibrated Roe and Baker distribution better reflects the IPCC judgment that “values substantially higher than 4.5°C still cannot be excluded.” The IWG2010 further notes that [EPA-HQ-OAR-2014-0827-1206-A1 p.10]

“Although the IPCC made no quantitative judgment, the 95th percentile of the calibrated Roe & Baker distribution (7.1 °C) is much closer to the mean and the median (7.2 °C) of the 95th percentiles of 21 previous studies summarized by Newbold and Daigneault (2009). It is also closer to the mean (7.5 °C) and median (7.9 °C) of the nine truncated distributions examined by the IPCC (Hegerl, et al., 2006) than are the 95th percentiles of the three other calibrated distributions (5.2-6.0 °C).” [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

In other words, the IWG2010 turned towards surveys of the scientific literature to determine its assessment of an appropriate value for the 95th percentile of the ECS distribution. Now, more than five years hence, the scientific literature tells a completely different story. [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

Instead of a 95th percentile value of 7.14°C, as used by the IWG2010, a survey of the recent scientific literature suggests a value of 3.5°C—more than 50% lower. [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

And this is very significant and important difference because the high end of the ECS distribution has a large impact on the SCC determination—a fact frequently commented on by the IWG2010. [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

For example, from IWG2010 (p.26):

“As previously discussed, low probability, high impact events are incorporated into the SCC values through explicit consideration of their effects in two of the three models as well as the use of a probability density function for equilibrium climate sensitivity. Treating climate sensitivity probabilistically results in more high temperature outcomes, which in turn lead to higher projections of damages. Although FUND does not include catastrophic damages (in contrast to the other two models), its probabilistic treatment of the equilibrium climate sensitivity parameter will directly affect the non-catastrophic damages that are a function of the rate of temperature change.” [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

And further (p.30):

*Uncertainty in extrapolation of damages to high temperatures:* The damage functions in these IAMs are typically calibrated by estimating damages at moderate temperature increases (e.g., DICE was calibrated at 2.5 °C) and extrapolated to far higher temperatures by assuming that damages increase as some power of the temperature change. Hence, estimated damages are far more uncertain under more extreme climate change scenarios. [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

And the entirety of Section V [sic] “A Further Discussion of Catastrophic Impacts and Damage Functions” of the IWG 2010 report describes “tipping points” and “damage functions” that are probabilities assigned to different values of global temperature change. Table 6 from the IWG2010 indicated the probabilities of various tipping points. [EPA-HQ-OAR-2014-0827-1206-A1 p.11]

[Table 6, 'Probabilities of Various Tipping Points from Expert Elicitation', can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

The likelihood of occurrence of these low probability, high impact, events (“tipping points”) is greatly diminished under the new ECS findings. The average 95th percentile value of the new literature survey is only 3.5°C indicating a very low probability of a warming reaching 3-5°C by 2100 as indicated in the 3rd column of the above Table and thus a significantly lower probability that such tipping points will be reached. This new information will have a large impact on the final SCC determination using the IWG’s methodology. [EPA-HQ-OAR-2014-0827-1206-A1 p.12]

The size of this impact has been directly investigated. [EPA-HQ-OAR-2014-0827-1206-A1 p.12]

In their Comment on the Landmark Legal Foundation Petition for Reconsideration of Final Rule Standards for Standby Mode and Off Mode Microwave Ovens, Dayaratna and Kreutzer (2013) ran the DICE model using the distribution of the ECS as described by Otto et al. (2013)—a paper published in the recent scientific literature which includes 17 authors, 15 of which were lead authors of chapters in the recent Intergovernmental Panel on Climate Change’s Fifth Assessment Report. The most likely value of the ECS reported by Otto et al. (2013) was described as “2.0°C, with a 5–95% confidence interval of 1.2–3.9°C.” Using the Otto et al. (2013) ECS distribution in lieu of the distribution employed by the IWG (2013), dropped the SCC by 42 percent, 41 percent, and 35 percent (for the 2.5%, 3.0%, 5.0% discount rates, accordingly). This is a significant decline. [EPA-HQ-OAR-2014-0827-1206-A1 p.12]

In subsequent research, Dayaratna and Kreutzer (2014) examined the performance of the FUND model, and found that it too, produced a greatly diminished value for the SCC when run with the Otto et al. distribution of the equilibrium climate sensitivity. Using the Otto et al. (2013) ECS distribution in lieu of the distribution employed by the IWG (2013), dropped the SCC produced by the FUND model to \$11, \$6, \$0 compared with the original \$30, \$17, \$2 (for the 2.5%, 3.0%, 5.0% discount rates, accordingly). Again, this is a significant decline. [EPA-HQ-OAR-2014-0827-1206-A1 p.12]

The Dayaratna and Kreutzer (2014) results using FUND were in line with alternative estimates of the impact of a lower climate sensitivity on the FUND model SCC determination. [EPA-HQ-OAR-2014-0827-1206-A1 p.13]

Waldhoff et al. (2011) investigated the sensitivity of the FUND model to changes in the ECS. Waldhoff et al. (2011) found that changing the ECS distribution such that the mean of the distribution was lowered from 3.0°C to 2.0°C had the effect of lowering the SCC by 60 percent (from a 2010 SCC estimate of \$8/ton of CO<sub>2</sub> to \$3/ton in \$1995). While Waldhoff et al. (2011) examined FUNDv3.5, the response of the current version (v3.8) of the FUND model should be similar. [EPA-HQ-OAR-2014-0827-1206-A1 p.13]

Additionally, the developer of the PAGES model, affirmed that the SCC from the PAGES model, too drops by 35% when the Otto et al. (2013) climate sensitivity distribution is employed (Hope, 2013). [EPA-HQ-OAR-2014-0827-1206-A1 p.13]

These studies make clear that the strong dependence of the social cost of carbon on the distribution of the estimates of the equilibrium climate sensitivity (including the median, and the upper and lower certainty bounds) requires that the periodic updates to the IWG SCC determination must include a critical examination of the scientific literature on the topic of the equilibrium climate sensitivity, not merely kowtowing to the IPCC assessment. There is no indication that the IWG undertook such an independent examination. But what is clear, is that the IWG did not alter its probability distribution of the ECS between its 2010, 2013, and 2015 SCC determination, despite a large and growing body of scientific literature that substantially alters and better defines the scientific understanding of the earth's ECS. It is unacceptable that a supposed "updated" social cost of carbon does not include updates to the science underlying a critical and key aspect of the SCC. [EPA-HQ-OAR-2014-0827-1206-A1 p.13]

We note that there has been one prominent scientific study in the recent literature which has argued, on the basis of recent observations of lower tropospheric mixing in the tropics, for a rather high climate sensitivity (Sherwood et al., 2014). This research, however, suffers from too narrow a focus. While noting that climate models which best match the apparent observed behavior of the vertical mixing characteristics of the tropical troposphere tend to be the models with high climate sensitivity estimates, the authors fail to make note that these same models are the ones whose projections make the worst match to observations of the evolution of global temperature during the past several decades. The figure below shows the observed global surface temperature history from 1951-2013 compared with the temperature evolution projected by the collection of models used in the new IPCC 2013 report. We broke the climate models down into two groups—those which have a climate sensitivity greater than 3.0°C (as suggested by Sherwood et al., 2014) and those with a climate sensitivity less than 3.0°C. The Figure shows that while neither model subset does a very good job is capturing evolution of global temperature during the past 15-20 years (the period with the highest human carbon dioxide emissions), the high sensitivity models do substantially worse than the lower sensitivity models. [EPA-HQ-OAR-2014-0827-1206-A1 p.13]

[Chart, 'Observed and Modeled Global Temperature Evolution 1951-2013', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

While Sherwood et al. (2014) prefer models that better match their observations in one variable, the same models actually do worse in the big picture than do models which lack the apparent accuracy in the processes that Sherwood et al. (2014) describe. The result can only mean that there must still be even bigger problems with other model processes which must more than counteract the effects of the processes described by Sherwood et al. After all, the overall model collective is still warming the world much faster than it actually is (see Figure below). In fact, for the observed global average temperature evolution for the past 30 years largely lies below the range which encompasses 95% of all climate model runs—an indication that the observed trend is statistically different from the trend simulated by climate models. And for periods approaching 40 years in length, the observed trend lies outside of (below) the range that includes 90% of all climate model simulations—and indication that the observed trend is marginally inconsistent with climate model simulations. [EPA-HQ-OAR-2014-0827-1206-A1 p.14]

We note that our statistics are based upon both the warm and the cold departures from predicted trends. In reality, the cold departure is what is of most interest from a policy perspective—for if warming is being demonstrably overpredicted, then policies based upon models that are in error are a substantial regulatory overreach. Our probability estimates are conservative as values at the .05 level are actually at the 2.5th percentile for warmth from the model ensemble. [EPA-HQ-OAR-2014-0827-1206-A1 p.14]

These results argue strongly against the reliability of the Sherwood et al. (2014) conclusion and instead provide robust observational evidence that the climate sensitivity has been overestimated by both climate models, and the IWG alike. [EPA-HQ-OAR-2014-0827-1206-A1 p.14]

[Chart, 'Models vs. Observations', can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

#### Agricultural Impacts of Carbon Fertilization

Carbon dioxide is known to have a positive impact on vegetation, with literally thousands of studies in the scientific literature demonstrating that plants (including crops) grow stronger, healthier, and more productive under conditions of increased carbon dioxide concentration. A recent study (Idso, 2013) reviewed a large collection of such literature as it applies to the world's 45 most important food crops (making up 95% of the world's annual agricultural production). Idso (2013) summarized his findings on the increase in biomass of each crop that results from a 300ppm increase in the concentration of carbon dioxide under which the plants were grown. This table is reproduced below, and shows that the typical growth increase exceeds 30% in most crops, including 8 of the world's top 10 food crops (the increase was 24% and 14% in the other two). [EPA-HQ-OAR-2014-0827-1206-A1 p.15]

[Table, 'Average percentage increase in biomass of each of the world's 45 most important food crops under an increase of 300 ppm of carbon dioxide', can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

Idso (2013) found that the increase in the atmospheric concentration of carbon dioxide that took place during the period 1961-2011 was responsible for increasing global agricultural output by 3.2 trillion dollars (in 2004-2006 constant dollars). Projecting the increases forward based on projections of the increase in atmospheric carbon dioxide concentration, Idso (2013) expects carbon dioxide fertilization

to increase the value of agricultural output by 9.8 trillion dollars (in 2004-2006 constant dollars) during the 2012-2050 period. [EPA-HQ-OAR-2014-0827-1206-A1 p.16]

This is a large positive externality, and one that is insufficiently modeled in the IAMs relied upon by the IWG in determining the SCC. [EPA-HQ-OAR-2014-0827-1206-A1 p.16]

In fact, only one of the three IAMs used by the IWG has any substantial impact from carbon dioxide fertilization, and the one that does, underestimates the effect by approximately 2-3 times. [EPA-HQ-OAR-2014-0827-1206-A1 p.16]

The FUND model has a component which calculates the impact on agriculture as a result of carbon dioxide emissions, which includes not only the impact on temperature and other climate changes, but also the direct impact of carbon dioxide fertilization. The other two IAMs, DICE and PAGE by and large do not (or only do so extremely minimally; DICE includes the effect to a larger degree than PAGE). Consequently, lacking this large and positive externality, the SCC calculated by the DICE and PAGE models is significantly larger than the SCC determined by the FUND model (for example, see Table A5, in the IWG 2013 report). [EPA-HQ-OAR-2014-0827-1206-A1 p.16-17]

But even the positive externality that results from carbon dioxide fertilization as included in the FUND model is too small when compared with the Idso (2013) estimates. FUND (v3.7) uses the following formula to determine the degree of crop production increase resulting from atmospheric carbon dioxide increases (taken from Anthoff and Tol, 2013a): [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

CO<sub>2</sub> fertilization has a positive, but saturating effect on agriculture, specified by [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

$$A_{tr}^f = \gamma_r \ln(\text{CO}_{2t}/275) \text{ [EPA-HQ-OAR-2014-0827-1206-A1 p.17]}$$

where

-A<sup>f</sup> denotes damage in agricultural production as a fraction due to the CO<sub>2</sub> fertilization by time and region; [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

-t denotes time; [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

-r denotes region; [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

-CO<sub>2</sub> denotes the atmospheric concentration of carbon dioxide (in parts per million by volume); [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

-275 ppm is the pre-industrial concentration; [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

-γ is a parameter (see Table A, column 8-9). [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

Column 8 in the table below shows the CO<sub>2</sub> fertilization parameter (γ<sub>r</sub>) used in FUND for various regions of the world (Anthoff and Tol, 2013b). The average CO<sub>2</sub> fertilization effect across the 16 regions of the world is 11.2%. While this number is neither a really weighted, nor weighted by the specific crops grown, it is clear that 11.2% is much lower than the average fertilization effect compiled by Idso (2013) for the world's top 10 food crops (35%). Further, Idso's fertilization impact is in

response to a 300ppm CO<sub>2</sub> increase, while the fertilization parameter in the FUND model is multiplied by  $\ln(\text{CO}_2/275)$  which works out to 0.74 for a 300ppm CO<sub>2</sub> increase. This multiplier further reduces the 16 region average to 8.4% for the CO<sub>2</sub> fertilization effect—some 4 times smaller than the magnitude of the fertilization impact identified by Idso (2013). [EPA-HQ-OAR-2014-0827-1206-A1 p.17]

[Table, 'Impact of climate change on agriculture in FUND model', can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

Although approximately four times too small, the impact of the fertilization effect on the SCC calculation in the FUND model is large. [EPA-HQ-OAR-2014-0827-1206-A1 p.18]

According to Waldhoff et al. (2011), if the CO<sub>2</sub> fertilization effect is turned off in the FUND model (v3.5) the SCC increases by 75% from \$8/ton CO<sub>2</sub> to \$14/ton CO<sub>2</sub> (in 1995 dollars). In another study, Ackerman and Munitz (2012) find the effective increase in the FUND model to be even larger, with CO<sub>2</sub> fertilization producing a positive externality of nearly \$15/ton CO<sub>2</sub> (in 2007 dollars). [EPA-HQ-OAR-2014-0827-1206-A1 p.18]

Clearly, had the Idso (2013) estimate of the CO<sub>2</sub> fertilization impact been used instead of the one used in FUND the resulting positive externality would have been much larger, and the resulting net SCC been much lower. [EPA-HQ-OAR-2014-0827-1206-A1 p.18]

This is just for one of the three IAMs used by the IWG. Had the more comprehensive CO<sub>2</sub> fertilization impacts identified by Idso (2013) been incorporated in all the IAMs, the three-model average SCC used by the IWG would be greatly lowered, and likely even become negative in some IAM/discount rate combinations. [EPA-HQ-OAR-2014-0827-1206-A1 p.18]

In its 2015 Response to Comments Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, the IWG admits to the disparate ways that CO<sub>2</sub> fertilization is included in the three IAMs. Nevertheless, the IWG quickly dismisses this as a problem in that they claim the IAMs were selected “to reflect a reasonable range of modeling choices and approaches that collectively reflect the current literature on the estimation of damages from CO<sub>2</sub> emissions.” This logic is blatantly flawed. Two of the IAMs do not reflect the “current literature” on a key aspect relating to the direct impact of CO<sub>2</sub> emissions on agricultural output, and the third only partially so. [EPA-HQ-OAR-2014-0827-1206-A1 p.19]

CO<sub>2</sub> fertilization is a known physical effect from increased carbon dioxide concentrations. By including the results of IAMs that do not include known processes that have a significant impact on the end product must disqualify them from contributing to the final result. The inclusion of results that are known a priori to be wrong can only contribute to producing a less accurate answer. Results should only be included when they attempt to represent known processes, not when they leave those processes out entirely. [EPA-HQ-OAR-2014-0827-1206-A1 p.19]

The justification from the IWG (2015) that “[h]owever, with high confidence the IPCC (2013) stated in its Fifth Assessment Report (AR5) that “[b]ased on many studies covering a wide range of regions and crops, negative impacts of climate change on crop yields have been more common than positive ones.” is completely irrelevant as CO<sub>2</sub> fertilization is an impact that is apart from “climate change.” And further, the IAMs do (explicitly in the case of FUND and DICE or implicitly in the case of PAGE) include damage functions related to the climate change impacts on agriculture. So not only is the IWG justification irrelevant, it is inaccurate as well. The impact of CO<sub>2</sub> fertilization on agricultural output and its impact on lowering the SCC must be considered. [EPA-HQ-OAR-2014-0827-1206-A1 p.19]



*The Misleading Disconnect Between Climate Change and the Social Cost of Carbon in the Integrated Assessment Models*

It is generally acknowledged, the results from IAMs are highly sensitive not only to the model input parameters but also to how the models have been developed and what processes they try to include. One prominent economist, Robert Pindyck of M.I.T. recently wrote (Pindyck, 2013) that the sensitivity of the IAMs to these factors renders them useless in a policymaking environment: [EPA-HQ-OAR-2014-0827-1206-A1 p.19]

Given all of the effort that has gone into developing and using IAMs, have they helped us resolve the wide disagreement over the size of the SCC? Is the U.S. government estimate of \$21 per ton (or the updated estimate of \$33 per ton) a reliable or otherwise useful number? What have these IAMs (and related models) told us? I will argue that the answer is very little. As I discuss below, the models are so deeply flawed as to be close to useless as tools for policy analysis. Worse yet, precision that is simply illusory, and can be highly misleading. [EPA-HQ-OAR-2014-0827-1206-A1 p.19]

...[A]n IAM-based analysis suggests a level of knowledge and precision that is nonexistent, and allows the modeler to obtain almost any desired result because key inputs can be chosen arbitrarily. [EPA-HQ-OAR-2014-0827-1206-A1 p.19]

Nevertheless, EPA has incorporated the IWG2013 determinations of the SCC into the cost/benefit analysis of this proposed regulation—ill-advisedly so in our opinion. Consider the following: the social cost of carbon should reflect the relative impact on future society that human-induced climate change from greenhouse gas emissions would impose. In this way, we can decide how much (if at all) we are willing to pay currently to reduce the costs to future society. It would seem logical that we would probably be more willing to sacrifice more now if we knew that future society would be impoverished and suffer from extreme climate change than we would be willing to sacrifice if we knew that future society would be very well off and be subject to more moderate climate change. We would expect that the value of the social cost of carbon would reflect the difference between these two hypothetical future worlds—the SCC should be far greater in an impoverished future facing a high degree of climate change than an affluent future with less climate change. [EPA-HQ-OAR-2014-0827-1206-A1 p.19-20]

But if you thought this, you would be wrong. [EPA-HQ-OAR-2014-0827-1206-A1 p.20]

Instead, the IAMs as run by the IWG2013 (and reflected in the July 2015 update) produce nearly the opposite result—the SCC is far lower in the less affluent/high climate change future than it is in the more affluent/low climate change future. Such a result is not only counterintuitive but misleading. [EPA-HQ-OAR-2014-0827-1206-A1 p.20]

We illustrate this illogical and impractical result using the DICE 2010 model (hereafter just DICE) used by the IWG2013 (although the PAGE and the FUND models generally show the same behavior). The DICE model was installed and run at the Heritage Foundation by Kevin Dayaratna and David Kreutzer using the same model set up and emissions scenarios as prescribed by the IWG2013. The projections of future temperature change (and sea level rise, used later in the Comment) were graciously provided to us by the Heritage Foundation. [EPA-HQ-OAR-2014-0827-1206-A1 p.20]

The figure below shows the projections of the future change in the earth's average surface temperature for the years 2000-2300 produced by DICE from the five emissions scenarios employed by the IWG2013. The numerical values on the right-hand side of the illustration are the values for the social cost of carbon associated with the temperature change resulting from each emissions scenario (the SCC

is reported for the year 2020 using constant \$2007 and assuming a 3% discount rate—numbers taken directly from Table A3 of the IWG2013 report). The temperature change can be considered a good proxy for the magnitude of the overall climate change impacts. [EPA-HQ-OAR-2014-0827-1206-A1 p.20]

[Figure, 'Temperature Change (DICE)', can be found on p.21 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

Notice in the figure above that the value for the SCC shows little (if any) correspondence to the magnitude of climate change. The MERGE scenario produces the greatest climate change and yet has the smallest SCC associated with it. The “5th Scenario” is a scenario that attempts to keep the effective concentration of atmospheric carbon dioxide at 550 ppm (far lower than the other scenarios) has a SCC that is more than 20% *greater* than the MERGE scenario. The global temperature change by the year 2300 in the MERGE scenario is 9°C while in the “5th Scenario” it is only 3°C. The highest SCC is from the IMAGE scenario—a scenario with a mid-range climate change. All of this makes absolutely no logical sense—and confuses the user. [EPA-HQ-OAR-2014-0827-1206-A1 p.21]

If the SCC bears little correspondence to the magnitude of future human-caused climate change, than what does it represent? [EPA-HQ-OAR-2014-0827-1206-A1 p.21]

The figure below provides some insight. [EPA-HQ-OAR-2014-0827-1206-A1 p.21]

[Figure, 'Global GDP (DICE)', can be found on p.22 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

When comparing the future GDP to the SCC, we see, generally, that the scenarios with the higher future GDP (most affluent future society) have the higher SCC values, while the futures with lower GDP (less affluent society) have, generally, lower SCC values. [EPA-HQ-OAR-2014-0827-1206-A1 p.22]

Combining the results from the two figures above thus illustrates the absurdities in the IWG’s use of the DICE model. The scenario with the richest future society and a modest amount of climate change (IMAGE) has the highest value of the SCC associated with it, while the scenario with the poorest future society and the greatest degree of climate change (MERGE) has the lowest value of the SCC. A logical, thinking person would assume the opposite. [EPA-HQ-OAR-2014-0827-1206-A1 p.22]

While we only directly analyzed output data from the DICE model, by comparing Tables 2 and Tables 3 from the IWG2010 report, it can be ascertained that the FUND and the PAGE models behave in a similar fashion. [EPA-HQ-OAR-2014-0827-1206-A1 p.22]

This counterintuitive result occurs because the damage functions in the IAMs produce output in terms of a percentage decline in the GDP—which is then translated into a dollar amount (which is divided by the total carbon emissions) to produce the SCC. Thus, even a small climate change-induced percentage decline in a high GDP future yields greater dollar damages (i.e., higher SCC) than a much greater climate change-induced GDP percentage decline in a low GDP future. [EPA-HQ-OAR-2014-0827-1206-A1 p.22]

Who in their right mind would want to spend (sacrifice) more today to help our rich decedents deal with a lesser degree of climate change than would want to spend (sacrifice) today to help our relatively less-well-off decedents deal with a greater degree of climate change? No one. Yet that is what the SCC

would lead you to believe and that is what the SCC implies when it is incorporated into federal cost/benefit analyses. [EPA-HQ-OAR-2014-0827-1206-A1 p.22]

In principle, the way to handle this situation is by allowing the discount rate to change over time. In other words, the richer we think people will be in the future (say the year 2100), the higher the discount rate we should apply to damages (measured in 2100 dollars) they suffer from climate change, in order to decide how much we should be prepared to sacrifice today on their behalf. [EPA-HQ-OAR-2014-0827-1206-A1 p.23]

Until (if ever) the current situation is properly rectified, the IWG's determination of the SCC is not fit for use in the federal regulatory process, such as this EPA regulation, as it is deceitful and misleading. [EPA-HQ-OAR-2014-0827-1206-A1 p.23]

### *Sea Level Rise*

The sea level rise module in the DICE model used by the IWG2013/2015 produces future sea level rise values that far exceed mainstream projections and are unsupported by the best available science. The sea level rise projections from more than half of the scenarios (IMAGE, MERGE, MiniCAM) exceed even the highest end of the projected sea level rise by the year 2300 as reported in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (see figure). [EPA-HQ-OAR-2014-0827-1206-A1 p.23]

[Figure, 'Sea Level Rise (DICE)', can be found on p.23 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

How the sea level rise module in DICE was constructed is inaccurately characterized by the IWG2013 (and misleads the reader). The IWG2013 report describes the development of the DICE sea level rise scenario as: [EPA-HQ-OAR-2014-0827-1206-A1 p.23]

“The parameters of the four components of the SLR module are calibrated to match consensus results from the IPCC's Fourth Assessment Report (AR4).6” [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

However, in IWG2013 footnote “6” the methodology is described this way (Nordhaus, 2010): [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

“The methodology of the modeling is to use the estimates in the IPCC Fourth Assessment Report (AR4).” [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

“Using estimates” and “calibrating” are two completely different things. Calibration implies that the sea level rise estimates produced by the DICE sea level module behave similarly to the IPCC sea level rise projections and instills a sense of confidence in the casual reader that the DICE projections are in accordance with IPCC projections. However this is not the case. Consequently, the reader is misled. [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

In fact, the DICE estimates are much higher than the IPCC estimates. This is even recognized by the DICE developers. From the same reference as above: [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

“The RICE [DICE] model projection is in the middle of the pack of alternative specifications of the different Rahmstorf specifications. Table 1 shows the RICE, base Rahmstorf, and average Rahmstorf.

*Note that in all cases, these are significantly above the IPCC projections in AR4.*” [emphasis added][EPA-HQ-OAR-2014-0827-1206-A1 p.24]]

That the DICE sea level rise projections are far above the mainstream estimated can be further evidenced by comparing them with the results produced by the IWG-accepted MAGICC modelling tool (in part developed by the EPA and available from <http://www.cgd.ucar.edu/cas/wigley/magicc/>). [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

Using the MESSAGE scenario as an example, the sea level rise estimate produced by MAGICC for the year 2300 is 1.28 meters—a value that is less than 40% of the average value of 3.32 meters produced by the DICE model when running the same scenario (see figure below). [EPA-HQ-OAR-2014-0827-1206-A1 p.24]

[Figure, 'Projected Sea Level Rise (MESSAGE)', can be found on p.25 of docket number EPA-HQ-OAR-2014-0827-1206-A1]

The justification given for the high sea level rise projections in the DICE model (Nordhaus, 2010) is that they well-match the results of a “semi-empirical” methodology employed by Rahmstorf (2007) and Vermeer and Rahmstorf (2009). [EPA-HQ-OAR-2014-0827-1206-A1 p.25]

However, subsequent science has proven the “semi-empirical” approach to projecting future sea level rise unreliable. For example, Gregory et al. (2012) examined the assumption used in the “semi-empirical” methods and found them to be unsubstantiated. Gregory et al (2012) specifically refer to the results of Rahmstorf (2007) and Vermeer and Rahmstorf (2009): [EPA-HQ-OAR-2014-0827-1206-A1 p.25]

The implication of our closure of the [global mean sea level rise, GMSLR] budget is that a relationship between global climate change and the rate of GMSLR is weak or absent in the past. The lack of a strong relationship is consistent with the evidence from the tide-gauge datasets, whose authors find acceleration of GMSLR during the 20th century to be either insignificant or small. It also calls into question the basis of the semi-empirical methods for projecting GMSLR, which depend on calibrating a relationship between global climate change or radiative forcing and the rate of GMSLR from observational data (Rahmstorf, 2007; Vermeer and Rahmstorf, 2009; Jevrejeva et al., 2010). [EPA-HQ-OAR-2014-0827-1206-A1 p.25]

In light of these findings, the justification for the very high sea level rise projections (generally exceeding those of the IPCC AR5 and far greater than the IWG-accepted MAGICC results) produced by the DICE model is called into question and can no longer be substantiated. [EPA-HQ-OAR-2014-0827-1206-A1 p.25]

Given the strong relationship between sea level rise and future damage built into the DICE model, there can be no doubt that the SCC estimates from the DICE model are higher than the best science would allow and consequently, should not be accepted by the IWG as a reliable estimate of the social cost of carbon. [EPA-HQ-OAR-2014-0827-1206-A1 p.25-26]

And here again, the IWG (2015) admits that these sea level rise estimates are an outlier on the high end, yet retains them in their analysis by claiming that they were interested in representing a “range” of possible outcomes. But, even the IWG (2015) admits that the IPCC AR5 assigned “a low confidence in projections based on such [semi-empirical] methods.” It is internally inconsistent to claim the IPCC as an authority for limiting the range of possibilities explored by the IAMs (which it did in the case of

equilibrium climate sensitivity) and then go outside the IPCC to justify including a wildly high estimate of sea level rise. Such inconsistencies characterize the IWG response to comments and weaken confidence in them. We thereby suggest that our comments should be considered independently from the IWG (2015) response. [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

We did not investigate the sea level rise projections from the FUND or the PAGE model, but suggest that such an analysis must be carried out prior to extending any confidence in the values of the SCC resulting from those models—confidence that we demonstrate cannot be assigned to the DICE SCC determinations. [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

### *High Social Cost of Carbon Estimates*

A few papers have appeared in the recent scientific literature that have argued that the SCC should be considerably higher than that determined by the IWG. However, these papers suffer from serious flaws. [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

For example, Van den Bergh and Botzen (2014) purport to make a “conservative” estimate of the SCC that is nearly four times larger than the central estimate made by the IWG. This estimate suffers from the many of the issues described previously—a low discount rate, high climate sensitivity, and little to no positive benefits from agriculture. By including all sorts of imagined bad climate outcomes—with high monetary damages—and being largely dismissive of positive impacts, high SCC values are readily created by the authors. [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

Another recent analysis which arrived at an estimate of the social cost of carbon that was considerably higher than those made by the IWG was conducted by Moore and Diaz (2015). However, a careful examination shows that the assumptions made and methodologies employed therein produce a non-robust and ultimately unreliable result (McKittrick, 2015). Applying a better and more thorough methodology leads to results which are virtually opposite to those initially reported by Moore and Diaz (2015)—one in which the social cost of carbon is quite low and perhaps even positive. [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

According to McKittrick (2015), the major underlying flaw in the Moore and Diaz paper is the reliance on the results of Dell et al. (2012) in which a warming climate was linked to economic declines in both rich and poor countries. Using a more up-to-date dataset, McKittrick shows that the negative economic linkage to a warming climate is statistically insignificant and “not a robust basis for a policy assertion.” [EPA-HQ-OAR-2014-0827-1206-A1 p.26]

Furthermore, McKittrick (2015) shows that if a the more standard methodology is applied, where the temperature changes are really-weighted rather than weighted by country-level population, the relationship between economic growth and temperature change reverses for rich countries and becomes statistically significant. According to McKittrick (2015), “each degree of warming significantly increases the annual income growth rate in rich countries by over 2 percentage points,” while in poor countries, the relationship “is statistically insignificant.” In conclusion, McKittrick (2015) finds: [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

The fact that the relevant poor-country coefficients are statistically insignificant implies they should not have been relied upon in Moore and Diaz (2015). And since the rich country coefficient corresponding to the [integrated assessment model] IAM structure is positive and significant, Moore and Diaz (2015) should actually have reported an acceleration of economic growth in rich countries associated with rising temperatures and a correspondingly reduced SCC. Also, since the rich countries begin with a

larger GDP it is also likely that the overall global effect of warming on income growth would be positive, even applying the poor country coefficient. In any case the computations in Moore and Diaz (2015) are uninformative since they used coefficients from DJO based on an incomplete sample and a definition of temperature incompatible with their IAM. [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

Bottom line is that the Moore and Diaz (2015) high SCC estimates as well as the Dell et al. (2012) results upon which they were based, do not stand up under careful re-analysis. In fact, when assessed properly, they produce a low SCC estimate, in support of our overall analysis. [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

And finally, Havranek et al. (2015) reviewed the collective literature on the social cost of carbon estimates (809 estimates across 101 studies) and concluded that it suffers from selective reporting—with negative values (i.e., social benefits of carbon dioxide emissions) being largely downplayed or unreported. According to Havranek et al.: [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

Our results are consistent with a situation when some authors of primary studies report preferentially estimates for which the 95% confidence interval excludes small values of the SCC, which creates an upward bias in the literature. In other words, we observe that small estimates of the SCC are associated with less uncertainty (expressed as the approximate standard error used to compute the lower bound of the confidence interval) than large estimates. The finding suggests that some small estimates with large uncertainty—that is, not ruling out negative values of the SCC—might be selectively omitted from the literature. Our results also indicate that selective reporting tends to be stronger in studies published in peer-reviewed journals than in unpublished manuscripts. [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

After applying a correction for the selective reporting, Havranek et al., conclude that the *upper* bound for the SCC from the collective literature is close to the *mean* value determined by the IWG—an indication that the IWG mean value is inflated: [EPA-HQ-OAR-2014-0827-1206-A1 p.27]

The result is USD 39 ( $= 134 \cdot 1.07/3.67$ ), which suggests that the upper boundary for mean estimates reported in the literature and corrected for selective reporting is remarkably close to the central estimate of 40 used by the US Government's Interagency Working Group on Social Cost of Carbon (IWGSCC, 2015). [EPA-HQ-OAR-2014-0827-1206-A1 p.27-28]

Further, and rather importantly, Havranek et al., note that selective reporting likely plagues other aspects of the climate change literature, further leading to an inflated SCC value as produced by the IWG: [EPA-HQ-OAR-2014-0827-1206-A1 p.28]

Moreover, other studies suggest that some of the parameters used for the calibration of integrated assessment models, such as climate sensitivity or the elasticity of intertemporal substitution in consumption, are likely to be exaggerated themselves because of selective reporting, which might further contribute to the exaggeration of the SCC reported in individual studies—including the results of the Interagency Working Group. [EPA-HQ-OAR-2014-0827-1206-A1 p.28]

Do the EPA and the IWG understand that they are contributing additional material and evidence that the Obama Administration is involved in clear and present scientific and economic mendacity? These new papers provide additional evidence. [EPA-HQ-OAR-2014-0827-1206-A1 p.28]

*Conclusion on Social Cost of Carbon*

The social cost of carbon as determined by the Interagency Working Group in their May 2013 Technical Support Document (updated in November 2013 and July 2015) and used by the EPA in its proposed Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 is unsupported by the robust scientific literature, fraught with uncertainty, illogical, and thus completely unsuitable and inappropriate for federal rulemaking. As such, use of the SCC in cost/benefit analyses in this proposed rulemaking should be suspended and not revisited until to above-mentioned weaknesses are fully rectified. [EPA-HQ-OAR-2014-0827-1206-A1 p.28]

Given the uncertainties that are involved, the EPA should cease the use of the SCC in this and all regulatory analyses. [EPA-HQ-OAR-2014-0827-1206-A1 p.28]

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**Response:**

The comments regarding the SC-CO<sub>2</sub> estimates and general application in a rulemaking context mirror those submitted to the Office of Management and Budget's separate comment solicitation on the SC-CO<sub>2</sub> (78 FR 70586; November 26, 2013). As a member of the interagency working group (IWG) on SC-CO<sub>2</sub>, EPA has carefully examined and evaluated comments submitted to OMB's separate solicitation. EPA has also carefully examined and evaluated all comments received regarding SC-CO<sub>2</sub> through this rulemaking process and determined that the IWG responses to the comments on the OMB solicitation address this commenter's statements about SC-CO<sub>2</sub> (use of global values, treatment of equilibrium climate sensitivity, CO<sub>2</sub> fertilization and sea level rise in the models, the validity of integrated assessment models used to develop the estimates) and use of the estimates in this RIA. Specifically, EPA concurs with the IWG's response to these comments and hereby incorporates them by reference.<sup>218</sup>

Furthermore, EPA disagrees with the commenter's assertion that the OMB Response to Comments on SC-CO<sub>2</sub> does not address the commenter's statements, which were submitted both to this rulemaking and to OMB's separate comment solicitation on SC-CO<sub>2</sub> (78 FR 70586; November 26, 2013). The commenter has not provided evidence supporting their assertion they have not received a response that addresses their comments; the remainder of this response elaborates on this point.

Also, EPA and other members of the U.S. Interagency Working Group on the SC-CO<sub>2</sub> are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward. The Academies' review will focus on the SC-CO<sub>2</sub> methodology, but recommendations on how to update many of the underlying modeling assumptions will also likely pertain to the SC-CH<sub>4</sub> and SC-N<sub>2</sub>O estimates. Going forward, the EPA will evaluate its approach to estimating the SC-CO<sub>2</sub>, SC-CH<sub>4</sub>, and SC-N<sub>2</sub>O based upon any feedback received from the Academies' panel.

After careful evaluation of the full range of comments and associated technical issues described in this RTC, EPA has determined that it will continue to use the SC-GHG estimates in the final rulemaking analysis. In particular, the current SC-CO<sub>2</sub> estimates and the Marten et al. SC-CH<sub>4</sub> and SC-N<sub>2</sub>O estimates represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental emissions changes into regulatory analysis. Therefore, EPA has presented these estimates in this rulemaking. EPA will continue to consider these comments and will share the recommendations with the IWG as it moves forward with the Academies process.

The remainder of this section elaborates on the points raised by the commenter in the context of this rulemaking.

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<sup>218</sup> Referred to as the "OMB Response to Comments on SC-CO<sub>2</sub>." See <https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf>.

### *Global and domestic values*

See response to “Mannix, Brian,” in RTC Section 11.8.

### *Equilibrium Climate Sensitivity*

The EPA strongly disagrees with the commenter’s assertion that the Interagency Working Group on the social cost of carbon (IWG) does not give credence to mainstream science, in particular for studies on equilibrium climate sensitivity (ECS). The EPA is aware that this is an active area of research and as stated in OMB’s Response to Comments on the SC-CO<sub>2</sub>, the IWG remains committed to updating the SC-CO<sub>2</sub> estimates to incorporate new scientific information and accurately reflect the current state of scientific uncertainty regarding the ECS. While EPA acknowledges that the ECS distribution, along with other climate modeling inputs to the SC-CO<sub>2</sub> calculation, should be updated periodically to reflect the latest scientific consensus, care must be exercised in selecting an appropriate range of estimates for this important parameter. Many studies estimating climate sensitivity have been published, based on a variety of approaches (instrumental record, paleoclimate observations, models, etc.). These individual studies report differing values and provide different information. Picking a single study from the high or low end of the range, or even in the middle, will exclude relevant information. A valid representation of uncertainty regarding climate sensitivity should be obtained from a synthesis exercise such as that done by the IPCC that considers the full range of relevant studies.

As noted in the SC-CO<sub>2</sub> TSDs, the EPA and the other IWG members are committed to periodic updates in the estimates to reflect ongoing developments in our understanding of the science and economics of climate change.<sup>219</sup> Moreover, the EPA has determined that the current SC-CO<sub>2</sub> estimates continue to represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental CO<sub>2</sub> emissions changes into regulatory analyses. As previously noted, the EPA and other members of the U.S. Interagency Working Group on the social cost of carbon are seeking independent expert advice on technical opportunities to update these estimates from the National Academies of Sciences, Engineering, and Medicine.

To date, the Committee has released an interim report, which recommended against doing a near term update of the SC-CO<sub>2</sub> estimates. In particular, the Committee concluded that the “equilibrium climate sensitivity (ECS) is only one parameter affecting the social cost of carbon (SCC). Each of the three SCC integrated assessment models also embodies a different representation of the climate system and its underlying uncertainties, including relationships and parameters beyond the ECS. Therefore, updating the ECS alone within the current SCC framework may not significantly improve the estimates.” (PDF page 56).<sup>220</sup>

The Committee elaborated:

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<sup>219</sup> EPA notes that the 2013 update was based on new versions of each IAM. The 2013 update did not revisit the 2010 modeling decisions with regards to the discount rate, reference case socioeconomic and emission scenarios, and equilibrium climate sensitivity distribution. Rather, improvements in the way damages are modeled are confined to those that have been incorporated into the latest versions of the models by the developers themselves and published in the peer-reviewed literature.

<sup>220</sup> National Academies of Sciences, Engineering, and Medicine. (2016). *Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update*. Committee on Assessing Approaches to Updating the Social Cost of Carbon, Board on Environmental Change and Society. Washington, DC: The National Academies Press. doi: 10.17226/21898. See PDF page 56, for quoted text.

“...there would not be sufficient benefit of modifying the estimates to merit a near-term update that would be based on revising a specific parameter in the existing framework used by the IWG to reflect the most recent scientific consensus on how global mean temperature is, in equilibrium, affected by CO<sub>2</sub> emissions. Furthermore, the committee does not recommend changing the distributional form used to capture uncertainty in the equilibrium CO<sub>2</sub> emissions-temperature relationship. Rather than simply updating the distribution used for equilibrium climate sensitivity—the link that translates CO<sub>2</sub> emissions to global temperature change—in the current framework, the IWG could undertake efforts toward the adoption or development of a common representation of the relationship between CO<sub>2</sub> emissions and global mean surface temperature change, its uncertainty, and its profile over time” (page 12).

For future revisions, the Committee recommended the IWG move efforts towards a broader update of the climate system module consistent with the most recent, best available science, and also offered recommendations for how to enhance the discussion and presentation of uncertainty in the SC-CO<sub>2</sub> estimates. Specifically, the Committee recommended that “the IWG provide guidance in their technical support documents about how [SC-CO<sub>2</sub>] uncertainty should be represented and discussed in individual regulatory impact analyses that use the [SC-CO<sub>2</sub>]” and that the technical support document for each update of the estimates present a section discussing the uncertainty in the overall approach, in the models used, and uncertainty that may not be included in the estimates. At the time of this writing, the IWG is reviewing the interim report and considering the recommendations. The EPA looks forward to working with the IWG to respond to the recommendations and will continue to follow IWG guidance on SC-CO<sub>2</sub>.

EPA also notes that at the time the 2013 SC-CO<sub>2</sub> update was released, the most authoritative statement about ECS appeared in the IPCC’s AR4. Since that time, the IPCC issued a Fifth Assessment Report that updated its discussion of the likely range of climate sensitivity compared to AR4. The new assessment reduced the low end of the assessed likely range (high confidence) from 2°C to 1.5°C, but retained the high end of the range at 4.5°C. Unlike in AR4, the new assessment refrained from indicating a central estimate of ECS. This assessment is based on a comprehensive review of the scientific literature and reflects improved understanding, the extended temperature record for the atmosphere and oceans, and new estimates of radiative forcing.

Several of the post-AR4 studies highlighted by the commenter were cited in the AR5 assessment. In particular, both Aldrin et al. (2012) and Otto et al. (2013) were cited in both Chapter 10 and Chapter 12 of the AR5 Working Group I assessment. Eight of the authors of Otto et al. (2013), including the lead author, were authors of Chapter 12 for AR5’s Working Group I and one was a lead author for the chapter. Hence it is clear that the IPCC considered Otto et al. (2013) in its synthesis of literature on the ECS. More broadly, the AR5 climate sensitivity distribution likely incorporates much of the literature identified by the commenters. EPA will continue to follow and evaluate the latest science on the ECS.

As discussed in Section I.A.2 of the Preamble, the 2009 Endangerment Finding, and in the OMB Response to Comments on SC-CO<sub>2</sub>, among other resources, the links between CO<sub>2</sub> and temperature are established beyond question by laboratory measurements, physical theory, paleoclimate observations, instrumental observations, and observations of other planets. Climate change and its impacts, such as sea level rise, have been exhaustively documented, and synthesized internationally by the IPCC and domestically by the U.S. National Climate Assessment. Based on the wide acceptance of these conclusions in the scientific community, EPA believes that: (1) anthropogenic emissions of greenhouse gases are causing atmospheric levels of greenhouse gases in our atmosphere to rise to levels unprecedented in human history; (2) the accumulation of greenhouse gases in our atmosphere is exerting a warming effect on the global climate; (3) there are multiple lines of evidence, including increasing average global surface temperatures, rising ocean temperatures and sea levels, and shrinking ice in

glaciers, ice sheets, and the Arctic, all showing that climate change is occurring, and that the rate of climate change in the past few decades has been unusual in the context of the past 1000 years; (4) there is compelling evidence that anthropogenic emissions of greenhouse gases are the primary driver of recent observed increases in average global temperature; (5) atmospheric levels of most greenhouse gases are expected to continue to rise for the foreseeable future; and (6) risks and impacts to public health and welfare are expected to grow as climate change continues, and that climate change over this century is expected to be greater compared to observed climate change over the past century.

While there are inherent uncertainties associated with modeling climate systems over long time spans, the general circulation models (GCMs) upon which estimates of ECS and other climate science research are based have been extensively evaluated. For example, since 1989 the DOE has had a large program (The Program for Climate Model Diagnosis and Intercomparison) dedicated to evaluating these models.

The ECS parameter is a useful parameter for summarizing the strength of the climate system's response to accumulating GHG concentrations in the atmosphere. However, it is influenced by many highly complex and uncertain natural processes, some of which adjust over very long periods of time. Therefore, persistent uncertainty about the ECS is not surprising. Furthermore, persistent uncertainty does not suggest an absence of useful information. However, EPA does not agree that progress has not been made in reducing this uncertainty. Over the last 30 years the scientific community has elucidated many aspects of the climate system's response to GHGs accumulating in the atmosphere. While the AR5 "likely" range is slightly larger than that of AR4, the assessment presented greater confidence in the tails. AR5 found that climate sensitivity is very unlikely to be greater than 6°C, whereas AR4 stated that the "lack of strong constraints limiting high climate sensitivities prevents the specification of a 95<sup>th</sup> percentile bound." Similarly, while the AR5 and the IPCC's (2001) Third Assessment Report (TAR) bounds look similar, the TAR bounds were presented as a range without estimated probabilities.

### *Comments on CO<sub>2</sub> Fertilization and on Sea Level Rise*

The commenter has misconstrued the IWG's response to comments (in the OMB RTC on SC- CO<sub>2</sub>) on carbon fertilization, also referred to as CO<sub>2</sub> fertilization.<sup>221</sup> The commenter (Michaels and Knappenberger) has referenced text that responded to conflicting public comments, which were submitted to OMB's separate solicitation, about damage functions. In particular, these public comments "disagreed about whether the IAMs overestimate or underestimate CO<sub>2</sub> fertilization effects in the agriculture and forestry sectors" (OMB Response to Comments on SC-CO<sub>2</sub>, page 9). The IWG response, which is only partially quoted by this commenter, acknowledged uncertainty about climate change impacts on agriculture and quoted the IPCC's observation that findings from the peer-reviewed literature of negative impacts of climate change on crop yields are more common than positive impacts. Specifically, the IWG stated on page 10:

"As a result there is uncertainty as to the magnitude of these impacts and the role of interactions between changes in the climate and other factors, such as CO<sub>2</sub> fertilization, temperature, precipitation, ozone, pests, etc. Additionally, these effects are likely to vary widely across regions and crops. However, with high confidence the IPCC (2013) stated in its Fifth Assessment Report (AR5) that "[b]ased on many studies covering a wide range of regions and crops, negative impacts of climate change on crop yields have been more common than positive impacts."

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<sup>221</sup> See OMB Response to Comments on SC-CO<sub>2</sub>, pages 9-10, <https://www.whitehouse.gov/sites/default/files/omb/infoc/scc-response-to-comments-final-july-2015.pdf>.

The distinction that the commenter draws here between CO<sub>2</sub> “positive impacts” mentioned in this passage from AR5 include primarily studies from high-latitude regions but do not exclude the effects of CO<sub>2</sub> fertilization. In fact, the IPCC explicitly states that there are “stimulatory effects on crop yields” associated with CO<sub>2</sub> fertilization and correctly identifies CO<sub>2</sub> fertilization as one of multiple factors that interact with changes in the climate.<sup>222</sup>

The commenter’s misinterpretation of the IWG response and AR5 passage notwithstanding, EPA disagrees with the commenter’s assertion that models that exclude “known processes” should be omitted. To date, the EPA and other members of the IWG have accepted the models as currently constituted, and omitted any damages or beneficial effects that the model developers themselves do not include. The EPA recognizes that none of the three IAMs fully incorporates all climate change impacts, either positive or negative. Some of the effects (e.g., damages related to agriculture broadly and CO<sub>2</sub> fertilization specifically) are explicitly modeled in the damage functions of one or more of the current models (although the treatment may not be complete), and the model developers continue to update their models as new research becomes available. The IWG undertook the 2013 revision because of updates to the models, which include new or enhanced representation of certain impacts, such as sea level rise damages. In addition, some of the categories are currently speculative or cannot be incorporated into the damage function for lack of appropriate data. Using an ensemble of three different models was intended to, at least partially, address the fact that no single model includes all of the impacts. We recognize that there may be effects that none of the three selected models addresses (e.g., impacts from ocean acidification) or that are likely not fully captured (e.g. catastrophic effects). However, EPA strongly disagrees with the commenter that models that do not include all known processes should therefore be omitted. The science underlying the assessment and valuation of climate change impacts is constantly evolving. In 2007 the Ninth Circuit Court remanded a CAFE fuel economy rule to DOT for failing to monetize the benefits of the CO<sub>2</sub> emissions reductions in its regulatory impact analysis, noting that “the value of carbon emissions reduction is certainly not zero.”<sup>223</sup> As discussed in this document and in the RIA, EPA has determined that the current estimates continue to represent the best scientific information on the impacts of climate change available in a form appropriate for incorporating the damages from incremental CO<sub>2</sub> emissions changes into regulatory analyses.

EPA acknowledges the comments on the sea level rise projections in DICE and the Agency recognizes that sea level rise projections are an area of ongoing research. One key issue involves projections of melt from the Greenland and West Antarctic ice sheets. The IPCC AR5 report notes there is a possibility of sea level rise “substantially above” their best estimate of a likely range because of uncertainties regarding the response of the Antarctic ice sheet (AR5 Working Group I, Chapter 13). In AR5 the IPCC also discusses semi-empirical methods, stating a low confidence in projections based on such methods, which calibrate a mathematical model against observations rather than projecting individual processes. However, the IPCC did not entirely discount these methods. Further supporting the use of semi-empirical methods, the U.S. National Climate Assessment uses an average of the high end of semi-empirical projections in order to define their “Intermediate-High” Scenario (Parris et al., 2012). Additionally, recent NRC assessments have also produced higher sea level rise projections than the IPCC: the NRC Sea Level Rise assessment projects a global sea level rise of 0.5 to 1.4 meters (1.6 to 4.6 feet) by 2100, the NRC National Security Implications assessment suggests that “the Department of the

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<sup>222</sup> The paragraph in AR5 that elaborates on the observation about the frequency of studies finding negative impacts compared to positive impacts states, “CO<sub>2</sub> has stimulatory effects on crop yields in most cases, and elevated tropospheric ozone has damaging effects. Interactions among CO<sub>2</sub> and ozone, mean temperature, extremes, water, and nitrogen are non-linear and difficult to predict (medium confidence)” (WGII, AR5 Part A, pg 47).

<sup>223</sup> See <http://cdn.ca9.uscourts.gov/datastore/opinions/2007/11/14/0671891.pdf>.

Navy should expect roughly 0.4 to 2 meters [1.3 to 6.6 feet] global average sea-level rise by 2100,”<sup>34</sup> and the NRC Climate Stabilization Targets assessment states that an increase of 3°C will lead to a sea level rise of 0.5 to 1 meter (1.6 to 3.3 feet) by 2100. Therefore, it is reasonable for one out of three models used by the IWG to include some reliance upon semi-empirical methods.

EPA continues to find this response, which was also presented by the IWG in the OMB Response to Comments on SC-CO<sub>2</sub>, to be valid and relevant, and therefore disagrees with the commenter’s suggestion that EPA disregard it. In particular, the EPA disagrees with the commenter’s suggestion that the IWG has inconsistently used the IPCC to justify methodological decisions, such as the development of the ECS distribution, and the treatment of sea level rise in DICE. The IPCC is an authoritative assessment but it is not the only assessment of the peer-reviewed literature. The fact that the IPCC AR5 did not entirely discount semi-empirical methods and the fact that both the highly credible and extensively reviewed U.S. National Climate Assessment and assessments from the National Research Council projected higher rates of sea level rise than did the IPCC led EPA and other members of the IWG to conclude that this approach is reasonable for one of the three models.<sup>224</sup>

Moreover, the commenter has not demonstrated why or how this response lacks validity, particularly in light of the fact that EPA and the other members of the IWG are seeking independent expert advice on technical opportunities to update the SC-CO<sub>2</sub> estimates from the National Academies of Sciences, Engineering, and Medicine. EPA is aware that more sophisticated yet still relatively simplified climate models, such as MAGICC, could be used to replace the highly simplified climate science components of the three IAMs. However, given the range of climate models available and the technical issues associated with such a change, replacing the climate modules or other structural features of the IAMs requires additional investigation before it can be applied to SC-CO<sub>2</sub> estimation. A committee convened by the Academies is reviewing the state of the science on estimating the SC-CO<sub>2</sub>, and will provide expert, independent advice on the merits of different technical approaches for modeling and highlight research priorities going forward.

### ***Integrated Assessment Models Used to Estimate the SC-CO<sub>2</sub>***

EPA strongly disagrees that the estimates are “deceitful and misleading.” The SC-CO<sub>2</sub> TSDs fully document the methodology used to develop the estimates and the considerations that led the IWG to adopt this methodology. EPA acknowledges uncertainty in the SC-CO<sub>2</sub> estimates but disagrees that the uncertainty is so great as to undermine use of the SC-CO<sub>2</sub> estimates in regulatory impact analysis. The uncertainty in the SC-CO<sub>2</sub> estimates is fully acknowledged and comprehensively discussed in the TSDs and supporting academic literature. As noted in the SC-CO<sub>2</sub> TSDs, the EPA and the other IWG members are committed to periodic updates in the estimates to reflect ongoing developments in our understanding of the science and economics of climate change, including the treatment of uncertainty.

Regarding the models, DICE, FUND, and PAGE are the most widely used and widely cited models in the economic literature that link physical impacts to economic damages for the purposes of estimating the SCC. As stated in the 2010 TSD:

These models are frequently cited in the peer-reviewed literature and used in the IPCC assessment. ... These models are useful because they combine climate processes, economic

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<sup>224</sup> As stated in the 2014 National Climate Assessment, page 3, the NCA “draws from a large body of scientific, peer-reviewed research, as well as a number of other publicly available sources” that have been “carefully reviewed...to ensure a reliable assessment of the state of scientific understanding.” See <http://nca2014.globalchange.gov/downloads>.

growth, and feedbacks between the climate and the global economy into a single modeling framework. ... Other IAMs may better reflect the complexity of the science in their modeling frameworks but do not link physical impacts to economic damages.

In addition, the National Academies of Science (NAS) identified these three models as "the most widely used impact assessment models" in a 2010 report (NAS, 2010). Furthermore, in a comprehensive literature review and meta-analysis conducted in 2008, the vast majority of the independent impact estimates that appeared in the peer-reviewed literature were derived from FUND, DICE, or PAGE (Tol, 2008).

While the development of the DICE, FUND and PAGE models necessarily involved assumptions and judgments on the part of the modelers, the damage functions are not simply arbitrary representations of the modelers' opinions about climate damages. Rather they are based on a review by the modelers of the currently available literature on the effects of climate change on society. The conclusions that the modelers draw from the literature, and the bases for these conclusions are documented, and all three models are continually updated as new information becomes available. While EPA recognizes that there are limitations with these models, including some of those discussed in Pindyck (2013), IAMs nonetheless provide valuable information for regulatory impact analysis. In a recent article in the peer-reviewed literature, Weyant (2014) addressed this issue as follows:

While Pindyck's observations about the empirical weaknesses of IAMs or calculations of the SCC are worthy of careful study, the conclusion that IAMs are therefore useless fundamentally misconceives the enterprise. IAMs and the [SC-CO<sub>2</sub>] are conceptual frameworks for dealing with highly complex, non-linear, dynamic, and uncertain systems. The human mind is incapable of solving all the equations simultaneously, and modeling allows making "If..., then..." analyses of the impacts of different factors. The models have provided important insights into many aspects of climate-change policy.

EPA has thus determined that it was appropriate for the IWG to base the SC-CO<sub>2</sub> estimates on the DICE, FUND and PAGE models. Moving forward, EPA will continue to follow and evaluate the latest peer reviewed literature applying IAMs. As previously noted, EPA and all of the other IWG members will seek external expert advice on the technical merits and challenges of using additional models (e.g., CRED, ENVISAGE) to estimate the SC-CO<sub>2</sub> and/or removing existing models from the ensemble (DICE, FUND, and PAGE) used to estimate the SC-CO<sub>2</sub>.

Regarding potential inconsistencies between scenarios and IAMs, given the nature of estimating the SC-CO<sub>2</sub> and available data/resources, a full harmonization along all possible dimensions of the three IAMs used to estimate the SC-CO<sub>2</sub> with the four models used to develop the scenarios was not possible. Therefore, the IWG chose to harmonize the models with respect to the scenario variables to which SC-CO<sub>2</sub> estimates are most sensitive (GDP, population, and emissions) using common techniques in the literature. The scenarios used were developed by highly respected international modeling groups and published in the peer-reviewed literature. In terms of potential inconsistencies across scenario variables past 2100, an effort was made to account for some basic correlations among scenario variables in the post-2100 extrapolation. For example, extrapolations were based on GDP per capita growth, which implicitly correlates population and GDP growth, rather than GDP levels or growth alone. Similarly, extrapolations were based on CO<sub>2</sub> emissions intensity with respect to GDP, which correlates emissions and GDP growth, rather than CO<sub>2</sub> emissions levels or growth alone.

Consistent with historical observations, it is expected that growth rates of rapidly developing economies will exceed those of already developed economies in the near term. Scenarios with projections of global economic growth that exceed recent trends in developed economies are consistent with this expectation.

The chosen scenarios capture a wide range of potential future states of the world, but were not intended to represent a comprehensive accounting of the full range of uncertainty, and therefore it is possible that future outcomes will fall outside of this range. EPA and the members of the IWG have acknowledged that the projection of the scenarios beyond 2100 has greater uncertainty than shorter-term projections and will continue to monitor the literature, including the development of extended RCP/SSP scenarios, for ways to improve the estimated trajectories and improve internal consistency.

## **11.8 Monetized Non-GHG Health Impacts**

**Organization:** BYD Motors

The current version of the plan will have real benefits for public health and will provide total cost of ownership benefits for fleet operators over the life of the vehicles. [EPA-HQ-OAR-2014-0827-1182-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.227.]]

**Response:**

We agree that the rulemaking will have real benefits for the public and have demonstrated these benefits in the regulatory impact analysis that accompanies this rulemaking.

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Scope of costs and benefits**

The NPRM requests comment on whether any costs or benefits are omitted from the analysis. CARB staff supports the inclusion of all quantifiable impacts of reductions in GHG and non-GHG pollutants. Specifically, CARB staff suggests the inclusion of ecosystem benefits from reduced non-GHG pollutants including those to crops as outlined in Murphy et al. (1999). Changes in fugitive emissions from altered driving patterns on paved roads may also impact agriculture and ecosystem health. These impacts should be included in the analysis to the extent that they can be quantified.<sup>79</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.182]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Economic value of reduction in criteria pollutants**

The NPRM requests comment on the economic valuation of reductions in criteria pollutants resulting from the proposed rulemaking. CARB staff supports the inclusion of criteria pollutant emission reductions as well as consideration of the impacts on toxic air contaminants such as diesel PM. CARB staff also suggests the impact of local pollutants be based on source-specific estimates of marginal damage.<sup>86</sup> CARB staff supports continued full-scale air quality modeling for the final rulemaking to capture local variability. [EPA-HQ-OAR-2014-0827-1265-A1 p.186]



79 (Murphy et al., 1999) Murphy, J.J., M.A. Delucchi, D.R. McCubbin, and H.J. Kim, "The cost of crop damage caused by ozone air pollution from motor vehicles," Journal of Environmental Management: 55, 273-289.

<sup>86</sup> (Muller and Mendelsohn, 2009) Muller, N.Z. and Mendelsohn, R., "Efficient pollution regulation: getting the prices right," *American Economic Review*: 99(5), 1714-39. (Muller and Mendelsohn, 2012) Muller, N.Z. and Mendelsohn, R., "Efficient pollution regulation: getting the prices right: reply," *American Economic Review*: 102(1), 608-12.

### **Response:**

EPA agrees with the commenter that the analysis would benefit from the full inclusion of all quantifiable impacts of reductions in GHG and non-GHG pollutants. EPA endeavors to include all of the human health and environmental impacts that can be quantified and monetized. However, the full complement of human health and welfare effects associated with PM, ozone, other criteria pollutants, and toxic air pollutants remain unquantified because of current limitations in methods or available data. We have not quantified a number of known or suspected health effects linked with ozone, PM, and other criteria pollutants for which appropriate health impact functions are not available or which do not provide easily interpretable outcomes (e.g., changes in heart rate variability). Regarding diesel PM, a toxic air pollutant, we do not estimate the change in health risk associated with reductions in diesel PM based on current limitations in methods and available data. However, we capture benefits related to reductions in diesel PM to the extent that diesel PM is included in measured PM<sub>2.5</sub>. Additionally, we are unable to quantify a number of known welfare effects, including reduced crop damage, reduced acid and particulate deposition damage to cultural monuments and other materials, and environmental benefits due to reductions of impacts of eutrophication in coastal areas. As a result, the health benefits quantified in this section are likely underestimates of the total benefits attributable to the standards. Please refer to Appendix 8A (and Table 8A-2) for a full description of the health and welfare impacts EPA is currently able to quantify.

EPA had planned on including PM- and ozone-related health benefits based on full-scale photochemical modeling in its analysis for the FRM. However, as described in Chapter 8.6 of the RIA, we have not included the results from the primary analysis because, out of necessity, the air quality modeling was based on emissions inventories that reflected the form of the standards as they were proposed, not finalized (air quality modeling results are presented in Appendix 6A). The length of time needed to prepare the inventories and run the air quality model required EPA to make air quality modeling input decisions early in the analytical process, and therefore made it impossible to base the health impacts analysis on the emissions changes associated with the final rulemaking.

The chief limitation when using air quality inventories based on emissions from the proposal is that they can diverge from the estimated emissions of the final rulemaking. How much the emissions might diverge and how that difference would impact the air quality modeling and health benefit results is difficult to anticipate. For the FRM, EPA concluded that when comparing the proposal and final rule inventories, the differences were enough to justify moving the typical Calendar Year (CY) benefits analysis (based on air quality modeling) from the primary estimate of costs and benefits to a supplemental analysis presented in Appendix 8A.<sup>225</sup> While we believe this supplemental analysis is still illustrative of the standard's potential benefits, EPA has instead chosen to characterize the CY benefits in the primary analysis in a manner consistent with the Model Year (MY) lifetime analysis. That is, we

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<sup>225</sup> See Chapter 5 of the RIA for a presentation and discussion of the differences between the proposal inventories used to conduct the air quality modeling and the final rule inventories.

apply PM-related “benefits per-ton” values to the CY final rule emission reductions to estimate the PM-related benefits of the final rule.

**Organization:** Fuller, Tony

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 149.]

Also I was thinking given the larger role the Federal government has been taking in healthcare and the costs associated with it, the monetary savings for the government alone should be a factor that should be considered.

**Response:**

EPA agrees that avoided health care costs from improvements in air quality should be accounted for in our rulemaking analyses. We account for criteria pollutant-related health improvement benefits in our regulatory impact analysis that supports this rulemaking.

## 11.9 Energy Security Impacts

**Organization:** Achates Power, et al.

The rulemaking has the potential to secure an even safer future by saving up to 200,000 more barrels of oil per day by 2035.<sup>1</sup> [EPA-HQ-OAR-2014-0827-1762-A2 p.2]

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1 Union of Concerned Scientists (UCS), Newly Proposed Heavy-duty Truck Efficiency Standards for 2018-2029, (July 2015), available at <http://www.ucsusa.org/sites/default/files/attach/2015/07/proposed-heavy-duty-vehicles-standards.pdf>.

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Energy security analysis**

The NPRM requests comment on the estimation of energy security benefits of the proposed rulemaking. CARB staff supports the estimation of energy security benefits and suggests that the benefit to national defense be included in the estimation. The National Research Council (2013) estimates that inclusion of the impact to national defense could impact the estimation of energy security benefit by 25 percent. CARB staff recommends additional analysis to determine methodologies to incorporate the impact of national defense in the analysis of energy security.<sup>87</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.186]

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<sup>87</sup> (NAS, 2013) National Research Council, “Transitions to alternative vehicles and fuels,” The National Academies Press: Washington, D.C.

**Organization:** Competitive Enterprise Institute et al.

Although the ostensible purpose of the rule is to reduce greenhouse gas (GHG) emissions and oil imports, the climate and energy-security benefits of the rule are entirely speculative and vanishingly small at best. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

## **II. The rule’s climate and energy security benefits are vanishingly small at best and completely unverifiable.**

The proposed standards, which phase in during model-years 2021–2027, apply to four types of HDVs: (1) combination tractors (semi-trucks), (2) trailers pulled by combination tractors, (2) heavy-duty pickups and vans, and (4) vocational trucks (a wide-ranging assortment of trucks and buses). The agencies estimate that the technologies needed to comply with the proposed standards will cost \$25 billion but that the rule will generate \$230 billion in net benefits over the lifetime of vehicles sold in the regulatory timeframe, including \$170 billion in fuel savings.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.5-6]

Although the ostensible objectives of the rule are to reduce GHG emissions and oil consumption, the climate and energy-security benefits, if any, are speculative and no one will actually experience them. [EPA-HQ-OAR-2014-0827-1251-A2 p.6]

Energy Security Impact The agencies argue that the “concentration” of global petroleum production in “potentially unstable” countries poses a significant energy-security risk to the U.S. economy. They worry that turmoil or conflict in those nations could cut global petroleum supply by as much as 10%, “leading to an unprecedented price shock.” They are also concerned that OPEC could use “monopoly power” to “restrict oil supply relative to demand.”<sup>16</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.7]

While such risks are possible, their likelihood is small and diminishing. Despite ongoing warfare in Middle East, UN sanctions that cut Iran’s oil exports nearly in half,<sup>17</sup> Russia’s invasion of Crimea,<sup>18</sup> and continuing warfare in Ukraine,<sup>19</sup> the price of crude oil is lower than at any time since February 2009.<sup>20</sup> U.S. motorists enjoyed the lowest Labor Day gasoline prices in a decade.<sup>21</sup> The decline in oil and gasoline prices, despite geopolitical tensions, is a testament to the ingenuity of U.S. producers, who have used directional drilling and hydraulic fracturing to increase domestic production every year since 2008.<sup>22</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.8]

Rather than restrict output to raise prices, OPEC is following a “no production cuts” policy,<sup>23</sup> with Saudi Arabia increasing output to a record 10.4 million barrels per day (MMBD) in the second quarter of 2015.<sup>24</sup> Perhaps OPEC members simply don’t want to lose even more market share to North American producers. Or perhaps they want to drive oil prices below the U.S. fracking industry’s production costs. Whatever the case, the proposed rule would do nothing to diminish Russia and OPEC’s share of world oil production. [EPA-HQ-OAR-2014-0827-1251-A2 p.8]

Other policies would more effectively shift global production from Russia and OPEC to the United States and Canada. Those include repeal of the crude oil export ban,<sup>25</sup> timely approval of major infrastructure projects such as the Keystone XL Pipeline, and allowing more oil and gas exploration in U.S. coastal waters and federal lands, such as the Alaska National Wildlife Refuge (ANWR).<sup>26</sup> The White House recently declined to comment on an Energy Information Administration (EIA) study finding net economic benefits from oil exports,<sup>27</sup> and the administration’s policies on Keystone<sup>28</sup> and ANWR<sup>29</sup> are counterproductive. [EPA-HQ-OAR-2014-0827-1251-A2 p.9]

NHTSA estimates its fuel economy standards will reduce U.S. oil imports by 0.16 MMBD in 2025, 0.37 MMBD in 2030, and 0.65 MMBD in 2040.<sup>30</sup> So by 2040, the rule would avoid 10% of projected imports. [EPA-HQ-OAR-2014-0827-1251-A2 p.9]

[Table IX-23 can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

Imports as a share of total production declined from 60% in 2005,<sup>31</sup> to 40% in 2012,<sup>32</sup> to 27% in 2014.<sup>33</sup> EIA expects the decline in import dependence to continue. The agency's 2015 Annual Energy Outlook (AEO 2015) forecasts net U.S. oil and petroleum product imports in four cases. In the reference case, the net import share falls from 33% in 2013 to 17% in 2040.<sup>34</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.9]

[Figure ES4 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

If imports as a share of consumption fall to 17% in 2040, and the proposed rule cuts imports by 10%, it will reduce national consumption by 1.7%. Such a minor change would do little to ameliorate price shocks from major disruptions in global petroleum supply. [EPA-HQ-OAR-2014-0827-1251-A2 p.10]

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16 80 FR 40465

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33 U.S. Energy Information Administration, How much petroleum does the United States import and from where? (accessed 8/31/2015), <http://www.eia.gov/tools/faqs/faq.cfm?id=727&t=6>

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**Organization:** Consumer Federation of America (CFA)

A number of other benefits round out the total. The largest component of this category is the national energy security benefits of reduced oil consumption and oil imports. Unlike past rulings that paid lip service to these benefits, EPA/NHTSA value the security benefits at a little over \$11/barrel in 2020, rising to almost \$18/barrel in 2040. [EPA-HQ-OAR-2014-0827-1336-A1 p.48]

**Organization:** Investor Network on Climate Risk

Lastly, strong standards will serve to mitigate the economic risks associated with our continuing dependence on oil as well as climate change. Strong standards would save an estimated 1.4 million barrels of oil per day by 2030. <sup>4</sup> [NHTSA-2014-0132-0113-A1 p.2]

In addition, climate change presents significant long-term risks to the global economy, and to investors across all asset classes. Strong standards will serve to mitigate that risk by providing significant GHG reductions; the standards we propose have the potential to save 270 million metric tons of GHG emissions annually by 2030.<sup>4</sup> [NHTSA-2014-0132-0113-A1 p.2]]

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4 American Council for an Energy-Efficient Economy (ACEEE), Environmental Defense Fund (EDF), Natural Resources Defense Council (NRDC), Sierra Club, and Union of Concerned Scientists (UCS). 2014. Big fuel savings available in new trucks. Web. <http://aceee.org/files/pdf/fact-sheet/truck-savings-0614.pdf>, Factsheet accessed June 29, 2015.

**Organization:** Mass Comment Campaign sponsored by the Pew Charitable Trusts (web) - (4,452)

In addition to financial benefits, vehicle efficiency has national security and environmental benefits. By using less petroleum, we can help reduce our imports. [EPA-HQ-OAR-2014-0827-1252-A1 p.1]

Burning less fossil fuel also means less pollution and related illnesses such as asthma [EPA-HQ-OAR-2014-0827-1252-A1 p.1]

**Organization:** Operation Free

I am a veteran of the United States Navy and a member of Operation Free, a nationwide coalition of more than 5,000 veterans who advocate for securing America with clean energy. I applaud the Obama administration for proposing standards that will make our trucks cleaner and more efficient. I joined the military because I care deeply about protecting our country. I am here today because along with a consensus of senior military and national security experts, I believe that we face a serious threat to our national security: dependency on oil. [EPA-HQ-OAR-2014-0827-1175 p.1] [These comments can also be found in EPA-HQ-OAR-2014-0827-1372, pp.191-192.]

Although trucks are only 7% of the total number of vehicles on the roads, they consume 25% of fuel often that same fuel that we had to protect going through the Strait of Hormuz. This marks a significant percent of emissions relative to the number of trucks on the road. With these new regulations, we will save 1.8 billion barrels of oil over the lifetime of the vehicles on the road an important step in combatting oil dependency. [EPA-HQ-OAR-2014-0827-1175 p.2] [These comments can also be found in EPA-HQ-OAR-2014-0827-1372, p.193.]

Currently, oil is essential for the military to defend us. Everything from tanks to fighter jets to Humvees use oil, and delivering it on the battlefield is a dangerous job. In Afghanistan, 1 in every 24 fuel convoys ended with a casualty; oil trade routes are slow, scheduled, and frequent, making them easy targets for the enemy. These rules benefit the military because trucks won't have to refuel as frequently, which can be dangerous and costly in combat zones. Additionally, too much of our money for oil ends up in the hands of hostile countries and extremist fighters. [EPA-HQ-OAR-2014-0827-1175 p.2][These comments can also be found in EPA-HQ-OAR-2014-0827-1372, pp.192-193.]

While these new EPA regulations make great strides to mitigate the impacts of carbon emissions such as reducing GHG emissions by 1 billion metric tons over the life of vehicles on the road we must take further measures to reduce our oil dependency in the interest of national security. Analysis shows that with modern engineering capabilities, stronger standards could reduce trucks' fuel use by 40% by 2025. Continued progress in environmental standards made by the EPA are vital to the well-being of our

nation and the global community. [EPA-HQ-OAR-2014-0827-1175 p.2] [These comments can also be found in EPA-HQ-OAR-2014-0827-1372, pp.195-196.]

In raising our standards for greenhouse gas emissions and fuel efficiency, we strengthen our national security by supporting the U.S. economy, increasing global stability, and sending fewer of our men and women into harm's way. Once again, I applaud the administration for proposing standards to make our trucks more efficient. [EPA-HQ-OAR-2014-0827-1175 p.2][These comments can also be found in EPA-HQ-OAR-2014-0827-1372, p. 196.]

### **Organization:** Securing America's Future Energy

Additional revisions should be considered to enhance the immediate effectiveness of the proposed Phase 2 standards with regard to increasing national energy security through reductions in medium- and heavy-duty vehicle petroleum demand. These revisions would also eliminate the differential treatment of medium- and heavy-duty vehicle manufacturers relative to their light-duty counterparts, resulting in a more seamless, integrated policy for motor vehicle greenhouse gas and fuel economy regulation. [EPA-HQ-OAR-2014-0827-1282-A1 p.1]

The U.S. transportation sector relies on oil for 92 percent of its total energy consumption. This dependence leaves the U.S. economy vulnerable to volatile price conditions. Increasing vehicle fuel efficiency is one of the most effective tools for decreasing the oil intensity of the U.S. economy, and thereby enhancing economic and national security. [EPA-HQ-OAR-2014-0827-1282-A1 p.3]

Medium- and heavy-duty vehicles represent the fastest growing component of U.S. transportation oil demand. Strengthening fuel economy standards for these vehicles is a critical part of any efforts to enhance U.S. energy security. [EPA-HQ-OAR-2014-0827-1282-A1 p.3]

However, improvements in vehicle fuel efficiency alone will not insulate the U.S. economy from the volatile oil price conditions typical of the global oil market. Securing America's Future Energy (SAFE) recommends multiple revisions to the proposed rule that if adopted will help strengthen U.S. energy security by achieving even greater oil savings over the long term through the wider use of medium and heavy-duty vehicles powered by alternative fuels. Specifically, SAFE recommends: (1) extending 49 USC 32905 manufacturing incentives into the medium- and heavy-duty sector and (2) implementing advanced technology credits for medium- and heavy-duty natural gas vehicles and reinstating them for technologies that qualify for the credit under Phase I. SAFE also provides comments on the agency's considerations related to upstream natural gas vehicle emissions. [EPA-HQ-OAR-2014-0827-1282-A1 p.3-4][This comment can also be found in section 12.3 of this comment summary]

### The Energy Security Implications of Petroleum in Transport

Almost 40 percent of total U.S. primary energy demand is met by oil, giving it an economic significance unmatched by any other fuel.<sup>1</sup> The transportation sector accounts for more than 70 percent of total U.S. oil consumption of approximately 19 mbd.<sup>2</sup> This sector relies on oil for 92 percent of its total energy consumption—97 percent when including ethanol blending—and has no readily available substitutes.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.4]

Between 2011 and 2014, the country's reliance on oil led to an average economy-wide spend of almost \$880 billion per year on petroleum products, equivalent to more than 5 percent of U.S. gross domestic product.<sup>4</sup> These high levels of spending—more than twice what they were in the early 2000s—strain the budgets of consumers, businesses, and governments alike.<sup>5</sup> Higher oil prices also added \$1.2 trillion to

the U.S. federal debt between 2002 and 2012, and every U.S. recession for the past 40 years has been preceded by, or coincided with, an oil price spike.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.4]

Although oil prices, and thus U.S. spending on oil, are expected to be markedly lower in 2015—a forecast \$54 per barrel versus \$99 per barrel in 2014 and approximately \$595 billion versus \$850 billion in 2014, respectively—total U.S. spending on petroleum fuels exceeded a combined \$3.5 trillion between 2011 and 2014.<sup>7</sup> Households are also expected to spend less on gasoline in 2015, at levels slightly below those last seen on an annual basis in both 2009 (during the Great Recession) and 2005.<sup>8</sup> Nevertheless, and despite rising domestic oil production, the United States still sends nearly \$1 billion abroad each day to pay for oil, often to countries that are hostile to U.S. interests.<sup>9</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.4]

The extreme economic importance of oil to the United States creates adverse national security challenges. Notably, more than 50 percent of daily oil supplies transit through seven major chokepoints in often unstable regions, particularly the Middle East.<sup>10</sup> The U.S. military is placed in harm's way to protect these maritime supply routes and vulnerable energy infrastructure across the globe. U.S. oil dependence also weakens the country's ability to address foreign policy challenges, including those with Iran. Effective sanctions on Iran's oil industry as far back as 2005 were undermined by the impact such sanctions would have on global oil prices. [EPA-HQ-OAR-2014-0827-1282-A1 p.4]

Uncertain events around the world also contribute to volatility in global oil markets and oil prices. For example, conflict in Yemen has affected oil prices despite Yemen's minimal oil production capacity, in part due to the country's strategic location adjacent to the Bab el-Mandeb strait and shared border with Saudi Arabia. Moreover, Russia's incursions into Ukraine and subsequent international sanctions, the emergence and expansion of Daesh (Islamic State of Iraq and the Levant, or ISIL) in Northern Iraq and Syria, and other developments increase concerns over the security and stability of global oil supplies. [EPA-HQ-OAR-2014-0827-1282-A1 p.4-5]

The global oil market is also frequently subject to unpredictable—and sometimes anti-competitive—behavior from oil-producing countries that supply it, most notably from members of the Organization of the Petroleum Exporting Countries (OPEC). For example, the organization's November 2014 decision not to reduce output despite a growing imbalance between global oil demand and supply helped contribute to a more than 50 percent decline in oil prices between the summer of 2014 and January 2015, resulting in levels of oil price volatility not observed since 2009, among other impacts.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.5]

Medium- and heavy-duty vehicles represent a sizable portion of U.S. transportation-related oil demand. In total, commercial trucks accounted for 2.8 mbd of U.S. oil consumption in 2013, equal to 20 percent of transportation-related oil consumption, a share that was second only to light-duty vehicles.<sup>12</sup> Long-haul heavy-duty trucks accounted for more than 70 percent of the oil consumed by trucks.<sup>13</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.5]

In noticeable contrast to the light-duty vehicle segment, energy and oil use by medium- and heavy-duty vehicles is forecast to rise, not fall, over the next 25 years from 2.8 mbd today to approximately 3.4 mbd in 2040. This rise in demand is attributable to an increase in the number of medium- and heavy-duty vehicles on U.S. roads (and corresponding increase in total vehicle miles driven), plus only very gradual improvements in vehicle fuel economy. Without the Phase 2 rule, for example, the U.S. Department of Energy forecasts that the average fuel economy of diesel-powered heavy-duty vehicles will increase by 17 percent over the next 25 years, from 6.15 miles per gallon (mpg) to 7.21 mpg.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.5]



Analysis commissioned by SAFE finds that achieving the improvements required by the Phase 2 rule are both technologically feasible and cost effective.<sup>15</sup> Subsequent analysis of the potential fuel savings finds that demand attributable to medium and heavy-duty vehicles could decline by almost 0.5 mbd by 2030 (-13 percent) and by nearly 0.8 mbd (-20 percent) by 2040 due to the rule.<sup>16</sup> As a result, total onroad fuel use could decline by 4.5 percent by 2030 and 7.5 percent by 2040, respectively.<sup>17</sup> Reductions of this magnitude are good for the security and economic prosperity of the United States. As such, SAFE supports the rulemaking with the following recommendations aimed at strengthening the energy security aspects of the proposed rule and increasing the flexibility of the rule to facilitate real-world compliance. [EPA-HQ-OAR-2014-0827-1282-A1 p.5]

Before finalizing the Phase 2 fuel efficiency and greenhouse gas emissions standards, there are several issues SAFE believes that EPA and NHTSA could address to enhance their immediate effectiveness with regard to strengthening U.S. energy security through reductions in medium- and heavy-duty oil use. The suggested revisions would also eliminate the differential treatment of medium- and heavy-duty vehicle manufacturers relative to their light-duty counterparts, resulting in a more seamless integrated policy for motor vehicle greenhouse gas and fuel economy regulation. [EPA-HQ-OAR-2014-0827-1282-A1 p.6]

The United States depends on oil to power 92 percent of its transportation sector, a virtual monopoly. This strategic commodity is priced on an unfree, volatile global oil market, posing serious risks to our national and economic security—the government spends an estimated \$67.5 billion annually just on protecting oil supply lines around the world, and consumers and businesses are forced to pay whenever conflict or supply disruptions cause an oil price spike. Reducing the nation's overall oil intensity is a critical step towards curtailing U.S. exposure to such volatility, thus improving energy security. [EPA-HQ-OAR-2014-0827-1462-A1 p.1]

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<sup>1</sup> EPA, NHTSA, 'Cutting Carbon Pollution, Improving Fuel Efficiency, Saving Money, and Supporting Innovation for Trucks,' June 2015, at 2.

<sup>2</sup> EIA, Annual Energy Outlook (AEO) 2015.

<sup>3</sup> Id.

<sup>4</sup> SAFE analysis based on data from BEA.

<sup>5</sup> SAFE analysis based on data from BEA and EIA.

<sup>6</sup> SAFE, *Oil and the Debt*, October 2013, at 1; and SAFE analysis based on data from BEA, EIA, and the National Bureau of Economic Research.

<sup>7</sup> SAFE analysis based on data from EIA.

<sup>8</sup> SAFE analysis based on data from BLS, Census Bureau, and EIA.

<sup>9</sup> SAFE analysis based on data from EIA (2014 data).

<sup>10</sup> See, e.g., EIA, World Oil Transit Chokepoints, November 10, 2014, at 2.

<sup>11</sup> SAFE analysis based on data from EIA.

<sup>12</sup> U.S. DOE, ORNL, Transportation Data Energy Book, Edition 33.

<sup>13</sup> Id.

<sup>14</sup> SAFE analysis based on data from EIA, Annual Energy Outlook (AEO) 2015.

<sup>15</sup> ICCT, Cost effectiveness of advanced efficiency technologies for long-haul tractor-trailers in the 2020-2030 timeframe, April 2015.

<sup>16</sup> SAFE-commissioned analysis based on data from EPA and NHTSA.

<sup>17</sup> Id.

**Response:**

In the proposal to this rule, the agency solicited comments on quantifying the military benefits from reduced U.S. imports of oil. Reduced U.S. imports of oil, particularly from potentially unstable areas, could reduce the need for the U.S. military to protect flows of oil from those areas. The California Air Resources Board (CARB) notes that the National Research Council (NRC) attempted to estimate the military costs associated with U.S. imports and consumption of petroleum. The NRC cited estimates of the national defense costs of oil dependence from the literature that range from less than \$5 billion per year (GAO, 2006; Parry and Darmstadter, 2004) to \$50 billion per year or more (Moreland, 1985; Ravenal, 1991; Kaufmann and Steinbruner, 1991; Copoulos, 2003; Delucchi and Murphy, 2008). Assuming a range of approximate range of \$10 billion to \$50 billion per year, the NRC divided national defense costs by a projected U.S. consumption rate of approximately 6.4 billion barrels per year (EIA, 2012). This procedure yielded a range of average national defense cost of \$1.50 - \$8.00 per barrel (rounded to the nearest \$0.50), with a mid-point of \$5/barrel (in 2009\$). EPA acknowledges this NRC study, but has not included the estimates as part of its cost-benefit analysis for this rule.

The Competitive Enterprise Institute (CEI) and others argue that there are little, if any, energy security benefits associated with this rule. In large part CEI argues that oil supplies are plentiful and that current oil prices are low so that reduced consumption of petroleum products due to this rule would have no effect on energy security. However, the discussion of current low oil prices ("lowest Labor Day gasoline prices in a decade") does not assure the absence of future oil supply shocks or price shocks, or even speak to their reduced likelihood. CEI points out that the current low oil prices have been observed before as recently as a decade ago, as they have in more than one instance before that. For example, oil prices were even lower in 1999. But in the intervening periods, oil supply and price shocks have continued to recur, and the recent price record only amplifies oil's high historical price volatility. Also, sharply lower world oil prices do not clearly imply greater energy security for the U.S. Current low world oil prices may reduce the U.S. fracking industry's tight oil production (as CEI points out), or other sources of oil supplies around the world. Some have hypothesized that reduction in oil production outside of OPEC may be the objective of some OPEC producers. With low oil prices, the U.S. oil import share over time might be larger, increasing the U.S. dependence on imported oil.

Securing America's Future Energy (SAFE), Operation Free and the Investor Network on Climate Risk agree that this rule does improve America's energy security. SAFE goes on to state that several policy options should be included in this rule to further enhance energy security. The Agency agrees that this

rule enhances America's energy security, but does not have information to evaluate the policy options that SAFE proposes.

## 11.10 Other Impacts

**Organization:** California Air Resources Board (CARB)

### Comment on Topic Where NPRM Requests Comment

#### **Comment – Accidents, congestion, and noise**

The NPRM requests comment on the input metrics used in the analysis of accidents, congestion, and noise. CARB staff supports the holistic inclusion of these inputs and suggests that the inputs related to congestion, accidents, and noise be consistent with any anticipated changes in vehicle usage, including VMT, mode switching, and route modification, due to the rebound effect of the proposed rulemaking. Any modification to the rebound effect from continued research should be reflected in the estimation of accidents, congestion, noise, and increased travel. [EPA-HQ-OAR-2014-0827-1265-A1 p.187]

#### **Response:**

The agencies agree with the commenter that accidents, congestion and noise due to increased VMT from rebound driving should be quantified in the regulatory impact analysis. If net operating costs of a heavy duty vehicle decline, then we expect a positive rebound effect. Increased vehicle use associated with a positive rebound effect contributes to increased traffic congestion, motor vehicle crashes, and highway noise. Depending on how the additional travel is distributed throughout the day and on where it takes place, additional vehicle use can contribute to traffic congestion and delays by increasing traffic volumes on facilities that are already heavily traveled during peak periods. These added delays impose higher costs on drivers and other vehicle occupants in the form of increased travel time and operating expenses. Because drivers do not take these added costs into account in deciding when and where to travel, they must be accounted for separately as a cost of the added driving associated with the rebound effect.

Our approach in this final rule is identical to that used in the proposal. EPA and NHTSA rely on estimates of congestion, crash, and noise costs caused by pickup trucks and vans, single unit trucks, buses, and combination tractors developed by the Federal Highway Administration to estimate the increased external costs caused by added driving due to the rebound effect.<sup>226</sup> The FHWA estimates are intended to measure the increases in costs from added congestion, property damages and injuries in traffic crashes, and noise levels caused by various classes of trucks that are borne by persons other than their drivers (or “marginal” external costs). EPA and NHTSA employed estimates from this source previously in the analysis accompanying the light-duty 2012-2016 vehicle rulemaking. Given the lack of alternative estimates in the literature, the agencies continue to find them appropriate for this analysis after reviewing the procedures used by FHWA to develop them and considering other available estimates of these values.

FHWA's congestion cost estimates for trucks, which are weighted averages based on the estimated fractions of peak and off-peak freeway travel for each class of trucks, already account for the fact that

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<sup>226</sup> These estimates were developed by FHWA for use in its 1997 Federal Highway Cost Allocation Study; see <http://www.fhwa.dot.gov/policy/hcas/final/index.htm> (last accessed July 21, 2010)

trucks make up a smaller fraction of peak period traffic on congested roads because they try to avoid peak periods when possible. FHWA's congestion cost estimates focus on freeways because non-freeway effects are less serious due to lower traffic volumes and opportunities to re-route around the congestion. The agencies, however, applied the congestion cost to the overall VMT increase, though the fraction of VMT on each road type used in MOVES range from 27 to 29 percent of the vehicle miles on freeways for vocational vehicles and 53 percent for combination tractors. The results of this analysis potentially overestimate the congestions costs associated with increased truck use, and thus lead to a conservative estimate of benefits.

**Organization:** California State Senator Ricardo Lara

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 56.]

In California, we understand that climate change is not just an abstract concept but a public health crisis that is disproportionately impacting our most vulnerable communities, namely the poor and communities of color.

**Response:**

We agree that elevated concentrations of GHG emissions in the atmosphere may reasonably be anticipated to endanger public health and welfare of current and future generations. We also agree that children, the elderly, and the poor are among the most vulnerable to these climate-related health effects. The impacts addressed by this action will reduce these adverse impacts within communities where the population may be especially vulnerable.

**Organization:** Walmart Transportation

Although perhaps not to be addressed within this rule, in the drive for greater fuel efficiency we encourage consideration of the significant impact of initiatives broader than equipment. Opportunities in congestion reduction, speed, payload efficiency, and infrastructure maintenance and upgrades will result in environmental, safety, and economic benefits far surpassing equipment innovations. A system view and approach will be essential to ensuring the vitality of the backbone of the U.S. economy. [NHTSA-2014-0132-0117-A1 p.2]

**Response:**

While the initiatives outlined by the commenter could very well result in beneficial impacts, they fall outside the scope of this rulemaking.

## 11.11 Employment Impacts

**Organization:** Achates Power, et al.

Our nation relies heavily on medium- and heavy-duty trucks and buses to keep our economy moving. The Phase 2 rulemaking has the potential to be a significant economic driver of jobs and prosperity, by rewarding innovative solution providers. [EPA-HQ-OAR-2014-0827-1762-A2 p.2]

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

The Phase 2 program also offers the potential of new jobs in the design and production of new vehicle technologies. [EPA-HQ-OAR-2014-0827-1280-A1 p.5][This comment can also be found in section 1.1 of this comment summary]

**Organization:** BlueGreen Alliance

These standards will increase fuel efficiency and cut greenhouse gas emissions from long-haul trucks—along with full size pick-ups, other trucks, buses, and vocational vehicles. These standards can also continue America’s auto and manufacturing resurgence. [EPA-HQ-OAR-2014-0827-1246-A2 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.71.]]

The BlueGreen Alliance and its 15 labor and environmental partners recognize the importance of the proposed medium- and heavy-duty truck fuel efficiency and greenhouse gas emissions reduction rule. America’s economy depends on leadership in building the next generation of clean globally competitive energy and vehicle technology. These new standards can provide a critical opportunity to sustain jobs, further reduce the pollution driving climate change and foreign oil dependence while enhancing the competitiveness of U.S.-manufactured trucks in global markets. [EPA-HQ-OAR-2014-0827-1246-A2 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.71-72.]]

For the past decade, the auto industry (in the light-, medium- and heavy-duty sectors), and American workers—represented by the United Auto Workers, the United Steelworkers and others—have been on the front lines when it comes to rebuilding manufacturing jobs and building the world-leading technology needed to achieve deep cuts in carbon pollution and save consumers billions at the pump. Soon to be released research carried out by several of our partners finds more than 380 plants that are manufacturing fuel efficient medium- or heavy-duty vehicles or their components today in states all across the country. [EPA-HQ-OAR-2014-0827-1246-A2 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.72.]]

These companies include major assemblers—like Freightliner manufacturing long haul trucks in Cleveland, North Carolina and companies making key subsystems—like Volvo Mack Powertrain, with semi-truck powertrain manufacture and advanced engine test facilities in Hagerstown, Maryland. They also include large and small manufacturers of components, trailers, tires, and the steel and aluminum that goes into them, such as Nexteer in Saginaw, Michigan; Bridgestone, in Tennessee; and Eaton in California, Michigan, Minnesota, North Carolina, and Ohio. [EPA-HQ-OAR-2014-0827-1246-A2 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.72-73.]]

[Map of US manufacturers of fuel efficient medium- and heavy-duty vehicles are components can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1246-A2]

Done right, this standard can spur investment, secure and grow jobs, and enhance U.S. competitiveness across these businesses and technologies—and the industry as a whole. With this rule EPA and NHTSA have the opportunity both to encourage continued investment in manufacturing more fuel-efficient trucks in the US and to ensure that these trucks can be designed and built without causing boom and bust cycles in vehicle purchasing and therefore employment. The final rule can and should do both. [EPA-HQ-OAR-2014-0827-1246-A2 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.73.]]

We greatly appreciate the thorough and systematic process EPA and NHTSA have undertaken in developing this proposal. It is critical that an effective final rule works for the environment, for the

economy and for the thousands of hard-working American women and men in the heavy truck, component and related industries. The auto industry and autoworkers have been at the forefront in proving that America can lead globally in combating climate change while rebuilding our manufacturing sector and creating and sustaining quality jobs. We urge the agencies to continue their thorough and deliberate process to ensure that the final truck rule will continue this trajectory. [EPA-HQ-OAR-2014-0827-1246-A2 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.73.]]

Together, the previous rounds of car and light-duty truck and medium- and heavy-duty truck standards achieve the largest greenhouse gas reductions ever undertaken in the U.S. and one of the largest globally. We thank EPA and NHTSA for their work to date and look forward to working with the agencies and all our partners to ensure that we keep on combating climate change by building great trucks. [EPA-HQ-OAR-2014-0827-1246-A2 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.73-74.]]

**Organization:** Ceres

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 201-202.]

Strict standards are also key to retaining the U.S. leadership position in efficient truck manufacturing and expanding job opportunities in that sector. We are currently the world leader in the development, production, and use of energy-efficient and hybrid trucks. Without strong standards in place, companies and investors will lack the requisite certainty to invest in the development and production of new technologies that will allow us to retain our primary position and increase job growth.

**Organization:** Environmental Defense Fund (EDF)

### **C. Fuel efficiency standards have positive impact on truck industry and employment**

EDF performed an extensive market analysis of heavy-duty vehicle purchases between 1992 and 2014 matched with the 2007 and 2010 engine standards.<sup>118</sup> Appropriately controlling for macroeconomic trends, our analysis showed that there was smooth growth in vehicle demand prior to, and during, implementation of the 2014 Phase 1 fuel efficiency standards. As further evidence, model year 2014 heavy-duty trucks saw the highest sales since 2005.<sup>119</sup> The results of our analysis support the premise that fuel savings provide an advantage in the competitive market. Lower freight costs drive higher demand for freight transport and demand for freight transport drives demand for new vehicles. [EPA-HQ-OAR-2014-0827-1312-A1 p.25][This comment can also be found in section 11.7 of this comment summary]

Our analysis also concluded that fuel efficiency standards insulate the heavy truck market from fuel price shocks – and that market stability translates into employment stability. In a marketplace without standards, not all manufacturers produce fuel-efficient models (e.g., the light-duty vehicle market pre-CAFE standards). When fuel prices spike, more fuel-efficient vehicles are in greater demand, shifting demand across manufacturers and disrupting sales and employment. Analysis by MIT and Northwestern economists found that for manufacturers on which CAFE standards are binding, marketing more fuel-efficient models reduces the impact of fuel-price shocks on aggregate new-vehicle demand and dampening the cross manufacturer impacts of fuel price shocks.<sup>120</sup> Consistent with their results, we found that demand for heavy-duty vehicles becomes less sensitive to fuel price changes as fuel economy of new heavy-duty vehicles increases – and lower variability in demand for heavy-duty vehicles means

steadier sales and employment. Combining employment and wage with fuel prices and vehicle standards over the last 35 years, we found that over time fuel efficiency standards are associated with declining impacts of fuel price shocks on employment and wages in light-duty and heavy-duty vehicle manufacturing. [EPA-HQ-OAR-2014-0827-1312-A1 p.25]

Despite these findings with respect to the Phase I program, some have suggested that previous criteria pollutant standards have resulted in “boom and bust” purchasing. This comparison is inappropriate, however,<sup>121</sup> and, in any event, our analysis shows that there was no meaningful adjustment in market purchasing due to those standards.<sup>122</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.25]

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118 Rittenhouse and Zaragoza-Watkins, Strategic Response to Environmental Regulation: Evidence from U.S. Heavy-Duty Vehicle Air Pollution Regulations, MIT CEEPR Working Paper, (2015).

119 “Healthy Demand Overall for Trucks in September,” Heavy Duty Trucking, available at <http://www.truckinginfo.com/channel/fleet-management/news/story/2014/10/healthy-demand-overall-for-trucks-in-september.aspx?ref=rel-recommended> (last accessed November 5, 2014).

120 Busse, et al., Who is Exposed to Gas Prices? How Gasoline Prices Affect Automobile Manufacturers and Dealerships, No. w18610, National Bureau of Economic Research (2012).

121 Fuel economy standards are not likely to impact new-vehicle sales, because, unlike criteria pollutant standards, the benefits of improved fuel-economy accrue directly to the vehicle purchaser. While improving the fuel-economy of new vehicles won't be costless, fuel-savings will provide offsetting benefits directly to the consumer. They quickly pay back the up-front investment cost, lower the long-run cost of operating the vehicle, and provide a critical advantage in the highly competitive freight industry.

122 Rittenhouse and Zaragoza-Watkins, Strategic Response to Environmental Regulation: Evidence from U.S. Heavy-Duty Vehicle Air Pollution Regulations, MIT CEEPR Working Paper, (2015).

**Organization:** Gilroy, JD

A third thing I find praiseworthy about the proposed standards is that they seem to involve powerful economic benefits even aside from environmental and health benefits---allegedly 124,000 jobs by 2030 and a ratio of benefits to costs of 10 to 1, or a savings for truckers of \$160 billion after new technology upgrades are paid off. That is probably why the affected industries have been largely supportive of the new standards, some even meeting the standards before required to do so, and that is a fourth reason I like them. [EPA-HQ-OAR-2014-0827-0751 p.2]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

We reject the false calculus that environmental regulations always cost jobs. It is not a zero-sum equation. Thoughtful, well-constructed regulations crafted with input from stakeholders can protect the environment while simultaneously protecting existing jobs and creating jobs in new advanced technology sectors of the economy. This can be a win-win for the environment and the economy. [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

We urge EPA and NHTSA to tread carefully in order to avoid creating economic insecurity for the hardworking men and women who toil in the industries affected by this proposal. Any new regulations should not negatively disrupt the economy or create a “pre-buy/no-buy” cycle that results in layoffs or job losses for American workers. [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

A significant market disruption is not only bad for workers; it is bad for the overall economy, which is still recovering from the Great Recession. Layoffs, regardless of their duration, are obviously bad for the workers who lose their jobs. Surrounding communities are also negatively impacted as families suddenly have less to spend on housing, car payments, groceries, clothes and other essential and discretionary items. [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

This is not a theoretical concern for UAW members. In mid-2006, there were almost 18,000 UAW members working at Freightliner, Navistar, Mack, Volvo and Peterbilt. By mid-2007, the number of active workers was down to just under 13,000 with over 4,000 workers laid-off. This occurred before the Great Recession and market disruptions caused by regulations were undoubtedly a major factor. [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

In 2008, the number of laid-off workers increased to over 6,000 and in 2009, there were over 10,000 laid-off UAW members at those manufacturers. The chart below shows UAW membership in the industry from 2004 to 2014: [EPA-HQ-OAR-2014-0827-1248-A2 p.2]

[Chart can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1248-A2]

These are much more than statistics. UAW members not only lost their jobs, many of them lost their homes and the stress brought on by financial insecurity led to divorces and other family crises. We have no interest in repeating scenes of boarded up storefronts on our main streets or families losing their homes. [EPA-HQ-OAR-2014-0827-1248-A2 p.3]

We urge EPA and NHTSA to ensure that the new regulations do not create economic uncertainty for working families by creating significant market disruptions. In order to achieve this goal the final rule must be consistent with the following principles: [EPA-HQ-OAR-2014-0827-1248-A2 p.4]

- Regulations Cannot Disrupt the Market
- Single National Program
- Regulatory Certainty
- Accurate Technology Market Penetration, Cost and Reliability Assumptions and Testing Protocols
- Flexibility to meet stringency standards [EPA-HQ-OAR-2014-0827-1248-A2 p.4]

Regulations Cannot Disrupt the Market or Create Economic Uncertainty for Working Families [EPA-HQ-OAR-2014-0827-1248-A2 p.4]

As previously mentioned engine regulations in the past have had adverse economic consequences and contributed to a pre-buy/no-buy boom and bust cycle. This proposal must guard against creating these conditions. Severe market disruptions would not only be bad for workers, they would also be bad for the environment and would undermine the regulation’s foundational goal of reducing harmful greenhouse gas emissions and increasing fuel efficiency. If fleets and other customers pull ahead truck purchases due to concerns about increased cost or unproven technology, the end result is more higher-polluting and less fuel efficient trucks on the road for a longer period of time. [EPA-HQ-OAR-2014-0827-1248-A2 p.4] [This comment can also be found in section 11.7 of this comment summary.]



UAW members in this industry suffered economic hardship caused by regulations during the last decade and we are sensitive to the potential impacts of Phase 2 regulations and are watching this process closely. The EPA established a comprehensive national program establishing emission standards in 2007 and 2010 for diesel engine emissions of oxides of nitrogen (NOx) and particulate matter (PM). The regulation's intent was to reduce the harmful emissions of NOx and PM from the truck fleet by 90 and 95 percent respectively, dramatically reducing the threat those pollutants posed to public health. [EPA-HQ-OAR-2014-0827-1248-A2 p.5]

Many truck fleets and other customers, weary of increased costs and new and possibly problematic technology, pulled ahead truck orders prior to the implementation of the 2007 standard. The effect of this pre-buy was felt by the thousands of UAW members and other workers who worked overtime building as many legacy engines as they could prior to the standard and then were laid off once the standards took effect. [EPA-HQ-OAR-2014-0827-1248-A2 p.5]

Overall UAW membership in the medium and heavy-duty truck sector did not meaningfully recover until 2012. It would be an error to attribute the lay-off of 10,000 UAW members in 2009 solely to the pre-buy associated with the 2007 engine standards because clearly, the Great Recession and the closure of an assembly plant were also major contributors to the downturn in overall sector employment and UAW membership. However, it is important to understand that some of these workers only returned to work within the last few years. Truck makers are hiring new workers for the first time in many years and workers are concerned about the potential of the negative impact of regulations. [EPA-HQ-OAR-2014-0827-1248-A2 p.5]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

UAW members support an achievable and realistic Phase 2 standard that is good for the environment and manufacturing workers (Docket No. EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). We reject the false argument that environmental protections and economic growth are not compatible. The final rule must be carefully crafted in order to avoid economic disruption of the medium- and heavy-truck, vocational, van, and heavy-duty pickup markets. [EPA-HQ-OAR-2014-0827-1895-A1 p.1]

The recently released commercial medium- and heavy-duty truck fuel efficiency technology study- Report #2 [(Reinhart, T. E. (2016, February). Commercial medium- and heavy-duty truck fuel efficiency technology study – Report #2. (Report No. DOT HS 812 194). Washington, DC: National Highway Traffic Safety Administration)] confirms that the proposed Alternative Four is not feasible and could lead to major economic disruptions in an industry that is already sensitive to the ups and downs of our economy. [EPA-HQ-OAR-2014-0827-1895-A1 p.1]

UAW members and their families know first-hand the cyclical nature of the medium- and heavy-duty truck, vocational, van, and heavy-duty pickup markets. They have also experienced the pre-buy/no-buy disruption that can be caused by regulations. [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

The Class 8 heavy-duty truck market was strong most of last year. However, in the latter part of 2015 and into 2016, heavy truck orders dropped significantly. In response, heavy truck manufacturers began laying off workers and cutting production. To date, Daimler and Volvo have announced the layoff of as many as 3,400 UAW members. Non-union PACCAR has also reduced their workforce in U.S. facilities. [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

The following chart illustrates UAW membership in the medium- and heavy-duty truck sector since 2004: [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

[Chart can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1895-A1]

This recent history warrants caution as we can't predict the ups and down of the market during the term of the Phase 2 standards. However, we can work together to reduce the likelihood of the Phase 2

standards creating economic hardship for not only hardworking men and women who assemble and make parts for trucks, but also their neighbors and communities. [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

Alternative Three proposes a 4% improvement in per vehicle fuel consumption and CO<sub>2</sub> improvement by MY 2027 compared to MY 2017 for diesel engines. According to the technology study, diesel engines can achieve this level of stringency without forcing problematic technologies like waste heat recovery. The study states, “Overall, diesel engines offer a potential for 2% to 5% improvement beyond the requirements of the Phase 1 GHG regulations.” The study lists the potential diesel engine improvement for long haul engines as 2-5%, medium-duty/vocational as 2-4% and pickup as 3-4% —all without waste heat recovery. [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

We are concerned that increasing engine stringency to levels that require an unrealistic market penetration and forcing expensive and unproven technologies will significantly disrupt the market and create hardships for manufacturing workers and their families. [EPA-HQ-OAR-2014-0827-1895-A1 p.2]

**Organization:** Mannix, Brian

### **Employment Impacts**

As required by President Obama’s Executive Order 13563 (January 18, 2011), the RIA includes an analysis of employment impacts of the proposed standards.<sup>12</sup> President Obama’s message announcing the standards indicated that he believed they would “bring jobs back to America.” [EPA-HQ-OAR-2014-0827-1222-A1 p.6]

The RIA acknowledges the difficulty of the task, reviews the literature, and makes heroic efforts to develop a credible model that would allow it to forecast job impacts within the motor vehicle manufacturing sector. Ultimately it is not able to reach a definitive conclusion: [EPA-HQ-OAR-2014-0827-1222-A1 p.6]

The overall effect of these proposed rules on motor vehicle sector employment depends on the relative magnitude of the output effect and the substitution effect. Because we do not have quantitative estimates of the output effect, and only a partial estimate of the substitution effect, we cannot reach a quantitative estimate of the overall employment effects of these proposed rules on motor vehicle sector employment or even whether the total effect will be positive or negative.<sup>13</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.6]

The RIA reaches similar conclusions about other sectors likely to be affected. One danger of this type of partial equilibrium analysis, which focuses primarily on the sectors directly affected by a rule, is that the analysis might have identified direct employment impacts while missing indirect impacts in sectors beyond the scope of the analysis. This is Bastiat’s classic “seen and unseen” problem, and the RIA appears to be sensitive to the danger: “In an economy with full employment, the primary employment effect of a rulemaking is likely to be to move employment from one sector to another, rather than to increase or decrease employment.”<sup>14</sup> It might have added that the same is likely to be true in an economy that does not exhibit full employment, at least within the limits of our ability to analyze such effects. [EPA-HQ-OAR-2014-0827-1222-A1 p.6]

This does not mean that unemployment is not a serious and chronic problem, nor that regulation is not an important cause of it. Regulation may be especially harmful when it inhibits recovery from a recession, and there are good reasons to examine the effect of regulatory policy on employment more broadly. Nonetheless, unless the rule affects the terms of employment directly, a forecast of employment impacts is not likely to be reliable or informative for any particular regulatory decision.

The RIA is right to be cautious about generating such forecasts.<sup>15</sup> [EPA-HQ-OAR-2014-0827-1222-A1 p.7]

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12 RIA Section 8.11, p. 8-93 ff.

13 RIA, p. 8-101.

14 RIA, p. 8-103.

15 For a more complete discussion of this problem, see Brian F. Mannix, "Employment and Human Welfare: Why Does Benefit-Cost Analysis Seem Blind to Job Impacts?" Chapter 10 in *Does Regulation Kill Jobs?*, University of Pennsylvania Press, 2013; Cary Coglianese, Adam Finkel, and Christopher Carrigan, editors.

**Organization:** NAFA Fleet Management Association

Additionally, the proposed standards place greater strain on driver and technician resources (capability), which are two vocational areas where fleets are becoming more challenged to hire enough (and qualified) employees. [NHTSA-2014-0132-0111-A1 p.2-3] [This comment can also be found in section 11.2 of this comment summary.]

Many fleets have seen an increase in downtime, which has manifested itself in driver productivity issues, shop capacity concerns and an overall increase in the number of spare vehicles required to have on hand to ensure that enough units are available to serve customers. [EPA-HQ-OAR-2014-0827-1011 p.3] [This comment can also be found in section 11.2 of this comment summary.]

Lastly, fleets have had to increase training significantly to stay on top of the changes that have increased our technician counts across the country. [NHTSA-2014-0132-0111-A1 p.3] [This comment can also be found in section 11.2 of this comment summary.]

**Organization:** Natural Resources Defense Council (NRDC)

NRDC believes that the Phase 2 rule will protect existing manufacturing jobs in the medium- and heavy-duty industry and could potentially lead to job growth in the sector as tighter standards require the development, production and installation of technologies to improve efficiency and reduce emissions. Included in these comments is analysis conducted by NRDC with the BlueGreen Alliance that shows that more than 36,600 engineers, technicians and assembly workers are employed in over 380 facilities across 43 states to develop, design and build components and trucks that help haul goods using less fuel. The Phase 2 standards will play an important role in maintaining these jobs and positioning U.S. manufacturers to be global leaders in truck technology, especially as other nations implement their own truck fuel efficiency programs. [EPA-HQ-OAR-2014-0827-1220-A1 p.2]

### **Employment Impacts**

NRDC believes that the Phase 2 heavy truck can have a positive impact on U.S. employment. We expect the standards to drive technology innovation that will increase labor intensity. We also expect the fuel savings that result from lower fuel consumption in shipping goods will be at least partially passed

on to consumers, providing the ability to inject more money into the broader economy and growing jobs. [EPA-HQ-OAR-2014-0827-1220-A1 p.10]

The Phase 2 standards are also likely to protect existing jobs. U.S. leadership in setting truck standards has encouraged U.S. vehicle and component manufacturers to establish engineering, development and manufacturing facilities in the U.S. to make world-leading truck technologies. As a result, the U.S. has a competitive edge for providing technologies that will be desired globally as more countries adopt more stringent truck standards. As noted in the proposed rule, EPA and NHTSA have “met with regulatory counterparts from several other nations who either have already or are considering establishing fuel consumption or GHG requirements, including outreach with representatives from the governments of Canada, the European Commission, Japan, and China.” A strong standard in the U.S. can help ensure fuel-efficient technologies are produced here to serve the domestic and international markets as they develop. [EPA-HQ-OAR-2014-0827-1220-A1 p.10-11]

#### **i. More than 36,600 Jobs are Associated with Producing Cleaner, More Fuel Efficient Trucks**

Working with the BlueGreen Alliance, NRDC is assessed the number of U.S. jobs associated with making and applying technologies that improve fuel efficiency in medium- and heavy-duty trucks. These are jobs represent private investment in the capabilities to meet necessary emissions and efficiency standards. By setting strong, long-term standards, the agencies provide continued market certainty to protect these existing investments and to encourage greater investment in jobs that produce additional fuel-saving technologies. [EPA-HQ-OAR-2014-0827-1220-A1 p.11] [[These comments can also be found in EPA-HQ-OAR-2014-0827-1372, pp. 44-45]]

Today, more than 36,600 engineers, technicians and assembly workers are employed in over 380 facilities across 43 states to develop, design and build components and trucks that help haul goods using less fuel. Below, the facility locations are placed on a map and employment is tabulated by state. [EPA-HQ-OAR-2014-0827-1220-A1 p.11] [[These comments can also be found in EPA-HQ-OAR-2014-0827-1372, p. 45]

[Map of U.S. Manufacturers of Fuel Efficient Medium- and Heavy-Duty Vehicles and Components and table of states and number of facilities and employment can be found on p.12-13 of docket number EPA-HQ-OAR-2014-0827-1220-A1]

#### **ii. Methodology**

The facilities captured in the table and map above are locations where components and vehicles are developed, designed, manufactured and/or assembled to improve fuel efficiency and lower carbon pollution in the on-road medium- and heavy-duty vehicle industry. The technologies produced by the facilities are expected to be deployed to meet standards through 2018 and will be important in achieving standards in subsequent years. [EPA-HQ-OAR-2014-0827-1220-A1 p.13-14]

The company facilities and employment included in this analysis are specifically involved in the medium-and heavy-duty truck market including buses and vehicles used in a variety of commercial uses. Many of the researched companies also are involved in the light duty automotive industry (as well as other industries including off-road equipment), but those included must be directly involved in the medium-and heavy-duty industry. The report includes components related to powertrain, the vehicles themselves (including trailers) and add-on componentry to adapt vehicles to various applications. We do not include componentry unless it is specifically related to fuel-saving activities. For example, companies that are involved in fuel saving activities including aerodynamic improvement are included,

while those producing structural components for these vehicles are not. [EPA-HQ-OAR-2014-0827-1220-A1 p.14]

This data should be viewed as a conservative estimate. We have not included facilities unless it could be specifically confirmed that the location provides products for medium- and heavy-duty trucks. In some cases the facilities (particularly of larger companies) have not been included because the information available could not provide that direct connection that is needed. It is likely that this requirement has significantly reduced the number of locations that are included, since in many cases it was difficult to obtain information on specific locations of companies that have multiple facilities. [EPA-HQ-OAR-2014-0827-1220-A1 p.14]

Employment estimates are conservative. We excluded employment figures for facilities where a no employment number was available. For facilities that serve both the automotive and medium- and heavy-truck markets, such as makers of turbochargers and plants assembling both light-duty and heavy-duty pickups, we counted only 5 percent of the total facility employment. The 5 percent is an approximation of the economic value of the medium- and heavy-duty market relative to the automotive market. [EPA-HQ-OAR-2014-0827-1220-A1 p.14]

The company, facility and employment database was developed by vehicle industry experts at Baum and Associates using a range of primary sources, including: [EPA-HQ-OAR-2014-0827-1220-A1 p.14]

- Available lists of major original equipment manufacturers and suppliers in the medium- and heavy-duty truck industry
- Membership directory of the NTEA-The Association for the Work Truck Industry,
- Databases including Hoovers and Lexis/Nexis,
- Internet research,
- Press reports from a wide variety of sources regarding fuel saving activities, and
- Direct contact with companies. [EPA-HQ-OAR-2014-0827-1220-A1 p.14]

**Organization:** Newell Coach Corporation

We also think it is worthy of consideration that the recreational vehicle industry is somewhat unique in that it offers products that are manufactured virtually exclusively by skilled labor in the United States. [EPA-HQ-OAR-2014-0827-1319-A1 p.2]

**Organization:** Recreational Vehicle Industry Association (RVIA)

There are presently thirty-four motorhome manufacturing sites in the United States employing 8,732 full-time employees. The annual employee payroll is over \$619.7 million, and motorhome manufacturer revenues exceed \$3.63 billion.<sup>10</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.9]

Nearly 100% of motorhomes sold in the U.S. are made here. Roughly 66% of all motorhomes are produced in the state of Indiana, with many others manufactured in Iowa, Alabama, Texas and California. It is an industry dominated by small volume manufacturers. About half of all motorhome manufacturers produce fewer than one hundred motorhomes per year.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1261-A1 p.9]

The Proposed Rule will have negative impact on motorhome shipments and jobs RVIA contracted with John Dunham and Associates<sup>31</sup> (Dunham) to assess the economic impact that compliance with the proposed Phase 2 standards could have on the motorhome industry. The methodology for this model is

available in Appendix C. In simplistic terms, Dunham's model assumes that some change in price will have an impact on motorhome sales (shipments)<sup>32</sup> and that this impact on sales will in turn impact industry jobs, wages, economic output, government tax revenue, etc. RVIA asked Dunham to estimate the economic impacts for the following four scenarios: [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.7 of this comment summary]

**Scenario 1:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.7 of this comment summary]

**Scenario 2:** Motorhomes buyers factor 100% of fuel savings into their purchase decision (8.5 years of discounted fuel savings were subtracted from estimated incremental cost increases; costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.7 of this comment summary]

**Scenario 3:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on EPA ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.7 of this comment summary]

**Scenario 4:** Motorhome buyers do not factor fuel savings into their purchase decision (costs based on motorhome industry ICMs were used) [EPA-HQ-OAR-2014-0827-1261-A1 p.20][This comment can also be found in section 11.3 and 11.7 of this comment summary]

The results of Dunham's assessment for 2021MY, 2024MY and 2027MY are found in the following three tables below. Additional details are located in Appendix D. [EPA-HQ-OAR-2014-0827-1261-A1 p.21][This comment can also be found in section 11.3 and 11.7 of this comment summary]

[Charts, economic impacts, can be found on p.21-22 of docket number EPA-HQ-OAR-2014-0827-1261-A1]

In RVIA's view, Scenario 4 represents the most likely outcome. Scenario 4 reflects costs based on an ICM that is more representative of actual practice in the motorhome industry which, as we have already discussed, is distinctly different from other vocational vehicle segments (largely because motorhomes are not purchased for commercial purposes). [EPA-HQ-OAR-2014-0827-1261-A1 p. 22][This comment can also be found in section 11.3 and 11.7 of this comment summary]

Scenario 4 also reflects the fact that the average motorhome buyer, unlike the commercial vehicle fleet manager, likely places little value on future fuel savings when purchasing a motorhome. These are not vehicles purchased for daily driving or commercial purposes. Rather, the purchaser generally focuses on cost, features and other factors. [EPA-HQ-OAR-2014-0827-1261-A1 p. 22] [This comment can also be found in section 11.7 of this comment summary]

Looking at Scenario 4 and 2024MY standards, we estimate that a total of 1,553 jobs would be lost. Of these, 460 would be motorhome manufacturing jobs. This is over 5% of the existing 8,732 motorhome manufacturing jobs that exist today in the thirty-four motorhome manufacturing sites in the United States. With motorhome manufacturing jobs located in a handful of rural communities in a small number of states, applying the proposed standards will have serious negative impact on these communities. The rule would negatively impact not just motorhome manufacturing employees (460 lost jobs) but also motorhome dealers and component part suppliers (144 and 404 lost jobs, respectively).

Also negatively impacted would be persons outside the industry who live in these manufacturing communities. Lost wages are estimated at nearly \$118 million. Federal, state and local governments will also have about \$34 million fewer tax dollars to invest in social programs, and infrastructure. [EPA-HQ-OAR-2014-0827-1261-A1 p.22][This comment can also be found in section 11.7 of this comment summary]

Regardless of the scenario and the extent to which our industry and the communities that manufacture motorhomes are affected, the negative impacts for our industry cannot be ignored. We have concrete evidence showing what happens when motorhome shipments decline. It has been only six years since 2009 when nearly two-thirds (64%) of all direct motorhome manufacturing employees lost their jobs.<sup>33</sup> As of 2013, the latest year for which data is available, there are 43% fewer motorhome manufacturer businesses and still 59% fewer motorhome manufacturer employees than pre-recession. [EPA-HQ-OAR-2014-0827-1261-A1 p.22-23][This comment can also be found in section 11.7 of this comment summary]

While the estimated job losses associated with this rule do not approach the numbers experienced just a few years ago during and after the recession, they will still result in much pain and suffering, particularly for a handful of low-income rural communities that are only now just starting to recover from the recession. At the very least, EPA must consider these economic costs and impacts under the Regulatory Flexibility Act and Executive Orders 12866, 13563 and 12898. [EPA-HQ-OAR-2014-0827-1261-A1 p.23][This comment can also be found in section 11.7 of this comment summary]

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10 RVs: Moving the Economy, 2015 Economic Impact Study prepared for RVIA by John Dunham and Associates: New York.

11 Statistical Surveys, Inc.

31 John Dunham & Associates (JDA) is an economic specialist in regulatory analysis. JDA generates economic and fiscal impact studies from a national level down to geographic regions, municipalities, marketing areas or Federal and state legislative districts. See <http://guerrillaeconomics.com/>.

<sup>32</sup> According to John Dunham and Associates, the base elasticity for motorhomes is -0.905, suggesting that a 10 percent change in prices will reduce demand by 9 percent (see Appendix C).

<sup>33</sup> Based on U.S. Economic Census data, available at: [www.census.gov/econ](http://www.census.gov/econ).

### **Response:**

Comments from Achates Power, ACEEE, BlueGreen Alliance, Ceres, EDF, NRDC, and JD Gilroy expressed support for the standards' potential positive effect on the labor market. Comments included arguments that the standards will drive new jobs, reward organizations that innovate with respect to fuel efficiency, and help solidify and maintain the U.S. position as a leader in industries related to HD vehicle manufacturing and fuel efficiency technology.

Both NRDC and BlueGreen Alliance point to joint research that estimates that there are currently more than 36,600 jobs at over 380 facilities in the United States that are involved in the manufacturing process for fuel efficient medium- or heavy-duty vehicles or their components. They argue that the standards will help to sustain and add to those jobs as investment in the industry increases.

The agencies discuss employment impacts in Preamble Section IX.L and RIA Chapter 8.11. Although we are unable to quantify all possible pathways in which the standards can affect employment, our analysis suggests that employment effects in the regulated sector (the motor vehicle, trailer, and parts manufacturing sectors) are likely to be modest. We do not quantify changes in employment that result from the output effect (changes in demand for fuel efficient vehicles), which is part of the argument that NRDC and BlueGreen Alliance allude to in their comments. We agree that increases in employment are associated with the increased use of efficiency technologies; the estimates for substitution-effect employment in Preamble IX.L.2.b and RIA Chapter 8.11.2.2 aims to approximate employment impacts for those employers due specifically for the need for additional technologies. Thus, our analysis agrees with the comment from UAW that environmental regulations need not cost jobs, as well as with the BlueGreen Alliance that the standards may promote investment that contributes to jobs, and with Ceres that the U.S. can be an international leader on efficiency technology. Comments from Brian Mannix point out the difficulty associated with generating complete employment forecasts that include all direct and indirect effects. He concludes that the agencies are correct to be careful about estimating a definitive forecast.

Additional comments from UAW urge EPA and NHTSA to exercise caution in a general sense to ensure that the standards avoid market disruptions or “pre-buy/no-buy” boom and bust cycles. UAW suggests that in the past, market disruptions caused by pre-buy in anticipation of the 2007 and 2010 NOx and PM standards contributed to the lay-off of 10,000 UAW workers in 2009, which was also partly driven by the Great Recession. As pointed out in the comments from EDF and discussed in Preamble Section IX.F.2, RIA Chapter 8.4.2, and Chapter 11.7.2 of this Response to Comments, fuel economy standards are less likely to cause disruptions to vehicle purchasing trends since increases in costs for new technology are offset by fuel savings that accrue to the vehicle owner. This makes the standards fundamentally different from the past standards discussed in UAW’s comments.

NAFA Fleet Management Association expressed concern that the standards would make it more difficult to hire qualified drivers and technicians, and would require additional employee training. EPA expects that normal market forces will help alleviate labor shortages, should they occur. If the rule increases demand for skilled labor, economic theory suggests that there should eventually be increased wages and job opportunities as companies comply with the standards. Without evidence on increased costs for employee training or wage increases, we have not included them in our regulatory analysis. The rule may provide the regulatory certainty necessary for companies to make investments in new technology, additional employee training, or higher wages for qualified technicians.

Newell Coach Corporation and the Recreational Vehicle Industry Association (RVIA) note that the recreational vehicle (RV) industry is unique in offering products made “virtually exclusively” in the U.S. RVIA cites contracted analysis with John Dunham & Associates that estimates the effects of the standards on the RV industry. As discussed in Section 11.7 of this Response to Comments, the concern is that the RV industry is at risk to suffer significant negative effects due to the rule, based, in part, on the question of whether RV consumers will factor fuel savings into their purchase decisions. If consumers do not consider fuel savings, then increases in RV price due to complying with the rule could reduce sales, eventually leading to job losses. The RV industry was disproportionately hurt during the Great Recession and has only recently experienced a recovery.<sup>227</sup> As RVIA itself notes, the employment

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<sup>227</sup> Quiggle, Ben. “RV sales projected to be stronger in 2016 thanks to low gas prices, steady economy,” *The Elkhart Truth*, March 6, 2016. <http://www.elkharttruth.com/news/business/2016/03/03/RV-sales-projected-to-be-stronger-in-2016-thanks-to-low-gas-prices-steady-economy.html>, accessed 3/28/2016; Morris, Frank. “Ready For A Road Trip? RVs Are Rolling Back Into Fashion,” *Morning Edition on NPR*, March 28, 2016.



impacts due to the recession were much larger than even their high-level estimates of employment impacts due to the standards: while RVIA's estimate of the maximum impact of the standards on employment is about 5 percent of current employment levels, it notes that nearly two-thirds of direct manufacturing employees lost their jobs in the recession. Preamble Section IX.L and RIA Chapter 8.11 discuss evidence that macroeconomic conditions appear to have a much more significant effect on employment than does environmental regulation. We also note, again, that the final rule provides optional standards for custom chassis vocational vehicles, including motorhomes, which are less stringent than the main standards, and which may satisfy many of this commenter's concerns with the proposal. (The custom chassis standards were developed, in part, in response to this and similar comments).

The analysis by John Dunham & Associates also provides indirect and induced effects – that is, effects beyond the direct manufacturing sector – of their estimated sales and employment changes. As discussed in Preamble IX.L and RIA Chapter 8.11, these effects are likely to be small in the scope of the national economy when the economy is near full employment; at such times, environmental regulation is more likely to move employment from one sector to another rather than to have a major effect on total employment. In times of significant unemployment, those impacts are likely to be larger. Because we do not know the state of the macroeconomy at the time that these standards will come into effect, the agencies focus our employment analysis on the directly regulated sector, with qualitative assessment of closely related sectors.

As also discussed in Preamble Section IX.L and RIA Chapter 8.11, employment effects of regulation are due not only to the output effect, the effect on sales of vehicles, but also to the substitution effect, the increased labor costs associated with complying with the standards: part of the increased costs due to meeting the standards goes into labor involved with designing, producing, and installing fuel-saving technologies. The analysis by John Dunham & Associates does not take into account the employment increases associated with this “substitution effect,” and thus is very likely to overstate the decrease in employment associated with the standards. For these reasons, as with overall employment impacts in the HD sector, we expect modest impacts on employment in the RV sector.

## 11.12 Cost of Ownership and Payback Analysis

**Organization:** Allison Transmission, Inc.

In the RIA on page 7-45 under section 7.2.4 “Payback Periods,” Table 7-47 shows a payback period for MHs for additional new technology (via a MOVES calculation), that exceeds 23 years. The next closest “long” payback period on the chart is for school buses at 11 to 18 years (at both a 3% or 7% discounted rate and dependent on the fuel choice). This highlights the large difference in the use patterns of MHs versus the other vocational vehicle classes. In other words, as noted above, MHs are seldom driven over the course of a full year. Thus, when compared to most of the other vocational classes, MHs simply do not generate operational costs on par with vocational vehicles from which significant cost savings could occur (e.g., through more mpg). Indeed, the operational savings per year created through increasing the efficiency of MHs would be comparatively miniscule when compared with vocational vehicles that may be driven long distances every day or standard delivery or service routes. Given a “payback period” in excess of 23 years, consumers would literally have no incentive to purchase a more efficient vehicle. [EPA-HQ-OAR-2014-0827-1284-A1 p.49][This comment can also be found in section 6.4 of this comment summary]

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<http://www.npr.org/2016/03/28/468172578/ready-for-a-road-trip-rvs-are-rolling-back-into-fashion>, accessed 3/28/2016.

**Response:**

The agencies considered potential payback as part of the consideration of the rule's costs, and have concluded that payback is one reason for finding the costs of the Phase 2 standards to be reasonable. We disagree with the assertion that consumers do not care about fuel savings and do not consider fuel savings when purchasing a new vehicle. Allison is claiming here that it is an important and, perhaps, the primary consideration in making a new vehicle purchase, at least for purchases of motor homes. We acknowledge that the payback metric for motor homes is not attractive due to fewer miles travelled and may not entice buyers into showrooms to get the more efficient motor homes. Importantly, the final rules contain custom chassis provisions meant to result in a simpler, less costly set of vehicle technologies than the primary standards would otherwise require.

**Organization:** American Trucking Associations (ATA)

**Technology Costs Remain Suspect**

ATA believes the agencies underestimated the costs of various technologies making the payback period on these technologies much longer than is stated in the proposed rule. A fleet owner typically demands an 18-month payback on technology purchases. If the actual payback extends beyond 24 months, it will likely lead to the risk of increased fleet pre-buy, low-buy, and no-buy scenarios. The Phase 2 Rule currently envisions a maximum 24-month payback period. If variables such as predicted technology costs, MPRs, and fuel costs are not accurate, fleet payback periods for equipment may not be recognized during the period of equipment ownership. Moreover, likely additional costs for maintenance and downtime for new technologies need to be wholly accounted for under the rule. If payback on equipment purchases is pushed beyond ownership periods, there is little or no incentive for fleets to make the initial investments in technologies under Phase 2. [EPA-HQ-OAR-2014-0827-1243-A1 p.10]

To further expand upon this point, let's focus on one payback period variable. The table below is an abbreviated version of the fuel pricing forecasts contained in the June 2015 Phase 2 Draft Regulatory Impact Analysis (with an additional line added for present-day fuel pricing comparisons). [EPA-HQ-OAR-2014-0827-1243-A1 p.10]

[Table, '2014 Early Release Reference Case Fuel Prices 92012\$/gallon', can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1243-A1]

If diesel fuel costs are indeed more than 50% higher than present day fuel pump prices, it is logical to assume that estimated payback periods are reduced (assuming the agencies have accurately forecasted future technology pricing). Moreover, likely additional costs for maintenance and downtime for new technologies need to be wholly accounted for under the rule. If these assumptions are incorrect or lacking and payback on equipment purchases is pushed beyond typical ownership periods (oftentimes 36-48 months), there is little or no incentive for fleets to make investments in technologies under Phase 2. [EPA-HQ-OAR-2014-0827-1243-A1 p.10]

**Increased Warranty, Maintenance, and Downtime Costs Should be Included**

The proposed Phase 2 standards represent a more technology-forcing approach than Phase 1, predicated on use of both off-the-shelf technologies and emerging technologies that are not yet in widespread use. Past experience with emerging technologies in heavy-duty engines has shown that warranty claims, where an operator takes a vehicle out of service to a maintenance facility to have a part under warranty

replaced, tend to be higher during the initial years of introduction. [EPA-HQ-OAR-2014-0827-1243-A1 p.12]

As shown in Appendix 3, based on warranty claims data required to be submitted to CARB, particulate filter-related warrantee claims were at 35% during their initial year of introduction (2007), decreased to 18% during the second year and fell to 4% during the fifth year (2011, the last year of data provided). Similarly, SCR-related warranty claims were at 20% during their initial year of introduction (2010) and decreased to 10% during the second year (2011). Also of note is how other technologies were affected during the introduction of a new technology. For example, warranty claims for engine/ECM/other components increased from 22% prior to the introduction of particulate filters to 90% during the first year this technology was introduced. [EPA-HQ-OAR-2014-0827-1243-A1 p.12]

This data highlights the fact that additional warranty, maintenance and downtime costs result when new or significantly altered technologies are introduced. It appears the proposed rule only includes increased maintenance costs associated with tires. Based on operational cost data collected from motor carriers, the cost of repair and maintenance accounts for 6-9% of the marginal cost of operating a truck.<sup>10</sup> This is 3 to 4 times more than tire costs. ATA requests the agencies to further examine the warrantee claims and operational cost data to develop an algorithm that accounts for additional warranty, maintenance and downtime costs as part of the final rule. [EPA-HQ-OAR-2014-0827-1243-A1 p.12-13]

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10 American Transportation Research Institute, An Analysis of the Operational Cost of Trucking: 2015 Update (September 2015).

**Response:**

We respond to comments regarding pre-buys in Section 11.7.2 of this Response to Comments. Further, we do not believe that extending paybacks beyond 24-months will result in pre-buys/low-buys/no-buys. We have included many more maintenance items in our maintenance cost estimates for the final rules. Please see RIA 7.2.3 for more details. Comments regarding the 2007/2010 criteria pollutant rule are addressed in Section 15.10.4 of this Response to Comments.

**Organization:** Amy's Kitchen et al.

Strong standards will be good for businesses, the trucking industry and American consumers. Importantly, the financial benefits of strong standards will be significantly greater than the costs. These lower life cycle costs will start accruing as soon as the first new trucks enter into service. In fact, trucking will see lower life cycle costs right away and these savings will grow to \$0.21 cents a mile in 2040;<sup>x</sup> that is an annual savings potential of more than \$25 billion.<sup>xi</sup> [NHTSA-2014-0132-0232-A1 p.2]

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x Lowell, D., EPA/NHTSA Phase 2 Fuel Efficiency and Greenhouse Gas Standards for Heavy-Duty Trucks: Projected Effect on Freight Costs, MJ Bradley & Associates. April 2014.

xi Ceres, Environmental Defense Fund. Report confirms cleaner, fuel efficient freight trucks yield big savings over the long haul. Ceres. Ceres and EDF, June 2015. Web. 17 Feb. 2016. <http://www.ceres.org/industry-initiatives/transportation/truck-standards-fact-sheet> Assumes 120 billion freight miles a year.

**Response:**

Thank you for your comments.

**Organization:** Association for the Work Truck Industry (NTEA)

Fuel Efficiency Payback

With regard to Alternative 3, in 2027 when the standard is fully phased in, heavy-duty vehicles across all classes would achieve up to the following CO<sub>2</sub> emissions and fuel use reductions.

- 24 percent for combination tractors designed to pull trailers and move freight when compared to Phase 1 standards
- 8 percent for trailers when compared to an average model year 2017 trailers
- 16 percent for pick-up trucks and light vans when compared to Phase 1 standards [EPA-HQ-OAR-2014-0827-1187-A1 p.3]

Further, the proposal calculates figures for expected payback periods based on the additional costs associated with the proposed standards and the economic savings based on the increased fuel efficiency expected with Alternative 3. The proposal estimates “Reasonable Payback Periods for the Trucking Industry In model year 2027,” for the buyer of a new vehicle. The notice states that the buyer would recoup the extra cost of technology used to achieve the standard (Alternative 3) within:

- 2 years for a tractor/trailer combo
- 3 years for pick-ups and vans

The expected payback periods for tractor/trailer combinations and pick-ups/vans seems reasonable. Most companies would look towards a 2-3 year payback period for moderate fuel efficiency gains. [EPA-HQ-OAR-2014-0827-1187-A1 p.4]

**Response:**

Thank you for your comments.

**Organization:** BYD Motors

The current version of the plan will have real benefits for public health and will provide total cost of ownership benefits for fleet operators over the life of the vehicles. [EPA-HQ-OAR-2014-0827-1182-A1 p.1][This comment can also be found in section 11.9 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.227.]]

**Response:**

Thank you for your comments.

**Organization:** CALSTART

Vocational Vehicles. As we shared at the Long Beach workshop, CALSTART recently published a report, titled “Higher Fuel Efficiency: Working for Fleets,” which assessed the business case for fleets from higher fuel efficiency trucks that might be driven by a new fuel economy rule. This report has highlighted two core issues: that there are achievable technologies that can provide higher efficiency on the rule timeline, and that these technologies on whole can be cost-effective and provide reasonable payback to fleets using them. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.152.]]

To understand the payback issue we took a different approach from the Agencies. We worked with a cross section of fleets representing various applications and truck types nationwide to validate the key components of a fleet business case assessment model, collaborating with the NAFA Fleet Management Association and its fleets. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.152.]]

In developing the model, we also surveyed fleets on their support for and concerns about increased fuel efficiency. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.152-153.]]

- Interestingly, we found 87-percent of fleet managers responding supported rules driving higher fuel efficiency. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.152-153.]]

- Their primary concern was cost; though 89-percent said they would be willing to pay more up front for fuel efficient trucks if they knew they would pay back over their life. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

- They also expressed concern about reliability and maintenance costs. This does have relevance for the rule duration. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

Using the life cycle cost model we validated with fleets we assessed business cases in seven specific truck use profiles: [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.1.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

- Class 8 Over the Road; [EPA-HQ-OAR-2014-0827-1190-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

- Class 8 Regional Haul; [EPA-HQ-OAR-2014-0827-1190-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

- three medium duty use profiles: Urban, rural/intra-city and work site support; and [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

- Class 2B pickups and vans. [EPA-HQ-OAR-2014-0827-1190-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

While structured before your draft rules were released, the categories are very similar to the three vocational segments you are proposing and which we do support. [EPA-HQ-OAR-2014-0827-1190-A1 p.2][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.153.]]

We looked at different technology packages that were most applicable to each use profile, assembling packages that could achieve up to a 40 percent reduction of fuel use over 2010 baseline trucks. These packages, and their projected costs, were adapted from National Research Council and Transportation Research Board studies. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.154.]]

Our top level findings were these: [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary]

- We found there is a reasonable business case payback, based on fleet-validated cost assessment tools, for higher fuel economy trucks at levels proposed in the rules. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.154.]]

- The stringency levels we modeled in the report were, in most cases, actually higher than those proposed in the Alternative 3 language. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.154.]]

- We saw the potential for higher fuel economy targets than those proposed in several use profiles – particularly urban trucks, regional trucks and those vehicles with high work site idle time. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.154.]]

- The biggest variables for payback were utilization – the mileage and fuel used – and the upfront cost of the technology. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.154-155.]]

- Fleets have suggested that modeling payback sensitivity to maintenance cost would be helpful and we encourage the Agencies to develop this information to address fleet concerns. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.155.]]

As mentioned, the report used different – and generally higher – assumptions for stringency than those recommended in the Agencies' preferred Alternative 3. Below we highlight the comparisons between the segments we studied, the corresponding segment in the rule (where there is one), and the stringency proposed in the draft rules compared with those studied in the report. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary]

[Table of segments studied and results can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1190-A1][This comment can also be found in section 6.2 of this comment summary]

More can be done in Class 8, particularly as concerns advanced engines such as being developed by innovative firms and work being done at the existing OEM levels. However, we believe the Class 8 segment stringency appears both achievable and drives GHG reductions close to the reduction path needed to achieve climate stability. In contrast, we are concerned that the vocational segments as proposed do not meet the same level of reduction path and we believe they could, while still providing

fleet users with the functionality they need and a payback they can afford. [EPA-HQ-OAR-2014-0827-1190-A1 p.3][This comment can also be found in section 6.2 of this comment summary]

In shaping the final rule, we believe the Agencies' payback projections from efficiency are reasonable and real. Indeed, we see a strong case for higher efficiency targets than those currently called for particularly in several vocational segments. We also see the ability to further push improvements in engine technology than proposed while still making sure those engines are a component of a full vehicle strategy. [EPA-HQ-OAR-2014-0827-1190-A1 p.9][This comment can also be found in section 6.1 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.155.]]

**Response:**

Thank you for your comments.

**Organization:** Ceres

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 201.]

Despite higher up-front costs, advanced fuel-efficient trucks will more than pay for themselves over a typical ownership period due to fuel cost savings. In fact, a joint analysis by Ceres and the Environmental Defense Fund found these standards would reduce freight costs by 3 percent in 2030 and 7 percent in 2040, an estimated \$34 billion annual saving potential.

**Response:**

Thank you for your comments.

**Organization:** City of West Hollywood

Setting a strong second-phase standard will help fleets save more money on fuel. For example, manufacturers could improve the efficiency of transit buses, school buses, utility trucks and other 'vocational' vehicles by almost a third by 2025, with technology that would pay for itself in fuel savings in less than 4 years (compared to an average life of 15 years for an average transit bus, for example). [NHTSA-2014-0132-0056-A1 p.2]

Payback times for heavy-duty pickups and vans would be less than three years. And for tractor-trailers, efficient technology could pay for itself completely in only 13 months. [NHTSA-2014-0132-0056-A1 p.2]

**Response:**

Thank you for your comments.

**Organization:** Clean Fuels Ohio (CFO)

In addition to class 8 trucks, the phase two rules will apply to vocational vehicles as well as pickup trucks and vans. Compliance with the rules will raise initial vehicle costs in all market segments. However, savings on fuel will pay for these increased initial costs. The EPA estimates payback periods

will be 2 years for class 8 tractors/trailers, three years for pickups, and 6 years for vocational vehicles. Clean Fuels Ohio appreciates the need and value for these rules despite increased up-front costs. Assuming EPA estimates are correct, payback periods for tractors, trailers and pickups fall within a reasonable timeframe for most commercial users. We do have concerns about the 6-year estimated payback for vocational vehicles, since this timeframe falls outside of planned ownership duration for many companies who buy vocational vehicles. [EPA-HQ-OAR-2014-0827-1192-A1 p.2]

Clean Fuels Ohio is hopeful that advancements in vehicle efficiency technologies will shorten this payback period to lessen the hardship on this industry sector. Clean Fuels Ohio also applauds the EPA for suggesting creative approaches, such as “delegated assembly,” that leverage innovation in the work truck industry by smaller-scale technology developers and third-party installers. [EPA-HQ-OAR-2014-0827-1192-A1 p.2]

**Response:**

Vocational vehicle payback periods are difficult to estimate given the variety of duty cycles and vehicle types in the vocational vehicle sector. We provide our estimates in a table in final RIA Chapter 7.2.4. We do not believe that the payback periods we have estimated will result in pre-/low-/no-buy outcomes.

**Organization:** Consumer Federation of America (CFA)

Early in the PHASE II NOPR, the agencies offer a fundamental observation about the proposed rule that is highlighted in Figure VI-1. “The standards will result in significantly lower operating costs for vehicle owners (unlike the 2007 standard, which increased operating costs).” Unlike many environmental regulations, this joint fuel economy/environmental regulation produces so much fuel savings that it pays for itself. Two-thirds of the benefits come in the form of fuel savings and these benefits are over five times as large as the costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.47]

[Figure VI-1 can be found on p.47 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

**Response:**

Thank you for your comments.

**Organization:** Edison Solar Inc.

Finally, we know that improving truck fuel efficiency can be achievable and can be done affordably: [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

- In model year 2027, a new tractor-trailer owner would recoup the extra cost of technology used to achieve the standards within 2 years. [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

**Response:**

Thank you for your comments.

**Organization:** First Industries Corporation

(2) EPA underestimates technology costs, meaning that payback periods will be longer than EPA estimates [EPA-HQ-OAR-2014-0827-1145-A2 p.2]



### EPA Underestimates the Costs of Various Technologies

Because EPA underestimates the costs of various technologies, the payback period on these technologies is actually much longer than is stated in the proposed rule. This is especially of importance as the agencies present the 'average' cost per truck of this rule, whereas customers must pay the actual costs at time of purchase; therefore, actual costs not 'average costs' should be estimated by the rule. Our customers typically demand an 18-month payback on technology. If the actual cost payback extends beyond two years, it will lead to a pre-buy/no-buy situation. [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

The estimated costs of the following technologies as presented in the proposed rule are too low: [EPA-HQ-OAR-2014-0827-1145-A2 p.4]

**Warranty Costs and Downtime:** The EPA must consider warranty costs and downtime in making its calculations of costs and pay back periods. This is especially important, and difficult to do, when the technology needed to meet the proposed rule is not yet adopted. However, such costs are critical in a customer's purchasing decision and will not be insignificant for a rule that pushes new technology into the market. [EPA-HQ-OAR-2014-0827-1145-A2 p.5]

#### **Response:**

Unfortunately, we do not understand the comment about our use of “average” costs rather than “actual” costs. Presumably the comment is meant to differentiate between cost estimates and price impacts. It is true that we do not attempt to estimate prices. Warranty costs are included in our markups estimating indirect costs. Downtime is not expected for the technologies projected for use. Downtime associated with prior EPA regulations should not be seen as an indication that downtime will occur in association with this regulation.

**Organization:** Gilroy, JD

A third thing I find praiseworthy about the proposed standards is that they seem to involve powerful economic benefits even aside from environmental and health benefits---allegedly 124,000 jobs by 2030 and a ratio of benefits to costs of 10 to 1, or a savings for truckers of \$160 billion after new technology upgrades are paid off. That is probably why the affected industries have been largely supportive of the new standards, some even meeting the standards before required to do so, and that is a fourth reason I like them. [EPA-HQ-OAR-2014-0827-0751 p.2][This comment can also be found in section 11.12 of this comment summary]

#### **Response:**

Thank you for your comments.

**Organization:** Hoosier Environmental Council

From an economic perspective, we support this rule as it will lead to net savings for Indiana truck owners, for whom fuel accounts for 40% of their operating cost (American Trucking Associations) and for which payback periods is projected to be as short as two years for later model year tractor-trailers. This is especially important for Indiana, which has made logistics a growth priority, as Indiana ranks in the top 10 in more than 40 logistics-related metrics (Indiana Economic Development Corporation). [EPA-HQ-OAR-2014-0827-1245-A1 p.1]

**Response:**

Thank you for your comments.

**Organization:** NAFA Fleet Management Association

Trucking fleets can better absorb cost increases associated with the purchase of fuel efficiency technologies if they deliver reasonable payback periods. We are concerned that the actual costs of Phase 2 technologies for model year 2017-2027 vehicles will greatly exceed the agencies' estimates. Fleets look at the total cost of ownership (TCO) —acquisition costs, fuel, personnel, maintenance, overhead, road charges, insurance, residual values, and taxes, to name a few components of TCO [NHTSA-2014-0132-0111-A1 p.2]

Fleet managers are responsible for the entire capital budget for new and replacement vehicles. Multi-year capital forecasts are done annually. The capital approval and release for spending is an annual exercise and depends on the organization's resources. [NHTSA-2014-0132-0111-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.179.]]

When deciding to purchase or lease a vehicle, a fleet manager looks first at the cost of the vehicle and how that cost affects the annual vehicle replacement budget. The initial cost of the vehicle is always a concern. The projected lifecycle costs and the payback period do factor in to making the business case for a vehicle; and no variable cost is more important than fuel. The projected payback periods in the proposal are based on fuel savings, but after cost, a fleet's primary focus is on making sure that the vehicle and drivetrain features meet the specific work and duty-cycle needs, before considering fuel savings. [NHTSA-2014-0132-0111-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.179.]]

A review of the American Trucking Research Institute analysis data find that the operational costs have increased about 8-9% year over year. (See Table below) [NHTSA-2014-0132-0111-A1 p.2]

[Table can be found on p.2 of docket number NHTSA-2014-0132-0111-A1]

There are also indirect costs related to excessive warranty repair recovery, as well as the external work required because vehicles increasingly need to be sent to the dealers due to complexity of the new technology. The latter causes increases in downtime, as the dealers are overwhelmed and ill equipped at times to handle the capacity and capability issues. [NHTSA-2014-0132-0111-A1 p.13]

**Response:**

We have made every effort to put forth what we believe to be the best cost estimates available to us. Realize that we do not attempt to estimate price impacts because so many factors go into eventual pricing, but we have attempted to estimate the increased costs necessary to comply with the standards. As such, we do not believe that the actual costs will greatly exceed our estimates.

**Organization:** Odyne Systems LLC

*Return on Investment Projections*

Odyne has constructed basic payback models for medium and heavy-duty truck systems to assist the EPA in its market penetration and cost assumptions for Phase Two final rule development. The figures

included here are best estimates using available industry and Odyne-specific data. Projections made here are based on plug-in hybrid systems for vocational trucks with PTOs that are able to attain full workday duty cycle GHG reductions of up to 50% or better. [EPA-HQ-OAR-2014-0827-1239-A1 p.10]

**Response:**

Thank you for your comments.

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

**Cost of Trucks**

The agencies claim an owner of a new truck designed under the proposal will be able to recoup costs in “less than two years” due to fuel savings, however, the agencies have yet to show a direct connection between specific technologies and specific costs savings. The GEM model that the agencies utilized to make these estimates does not reflect all types of operations or geography. Moreover the OEMs have unmistakably declared that such a payback period is unrealistic considering the actual costs of the rule. Again, the agencies estimated that a new MY 2027 tractor will cost roughly between \$10,000 and \$13,000 more due to the Phase II standards. Nevertheless, this is based on the false assumption that typical heavy-duty truck costs \$100,000. According to the OOIDA Foundation’s Owner-Operator Member Profile Survey, the average price of a new truck today is \$123,351. [EPA-HQ-OAR-2014-0827-1244-A1 p.41-42]

[Chart 2 can be found on p.42 of docket number EPA-HQ-OAR-2014-0827-1244-A1]

While a \$10,000 increase, which is an underestimation of actual costs, does not seem to be a large sum to the agencies proposing the rule, this cost is quite substantial for an owner-operator who takes home a net revenue of approximately \$30,000 per year. If an individual were to purchase a new 2016 Kenworth T660 and a new 2016 Reitreneur Dropdeck flatbed trailer for \$164,593 and \$49,500,<sup>46</sup> respectively, before taxes and fees. This price does not include the additional costs for chains, tarps, nylon straps, ratchet binders, etc., which are necessary in order to secure a load to the trailer. Even with a promise of a return on their investment via improved fuel economy, which again, is not realistic, the investment must be attainable in order to receive any positive benefits from the technology. An increase of \$10,000 can easily put the purchase of a new truck out of reach for an owner-operator or small fleet. Simply stated, if the cost of the equipment exceeds the point where a person can attain credit in order to purchase it, an owner-operator will not buy it. This is an increasingly likely scenario with the Phase 2 NPRM, thus the opportunity for safe and experienced drivers to become an owner-operator will be reduced. It is important for the agencies to also include as part of their cost and benefit analysis, the increased purchase price of used trucks in response to the uptick in demand for vehicles without Phase II technologies. [EPA-HQ-OAR-2014-0827-1244-A1 p.42-43]

**Warranty, Maintenance, and Downtime Costs**

The proposed rule will force new technologies into the market and with new technologies will come increased warranty costs, maintenance costs, and costs associated with increased downtime. The proposed rule only counts some of the increased maintenance costs associated with tires. In doing so, the agencies are greatly underestimating the overall impact of new technology. The agencies should calculate in the analysis additional warranty, maintenance and downtime costs. In an April 2014 Board Meeting, OOIDA Board Member Lewie Pugh presented to the EPA a 7-foot long printout of everything that had gone wrong with the MaxxForce engine truck that he had purchased in 2011. He said, “When

the truck breaks down, the mechanics don't even know what's wrong. They don't know how to work on them. The dealership I go to is packed with trucks with emission problems.<sup>48</sup> [EPA-HQ-OAR-2014-0827-1244-A1 p.45]

If an Alternative that forces new technologies is chosen by the agencies, the impact of increased repairs beyond traditional warranty coverage needs to be taken into account. Small business owners and fleets cannot continue to bear the cost of forced technologies and the ensuing repairs. The irony with this situation is that any increased warranty coverage would increase the purchase price of a new truck. Additionally, this will negatively impact the resale value of the truck. For example, the trucks subject to the Phase I standards, such as the MaxxForte engine which caused large amounts of downtime, will be passed along to the new consumer, without an extended warranty, many owner-operators could be placed out of business. According to the OOIDA Foundations Member Profile Survey, 74 percent of owner-operators purchase used trucks. Any unreliable or problematic truck produced as a consequence of the Phase II standards will eventually be placed on the used market, thus adversely impacting owner-operators who purchase them several years into the future. [EPA-HQ-OAR-2014-0827-1244-A1 p.45-46]

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46 <http://www.trailermarketinginc.net/>

48 "EPA takes notes on OOIDA concerns."

**Response:**

The commenter states that, "the agencies have yet to show a direct connection between specific technologies and specific costs savings." We respond to comments regarding GEM in Section 2 of this Response to Comments, the effectiveness of engine technologies in Section 3 of this Response to Comments, and the effectiveness of tractor technologies in Section 4 of this Response to Comments.

Our cost estimate for tractors is not in any way based on a false assumption that the cost of a tractor is \$100,000. We take a bottom up approach to estimating our tractor cost by first estimating individual technology costs, then estimating their adoption rates, then estimating the resulting cost impact. That estimate is independent of the total cost or price of a tractor. We mentioned the \$100,000 tractor only as a means of providing some scale. Most readers of our regulatory documents are far more familiar with light-duty vehicle prices in the \$25,000 to \$40,000 range. So it was seen as important to provide some scale when presenting a cost impact on the order of \$10,000 to \$13,000. If a tractor is more like \$123,000, that simply means the cost impact of the new standards is a lower percentage than we suggested when we used the \$100,000 value. As for increased warranty, we include these in our indirect cost markups. As for downtime, we do not foresee any increased downtime associated with the technologies expected in response to the new standards.

**Organization:** PepsiCo

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 43.]

The EPA and NHTSA's approach to evaluate current and future technology adoption into the heavy-duty truck industry with an average two-year payback is a fair assumption and creates a standard built on facts and grounded in logic.

**Response:**

Thank you for your comments.

**Organization:** Quasar Energy Group

Finally, we know that improving truck fuel efficiency can be achievable and can be done affordably: [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

In model year 2027, a new tractor-trailer owner would recoup the extra cost of technology used to achieve the standards within 2 years. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

**Response:**

Thank you for your comments.

**Organization:** Truck Renting and Leasing Association

The economic savings touted by the agencies, to the extent they materialize, will not be seen by the renting and leasing industry. The agencies' economics are premised on the notion that increased up-front costs due to the addition of expensive fuel-economy technologies will be made up later, in whole or in part, through future savings via reduced fuel consumption and thus fuel expenditures. Proposed Standards, at 40483. In the vehicle leasing context, whatever benefits may accrue from reduced fuel expenditures will be reaped by the vehicle operator/lessee, not the lessor. That scenario, in turn, may tend to favor vehicle ownership over leasing – an outcome that could result in negative environmental and economic outcomes to society overall given the benefits provided by the leasing industry.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1140-A1 p.4]

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<sup>3</sup> See, e.g., “Driving the Bottom Line: Environmental Impact Supports Case for Company-owned Fleets Vice Driver Reimbursement” (American Automotive Leasing Association, 2008) (available at <http://www.enterprise.com/content/fleets/pdf/whitePaperenvironmental.pdf>).

**Response:**

The new standards are not intended to provide benefits or costs to any individual stakeholder out of line with any other stakeholder. In fact, the new standards are meant to result in net benefits to society, which they do. We do not believe that the current market will undergo any meaningful disruption due to the new standards.

**Organization:** Werner Enterprises

There are several key areas the Agencies need to address: [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

- Accurately reflect operators' total cost of ownership [EPA-HQ-OAR-2014-0827-1236-A1 p.2]
- Correct underestimated costs of technology and maintenance costs meaning the payback periods will be longer than estimated. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

**Response:**

The commenter has not provided sufficient detail for us to consider possible improvements to our estimates. We have made changes as discussed throughout the final RIA in an effort to improve every aspect of our analysis.

**Organization:** Recreational Vehicle Industry Association (RVIA)

If the standards for work trucks (e.g., Ford F-250 or Ram 2500 pickups) are finalized as proposed, these vehicles that are used for RV towing would need to become more fuel efficient during the 2021-2027 timeframe. The fuel economy standards would reduce fuel consumption by 2.5% each year such that by 2027 these vehicles would consume 16% less fuel than pre-2021 vehicles. [EPA-HQ-OAR-2014-0827-1261-A1 p.26]

According to agency estimates, these improvements will cost an estimated \$493 in 2021 to \$1,366 in 2027. Thus, for a \$40,000 work truck, the price increase would range from 1.2% to 3.4%. [EPA-HQ-OAR-2014-0827-1261-A1 p.26]

Although EPA finds that the savings at the pump may eventually offset the increase in cost associated with the fuel savings technology required for compliance with work truck standards, we are concerned that the cost increase associated with this regulation, when coupled with cost increases relating to a number of other regulatory requirements coming from CARB and NHTSA, will cause harm to the RV industry. [EPA-HQ-OAR-2014-0827-1261-A1 p.26]

If the cost of purchasing a towable RV, such as a travel trailer, fifth-wheel, folding camping trailer, or truck camper and the vehicle needed to tow the RV is no longer cost-competitive with other recreation alternatives, consumers will leave 'RV'ing' for a more affordable alternative such as boating. This could have a devastating impact on the RV industry and more specifically the same small rural communities that produce motorhomes (see Section VIII). EPA should more carefully consider the impact of this regulation in conjunction with other regulations. In fact, this is required by Section 1(b) of Executive Order 13563 (Improving Regulations and Regulatory Review) which states that, when issuing new regulations, agencies shall tailor their regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations." (emphasis added). [EPA-HQ-OAR-2014-0827-1261-A1 p.26-27]

Operating in a vacuum can have dangerous consequences and EPA should carefully consider the cost impact of not just this regulation on tow vehicles but other regulations that are in development or likely to be put into effect in the next decade by either NHTSA or EPA that could affect these vehicles. As EPA is conducting this rulemaking jointly with NHTSA and closely coordinating with CARB, there is no reason why these three agencies, the primarily regulators of the auto industry in the U.S., should not be able to undertake this very important task of looking at what future regulatory requirements are on the horizon and what will be the cumulative costs associated with them in the aggregate. [EPA-HQ-OAR-2014-0827-1261-A1 p.27]

**Response:**

RVIA has raised concerns that the increased price for pickups hauling recreational vehicles (RVs) might reduce interest in RVs, and people might switch to another activity, such as boating. We note that, for HD pickups generally used for hauling RVs, the savings outweigh the costs within the third year of ownership (see RIA Chapter 7.2.4). We are unaware of evidence on the combined effects of higher up-front costs and lower operating costs on the purchase or use of pickups for hauling RVs: the lower

operating costs might encourage use, even if the higher up-front costs might discourage purchase. We are also unaware of evidence that people interested in “RVing” might choose instead to do something so different, such as boating, based on the increased cost of the pickup needed to tow the RV.

RVIA would also like the agencies to consider the costs of future regulations as well as current ones in its estimates. We include in the reference case the costs of all existing regulations on vehicles. Because it is impossible to know the requirements or costs of future regulations before they are finalized, it is not possible to include the costs of future regulations in this analysis.

### 11.13 Safety Impacts

**Organization:** American Chemistry Council (ACC)

Lightweight plastic and composite materials have the ability to reduce vehicle weight without compromising safety, and Congress has taken steps to recognize that fact. Over the last 9 years, Congress has directed NHTSA to create a safety roadmap for lightweight Plastic and Composite Intensive Vehicles (PCIVs) through the THUD Appropriations bills. The report, titled “A Safety Roadmap for Future Plastics and Composites Intensive Vehicles”<sup>3</sup> and published in 2007, evaluates the potential safety benefits of PCIVs to enable their deployment by 2020. [EPA-HQ-OAR-2014-0827-1147-A2 p.4]

In support of the Roadmap’s implementation, NHTSA conducted a study to lightweight a 2008 Silverado by approximately 20% utilizing plastic and polymer composites.<sup>4</sup> The lightweight study vehicle was shown to maintain equivalent safety based upon NCAP test results. The study, entitled “Investigation of Opportunities for Lightweight Vehicles Using Advanced Plastics and Composites” was finalized and published by NHTSA in 2012. As in comments submitted in 2011 in response to the Phase I, ACC continues to urge EPA/NHSTA to make full implementation of the PCIV safety roadmap, because it not only exhibits the full performance potential that PCIVs hold, but also recognizes the importance of ensuring safety at each phase of product development. ACC stands ready to assist the agencies in this regard. [EPA-HQ-OAR-2014-0827-1147-A2 p.4]

The high strength and energy absorption of structural polymer composites can also improve crash safety by strengthening vehicle compartments to help protect passengers during crashes.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1147-A2 p.5]

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3 NHTSA. 'A Safety Roadmap for Future Plastics and Composites Intensive Vehicles' (DOT HS 810 863), 2007;

<http://www.nhtsa.gov/DOT/NHTSA/NVS/Crashworthiness/Vehicle%20Aggressivity%20and%20Fleet%20Compatibility%20Research/810863.pdf>.

4 NHTSA. “Investigation of Opportunities for Lightweight Vehicles Using Advanced Plastics and Composites” (DOT HS 811 692), 2012;

<http://www.nhtsa.gov/DOT/NHTSA/NVS/Crashworthiness/Plastics/811692.pdf>

5 Aviva Brecher and John Brewer, Volpe National Transportation Systems Center, and Stephen Summers and Sanjay Patel, National Highway Traffic Safety Administration, Characterizing and Enhancing the Safety of Future Plastic and Composite Intensive Vehicles (PCIVs), <http://www-nrd.nhtsa.dot.gov/pdf/esv/esv21/09-0316.pdf>

**Organization:** American Trucking Associations (ATA)

### **NHTSA Should Continue to Review and Analyze Potential Safety Impacts of Fuel Efficiency Technologies**

In June 2015, NHTSA published its Review and Analysis of Potential Safety Impacts of and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles.<sup>12</sup> This report undertook a safety analysis of medium- and heavy-duty vehicles equipped with fuel efficiency technologies and/or using alternative fuels (i.e., CNG, LNG, propane, biodiesel, and power train electrification). This peer-reviewed study included a comprehensive literature review, complemented with inputs from subject matter experts, and a scenario-based hazard analysis. Specific fuel efficient technologies examined included: Intelligent Transportation Systems and telematics, speed limiters, idle reduction devices, tire technologies (single-wide tires, TPMS and ATIS), aerodynamic components, longer-combination vehicles, and light-weighting materials. Federal and state safety regulations and voluntary technical standards affecting fleet adoption rates of fuel efficient technologies and alternative fuels were discussed, as were potential regulatory barriers. The findings, while based on literature reviews up through 2013 and prior to the implementation of Phase 1, suggest that potential safety hazards identified can be prevented or mitigated by complying with safety regulations, voluntary standards, and industry best practices. The study did not identify any major regulatory barriers to rapid adoption of fuel efficient technologies and alternative fuels by both medium and heavy-duty fleets. [EPA-HQ-OAR-2014-0827-1243-A1 p.17]

ATA is pleased that NHTSA has undertaken such a study and asks that DOT's Volpe National Transportation Systems Center continue to assess and evaluate potential safety impacts that may be attributed to the use of fuel efficiency devices. ATA recommends that regular updates and publication of results be undertaken on an established schedule as determined by NHTSA but not less frequent than once every three years. Such analysis should build upon the technologies already identified under the 2015 report and should be expanded to include warranty claim reviews as well as fleet interviews and surveys. [EPA-HQ-OAR-2014-0827-1243-A1 p.17]

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12 Brecher, A., Epstein, A. K., & Breck, A., Review and Analysis of Potential Safety Impacts of and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles, National Highway Traffic Safety Administration, Washington, DC (Report No. DOT HS 812 159, June 2015).

**Organization:** Diesel Technology Forum

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows: [EPA-HQ-OAR-2014-0827-1171-A2 p.5]

- **That it is mindful of the other requirements placed on industry relative to environmental and safety requirements of commercial vehicles:** Unlike passenger cars, commercial trucks must adhere to a number of additional federal and state safety and operational requirements. Provisions that impact fuel economy must not compromise safety or utility of the vehicle. [EPA-HQ-OAR-2014-0827-1171-A2 p.6]

**Organization:** Optimus Technologies

**Biodiesel**



Regarding the comment at 80 FR 40486 (Column 3, Paragraph 5) about issues with biodiesel specifically that biodiesel has “presented some operational safety concerns dependent on blending fraction, such as material compatibility, bio-fouling sludge accumulation, or cold-weather gelling,” Optimus Technologies would like the EPA and NHTSA to be aware of Optimus’ biodiesel conversion system which is retrofitted onto diesel vehicles (for which Optimus has achieved EPA compliance) and eliminates the problems with material compatibility and cold-weather gelling. [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

**Response:**

Thank you the comment. The conversion systems would need to be considered by the manufactures as an alternative technology as they have internal vehicle requirements for packaging, quality, serviceability and other factors. Safety and legal requirements of this technology would need to be addressed during complete system testing. The testing methods of each manufacturer are proprietary and provisioned to different vehicle applications.

### 11.14 Consumer Impacts

**Organization:** Amy's Kitchen et al.

Strong standards will be good for businesses, the trucking industry and American consumers. Importantly, the financial benefits of strong standards will be significantly greater than the costs. These lower life cycle costs will start accruing as soon as the first new trucks enter into service. In fact, trucking will see lower life cycle costs right away and these savings will grow to \$0.21 cents a mile in 2040;<sup>x</sup> that is an annual savings potential of more than \$25 billion.<sup>xi</sup> [NHTSA-2014-0132-0232-A1 p.2]

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x Lowell, D., EPA/NHTSA Phase 2 Fuel Efficiency and Greenhouse Gas Standards for Heavy-Duty Trucks: Projected Effect on Freight Costs, MJ Bradley & Associates. April 2014.

xi Ceres, Environmental Defense Fund. Report confirms cleaner, fuel efficient freight trucks yield big savings over the long haul. Ceres. Ceres and EDF, June 2015. Web. 17 Feb. 2016. <http://www.ceres.org/industry-initiatives/transportation/truck-standards-fact-sheet> Assumes 120 billion freight miles a year.

**Organization:** Business for Innovative Climate & Energy Policy

In turn, these benefits would accrue to consumers and the greater economy; under stricter standards, the average U.S. household stands to save \$250 per year in lower priced goods.<sup>3</sup> [NHTSA-2014-0132-0095-A1 p.1-2]

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3 Cooper, Mark Dr. and Gillis, Jack. “The Consumer Benefits of Increasing the Fuel Economy of Medium and Heavy Duty Trucks.” The Consumer Federation of America. February 2014. Web. <http://www.consumerfed.org/pdfs/Paying-the-Freight.pdf>

**Organization:** Clean Fuels Ohio (CFO)

EPA also has suggested that the proposed rule will help bring down the costs of transporting goods, with the average household saving \$150 a year by 2030, assuming the savings and costs are passed through to consumers. [EPA-HQ-OAR-2014-0827-1192-A1 p.2]

**Organization:** Consumer Federation of America (CFA)

As discussed below, the fuel consumption of medium and heavy duty trucks is an important consumer issue and the performance standard approach taken by the agencies is exactly the right approach. Our technical expertise is not in the design and construction of these consumer durables, it is in the design and implementation of minimum energy standards focusing on their impact upon consumers. We believe that knowing how to build an effective standard is at least as important to arriving at a successful energy saving outcome as knowing how to build a consumer durable. Moreover, although we do not claim expertise in the technical design of consumer durables, we do claim expertise in the economic analysis of technologies. Our analysis combines a review of the technical economic studies prepared by others and evidence on the market performance of heavy duty trucks to determine whether there are significant potential consumer savings that would result from a higher standard. [EPA-HQ-OAR-2014-0827-1336-A1 p.7-8]

## **B. APPROACH AND OUTLINE**

We approach the setting of standards from a uniquely consumer point of view,<sup>4</sup> always starting from a series of basic questions: [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

- Will a standard save consumers money? If there appears to be potential savings, we ask: [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

- Why is there an efficiency gap that appears to impose unnecessary costs on consumers? If we find market imperfections that prevent the efficiency gap from being closed and cost savings from being realized, we then ask: [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

- Is a standard an appropriate policy and, if so, how can the standard be best designed to achieve the goal of lowering consumer cost? If a standard seems to be a good option, we then ask: [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

- Does the proposed standard do a good job? Here we evaluate the standard EPA/NHTSA has proposed against the answers to the first three questions. [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

These comments are divided into five sections. We answer the first question above in two steps. First, in Section II, we estimate the amount and cost of fuel consumed by the medium and heavy duty trucks subject to the proposed rule compared to the amount of money households pay for gasoline and electricity, which is the second largest home energy cost. [EPA-HQ-OAR-2014-0827-1336-A1 p.8]

Then, in Section III, we show that consumers are very likely to “Pay the Freight. Household budgets bear the burden of truck fuel costs indirectly in the cost of goods and services they buy. As a result, the Phase II rule deserves close attention from the consumer point of view. [EPA-HQ-OAR-2014-0827-1336-A1 p.9]

## **II. THE CONSUMER STAKE IN THE FUEL USE OF HEAVY DUTY TRUCKS**

Over the past decade public opinion polling by the Consumer Federation of America and other organizations has revealed strong and widespread support for energy efficiency standards for consumer durables including automobiles and household appliances.<sup>6</sup> Because gasoline and electricity bills are such a large part of household annual expenses – currently about \$2,600 for gasoline and over \$1400 for electricity<sup>7</sup> — it is not surprising that polls consistently elicit this support. Consumers clearly feel the

pain in their pocketbooks and understand the economic impact of those energy costs on their household budgets. [EPA-HQ-OAR-2014-0827-1336-A1 p.9-10]

Economic analysis has shown that there is a sound basis for consumer support of energy efficiency standards.<sup>8</sup> Although energy saving technologies require an investment, when they lower energy bills by more than their cost, the result is ultimately net savings to consumers. [EPA-HQ-OAR-2014-0827-1336-A1 p.10]

While direct household expenditures on personal energy consumption are significant, they are only part of the consumer's expenditures on energy. Consumers also pay indirectly for the energy consumption in the commercial and industrial sectors through the prices of goods and services. As shown in Figure I-1, the total residential energy consumption represents just over one-third of total national energy consumption. In other words, almost two thirds of the nation's energy consumption takes place in the production and distribution of goods and services and the costs incurred are recovered in the prices of those goods and services. [EPA-HQ-OAR-2014-0827-1336-A1 p.10]

[Figure I-1, 'Energy consumption in the residential, commercial and industrial sectors' can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

In fact, these comments show that indirect freight truck fuel costs passed on to consumers are about half as large as direct gasoline expenditures and almost equal to household electricity bills. [EPA-HQ-OAR-2014-0827-1336-A1 p.11]

Consumers recognize that when fuel prices rise, so does the cost of consumer goods due to the cost of transporting those goods. Conversely, because of competition, a reduction in transportation costs will result lowering the cost of goods and services for consumers. Reducing the energy consumption of medium and heavy duty trucks will reduce household expenditures by lowering the cost of all goods and services. Therefore, the rulemaking currently underway regarding medium and heavy duty truck fuel consumption deserves close scrutiny and support from consumers and consumer advocates. This section examines the costs of energy used by medium and heavy duty trucks and the positive impact increased truck<sup>9</sup> fuel efficiency can have on America's households. [EPA-HQ-OAR-2014-0827-1336-A1 p.11]

In this section we estimate the potential size of the indirect consumer expenditure. In the next section, we discuss the evidence that the costs are passed through to consumers and survey evidence that shows the public understands the impact of transport costs on their pocketbooks and the role of truck fuel economy standards in alleviating the burden. [EPA-HQ-OAR-2014-0827-1336-A1 p.11]

#### A. HOUSEHOLD EXPENDITURES FOR MEDIUM AND HEAVY DUTY TRUCK FUEL

Expenditures for transportation fuels, whether direct or indirect, are the result of the amount of energy consumed and the price of that energy. [EPA-HQ-OAR-2014-0827-1336-A1 p.11]

To estimate the potential consumer savings from improvements in the fuel economy of trucks, we first estimated the fuel used by the three main vehicle categories (household light duty, commercial light duty, and medium-heavy duty trucks). We undertake this analysis because different organizations that analyze energy use slightly different categorizations of energy use by different types of vehicles, and we want to make clear how we arrived at our figures. However, because light duty vehicles, which make up the vast majority of households vehicles, are already covered by CAFE standards, we do not include them in our analysis. We have been careful not to double count energy light duty consumption in our

estimate of indirect household expenditures on medium and heavy duty transportation fuel. [EPA-HQ-OAR-2014-0827-1336-A1 p.12]

Table II-1 (below) shows three different approaches to estimating household gasoline consumption. We used several data sources to build our estimate: EIA Residential Consumption Survey, the Department of Transportation's, National Household Transportation Survey; the Energy Information Administration's Annual Energy Outlook; the Bureau of Labor Statistics' Consumer Expenditure Survey; and the U.S. Department of Transportation's, Bureau of Transportation statistics each of which estimates fuel usage by types of vehicles. [EPA-HQ-OAR-2014-0827-1336-A1 p.12]

[Table II-1, 'three methodologies for estimating the indirect, aggregate, annual household consumption of transportation energy', can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

The 2009 calculation compares an estimate based on the Bureau of Labor Consumer Expenditure Survey to an estimate based on the National Household Transportation Survey, both for 2009. Using each of the estimates, we divided the household expenditure by the average price per gallon to arrive at the number of gallons per household. We then multiplied the household consumption by the total number of households. The National Household Transportation Survey estimates the total number of vehicle miles traveled by households. We divided this by the average miles per gallon of the light duty vehicle fleet to arrive at the amount of gasoline consumed. These two estimates are quite close. [EPA-HQ-OAR-2014-0827-1336-A1 p.13]

The 2010 estimate is based on EIA data that identifies the amount of energy consumed by automobiles and light duty vehicles, medium duty vehicles and heavy duty trucks. The EIA data does not separate out household and commercial use of light duty vehicles, so we used the Consumer Expenditure Survey from the Bureau of Labor Statistics to estimate the gasoline consumed by households. We subtracted this from the total for light duty vehicles, as reported in the Annual Energy Outlook, to determine the amount of energy consumed by light duty vehicles that is not consumed by households. We call this commercial light duty. [EPA-HQ-OAR-2014-0827-1336-A1 p.13]

As shown in Table II-1, this approach provides an estimate that is consistent with the Department of Transportation data, which categorizes vehicles by axle length and the number of tires. Again, the estimates are quite close, although they are lower than the estimate for 2009. There was a decrease in consumption between 2009 and 2010 in the aggregate consumption. The consistency of this data provides us with a substantial level of confidence in the amount of medium and heavy duty truck fuel we use for our calculations. [EPA-HQ-OAR-2014-0827-1336-A1 p.13]

Table II-2 applies the BLS/EIA approach from Table II-1 to the data for 2013 and 2014.<sup>10</sup> We prefer this approach since it can be updated easily. As a result, for 2013, we estimate 92 billion gallons of household gasoline consumption and 43 billion in medium and heavy duty truck consumption. We reduce the freight truck consumption by 11% to account for exports, since their cost burden would not fall on consumers. [EPA-HQ-OAR-2014-0827-1336-A1 p.14]

[Table II-2, 'Household expenditures', can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

This confirms the conclusion we reached in our earlier analysis.<sup>11</sup> We estimate 730 direct gallons per household and 300 indirect gallons of diesel fuel consumption. Keeping in mind that diesel prices were 10% higher than gasoline prices in 2013, for every dollar that consumers spend on household gasoline, they spend about \$0.47 on freight transport fuel consumption. At an annual cost of nearly \$1,200,

households spend almost as much on freight truck fuel as they do on electricity. [EPA-HQ-OAR-2014-0827-1336-A1 p.15]

## B. FUTURE HOUSEHOLD EXPENDITURE TRENDS

Any cost/benefit analysis of a proposed standard must be forward looking and factor in expected costs at the time of implementation. As shown in Figure II-2, the EIA projects lower prices for both gasoline and diesel in 2020, followed by a steady increase in prices to 2030. The Figure shows both “real” prices, which are adjusted to compensate for inflation and actual expected prices. The EIA, which is the primary source that government agencies use for future pricing, projects diesel prices to rise slightly faster than gasoline prices, which has been the trend for the past decade. [EPA-HQ-OAR-2014-0827-1336-A1 p.15]

[Figure II-2, 'future prices, real and discounted', can be found on p.15 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Figure II-2 also shows the effect of “discounting” future prices. The reason to discount is that the use of money has value. It could have been put to other uses and earned a return. The standard discount rates established by the Office of Management and Budget (OMB) for regulatory analysis are 3% for the consumer discount rate and 7% for the producer discount rate.<sup>12</sup> In our analysis of the proposed rule, we use the consumer discount rate of 3%. [EPA-HQ-OAR-2014-0827-1336-A1 p.16]

As large as current household spending is on transportation fuel used by medium and heavy duty trucks, it will become even larger in the future. Going forward, the new CAFE requirements will lower the household impact of fuel costs associated with consumer and commercial light duty vehicles. On the other hand, without some controls, the burden on households due to medium and heavy duty truck fuel costs will only increase both absolutely and relative to their direct expenditures on gasoline. Figure II-3 shows that, historically, the fuel economy of medium-heavy duty trucks has not increased. [EPA-HQ-OAR-2014-0827-1336-A1 p.16]

[Figure II-3, 'motor economy 1949-2011', can be found on p.16 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

The most recent Annual Energy Outlook from the EIA, incorporating the new fuel economy standard for light duty vehicles, projects a substantial decline in fuel consumption as a result of increasing fuel economy standards, as shown in the top graph of Figure II-4. [EPA-HQ-OAR-2014-0827-1336-A1 p.17]

[Figure II-4, 'Trends in fuel economy and consumption mileage by vehicle type expected mpg', can be found on p.17 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

As shown in the bottom graph of Figure II-4, fuel consumption of light duty vehicles (and therefore household gasoline) is projected to decline because the increase in fuel economy is larger than the expected increase in miles driven.<sup>13</sup> On the other hand, in spite of the recently adopted truck standard (2014), the EIA projected MPG for these vehicles to remain flat. As the use of these vehicles increases, the lack of MPG improvement and rising fuel prices will significantly increase fuel costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.18]

Without long-term standards for freight trucks, fuel consumption of trucks is projected to increase because fuel economy improvements will not keep up with increasing demand for freight services.

Within 20 years, taking the price difference between gasoline and diesel into effect, the gap between direct and indirect household expenditures on transportation energy will narrow considerably. As show above, today, the burden imposed indirectly on household budgets by truck fuel consumption equals about half the burden imposed directly by gasoline consumption. Without stronger fuel economy standards for trucks, that burden will grow to 80% of the future gasoline burden because the current light duty standard will drive down consumption. [EPA-HQ-OAR-2014-0827-1336-A1 p.18]

This analysis of the indirect cost burden that medium and heavy duty trucks place on household budgets indicates that consumers have a big stake in the Phase II rule. [EPA-HQ-OAR-2014-0827-1336-A1 p.18]

### III. COMMERCIAL FUEL COSTS ARE PASSED THROUGH TO HOUSEHOLDS

#### A. A COST OF DOING BUSINESS

While we have calculated the size of fuel expenditures on a per household basis, we must ask, “do households actually pay these costs?” To a large degree, the answer is “Yes.” These costs are just like any other commercial costs in the economy. When a farmer pays for fertilizer or the delivery driver gets his paycheck, these business costs are recovered in the price of the related goods and services. The same is true with fuel costs. In fact, the Mid-Atlantic Freight Coalition confirms the pass-through of transportation costs in a report on how transportation and logistics consume a significant portion of household budgets. According to the report, [EPA-HQ-OAR-2014-0827-1336-A1 p.19]

“the freight logistics system costs nearly \$4,500 per person, which is spent moving and warehousing goods. This \$4,500 factors into the cost of every product we buy. Anything that industry or government can do to make the logistics system more efficient will return benefits in terms of lower cost and greater global competitiveness.”<sup>14</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.19]

Although this estimate of the size of the expenditure on freight logistics includes all transportation modes (truck, rail, barge, etc.) and all costs, (equipment, maintenance, salaries, etc.), it acknowledges the importance of transportation costs to the economy which includes truck fuel costs. In addition to the pass-through of these costs to consumers, there is the significant dependence on foreign sources for this fuel. Imported petroleum now makes up just under half (48%) of the total U.S. product supplied,<sup>15</sup> which is a drain on the U.S. economy. [EPA-HQ-OAR-2014-0827-1336-A1 p.19]

While the recognition that transportation costs are paid by consumers is obvious, the concept is reinforced by two observations: First, although transportation costs are a small part of the total economy (just under 3%), they are as large or larger, than several other sectors, including agriculture, mining, utilities and construction (see Figure III-1). It is widely recognized that those costs are passed on to consumers. [EPA-HQ-OAR-2014-0827-1336-A1 p.19]

[Figure III-1, 'gross domestic product by sectors', can be found on p.19 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Second, fuel costs are the single largest component of transportation costs, representing over one-third of the total transportation costs (see Figure III-2). Fuel costs are slightly larger than driver pay and three times as large as the cost of owning and insuring the truck. As transportation costs are passed through to consumers, fuel is the largest component of that pass through. There is certainly no reason to believe that fuel costs are less likely to be recovered from consumers than drivers' wages or owners' capital costs. [EPA-HQ-OAR-2014-0827-1336-A1 p.20]

[Figure III-2, 'average truck operation costs', can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

## B. ECONOMETRIC MODELS DEMONSTRATE THE PASS-THROUGH NATURE OF TRANSPORTATION FUEL COSTS

The economic reality of the flow through to consumers of transportation fuel costs is reflected in the way econometric models describe the growth of the economy. Such models are built on input/output tables, and transportation costs are a significant input in the models. In building these models, the pass-through of transportation costs is assumed, since transportation plays a fundamental role in the overall cost of production. [EPA-HQ-OAR-2014-0827-1336-A1 p.21]

Transportation is an economic factor of production of goods and services, implying that relatively small changes can have substantial impacts on costs, locations and performance...[EPA-HQ-OAR-2014-0827-1336-A1 p.21]

Transport also contributes to economic development through job creation and its derived economic activities. Accordingly, a large number of direct (freighters, managers, shippers) and indirect (insurance, finance, packaging, handling, travel agencies, transit operators) employment are associated with transport. Producers and consumers make economic decisions on products, markets, costs, location, prices which are themselves based on transport services, their availability, costs and capacity.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1336-A p.21]

The importance of transportation in these economic models is reflected in the high multiplier it is given. In order to build a model of the economy, analysts study the places where a sector purchases inputs and sells output. Typically, the more places that are touched by a sector, the larger its multiplier. Because most economic models are built on the flow of goods and services through the economy, they depend on the geographic scope and nature of activity within the economy being modeled. Transportation is generally seen as a central input to measuring broader economic activity. To further reinforce the impact of transportation costs on consumer pocketbooks, Figure III-3 presents the sector multipliers for the state of California. [EPA-HQ-OAR-2014-0827-1336-A1 p.21]

[Figure III-3, 'Sector Multipliers for the California Economy', can be found on p.22 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

Transportation has the 20th largest multiplier, in a study of 60 California sectors. Not only is the transportation cost multiplier above average, but it is substantially larger than the multipliers related to petroleum production. [EPA-HQ-OAR-2014-0827-1336-A1 p.22]

In modeling the impact of higher fuel economy with these econometric models, it is important to understand certain market factors. As the cost of transportation declines, demand for transportation increases because the demand for goods and services increases due to their lower costs. In addition, as the population and economy grows, the need for commercial transportation increases as well. Nevertheless, the fuel savings from greater efficiency are much larger than the increase in consumption. The net effect is to reduce expenditures on fuel as a percent of total output. In fact, the reduction in energy consumption may be so large that the absolute level of consumption is lowered. This has a positive effect on the economy. We consume less petroleum products and more of other goods and services. Because those other goods and services have bigger multipliers, the economy expands. So it is clear that the passthrough to consumers of truck fuel costs is important for both energy policy and economic policy. [EPA-HQ-OAR-2014-0827-1336-A1 p.22]

## C. PUBLIC OPINION

Since we have been able to demonstrate that these fuel costs are considerable and, in fact, likely to be passed on as indirect costs to households, we should not be surprised to find that consumers understand that fact (see Figure III-4). [EPA-HQ-OAR-2014-0827-1336-A1 p.23]

Two recent Consumer Federation of America surveys, found that the vast majority of consumers (over 90%) understand that “some, most, or all” of the fuel costs of heavy-duty trucks, which transport virtually every consumer good, are passed on to consumers, as shown in the upper graph of Figure III-4. In fact, over 55 percent believe that “all or most” of these costs are passed on to the consumer. [EPA-HQ-OAR-2014-0827-1336-A1 p.23] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.237.]]

In both of the CFA surveys, consumers clearly understood the possibility of these savings as nearly three quarters of the respondents favored requiring truck manufacturers to increase the fuel economy of large trucks (see the lower graph in Figure III-4).<sup>17</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.23]

[Figure III-4, 'Consumer Attitudes about freight fuel costs and standards', can be found on p.23-24 of docket number EPA-HQ-OAR-2014-0827-1336-A1]

### 2. Pass-through

A second theoretical explanation that played an important part in the earlier analysis and was addressed by EPA/NHTSA is the question of the pass-through of cost savings to consumers. [EPA-HQ-OAR-2014-0827-1336-A1 p.51] [This comment can also be found in section 11.5 of this comment summary.]

As a result of this proposed rulemaking, it is anticipated that trucking firms will experience fuel savings. Fuel savings lower the costs of transportation goods and services. In a competitive market, some of the fuel savings that initially accrue to trucking firms are likely to be passed along as lower transportation costs that, in turn, could result in lower prices for final goods and services. Some of the savings might also be retained by firms for investments or for distributions to firm owners. Again, how much accrues to customers versus firm owners will depend on the relative elasticities of supply and demand. Regardless, the savings will accrue to some segment of consumers: Either owners of trucking firms or the general public, and the effect will be increased spending by consumers in other sectors of the economy, creating jobs in a diverse set of sectors, including retail and service industries.<sup>41</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.51-52] [This comment can also be found in section 11.5 of this comment summary.]

The pass-through issue also turns up in another key aspect of the overall analysis, the rebound effect. The increase in consumption associated with the rebound effect occurs because consumers have more money to spend. The first effect is through the reduction of the cost of travel, but there is a second effect through the increase in disposable income available for other consumption. [EPA-HQ-OAR-2014-0827-1336-A1 p.52] [This comment can also be found in section 11.5 of this comment summary.]

Elasticities with respect to fuel price and fuel cost can provide some insight into the magnitude of the HDV VMT rebound effect.... Freight price elasticities measure the percent change in demand for freight in response to a percent change in freight prices, controlling for other variables that may influence freight demand such as GDP, the extent that goods are traded internationally, and road supply and capacity. This type of elasticity is only applicable to the HDV subcategory of freight trucks (i.e., combination tractors and vocational vehicles that transport freight). One desirable attribute of such



measures for purposes of this analysis is that they show the response of freight trucking activity to changes to trucking rates, including changes that result from fuel cost savings as well as increases in HDV technology costs. Freight price elasticities, however, are imperfect proxies for the rebound effect in freight trucks for a number of reasons. For example, in order to apply these elasticities we must assume that our proposed rule's impact on fuel and vehicle costs is fully reflected in freight rates. This may not be the case if truck operators adjust their profit margins or other operational practices (e.g., loading practices, truck driver's wages) instead of freight rates. It is not well understood how trucking firms respond to different types of cost changes (e.g., changes to fuel costs versus labor costs).<sup>42</sup> [EPA-HQ-OAR-2014-0827-1336-A1 p.52] [This comment can also be found in section 11.5 of this comment summary.]

These observations make it clear that there is a significant level of pass-through of cost savings. Given the competitiveness of the trucking industry and its importance, we believe it is substantial. EPA/NHTSA conclude that there will be pass-through, but they do not provide an estimate. Their estimate of the rebound effect is moderate – 10% – based on a variety of factors. We have discussed this earlier. Given the very large economic benefits, the magnitude of the rebound effect does not significantly affect the bottom line of the analysis. Without specifying the precise level, it is clear that pass-through is significant and has important macroeconomic benefits. [EPA-HQ-OAR-2014-0827-1336-A1 p.52-53] [This comment can also be found in section 11.5 of this comment summary.]

## VII. STRIKING THE BALANCE BETWEEN FUEL SAVINGS AND FEASIBILITY

In this section we examine the challenge of striking a balance between achieving the maximum energy savings/emissions reductions and the constraints of feasibility. Failing to achieve the maximum economically beneficial savings imposes a direct and significant harm on consumers – they are forced to pay too much for the goods and services that they consume. Mandating technologies that are infeasible will drive up costs and ultimately cause the performance standards to fail. These two considerations deserve equal weight, particularly in a sector where efficiency improvements have been largely flat, while the rest of the economy has been improving dramatically. The “burden of proof” established by the underlying statutes does not favor one concern over the other and leaves the agencies a great deal of discretion. [EPA-HQ-OAR-2014-0827-1336-A1 p.58]

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4 Appendix A is a presentation to the California Energy Commission's Energy Academy that summarizes the analytic framework (Mark Cooper, “Energy Efficiency Performance Standards: Driving Consumer and Energy Savings in California, February 20, 2014). Appendix B (Mark Cooper, Energy Efficiency Performance Standards: The Cornerstone of Consumer-Friendly Energy Policy, October 2013) provides our comprehensive review of the literature and the detailed analytic framework we have developed to examine performance standards.

6 Mark Cooper, 2013, Energy Efficiency Performance Standards: The Cornerstone of Consumer-Friendly Energy Policy, Consumer Federation of America, presents an extensive bibliography of survey analysis by the Consumer Federation of America and other consumer groups.

7 Based on Bureau of Labor statistics, Consumer Expenditure Survey, for 2013 and 2013-2014

8 Cooper, 2013

9 For the purposes of simplicity, in this paper, we will refer to medium and heavy duty trucks as ‘freight trucks’.

10 We estimate 2014 based on total products supplied and average price for the year, assuming a 1% increase in the number of households and constant consumption per household. This is consistent with the difference between the 2013 Consumer Expenditure Survey and the mid-year 2014 Consumer Expenditure Survey. While price is down 3% between 2014 and 2013, expenditures are down 1.5% in the year July 2013-July 2014. By the end of the year we would expect the increase in consumption stimulated by declining prices to be offset by the decrease in consumption reflecting more fuel efficient vehicles and the underlying trend. For diesel, we divide the total expenditures by the estimated number of households.

11 Mark Cooper and Jack Gillis, Paying the Freight: The Consumer Benefits of Increasing the Fuel Economy of Medium and Heavy Duty Trucks, Consumer Federation of America, February 2014.

12 EPA/NHTSA, PHASE II NOPR, p. 40434, PHASE II RIA, p.8-1. The benefits and costs of these rules are analyzed using 3 percent and 7 percent discount rates, consistent with current OMB guidance. These rates are intended to represent consumers’ preference for current over future consumption (3 percent), and the real rate of return on private investment (7 percent) which indicates the opportunity cost of capital. However, neither of these rates necessarily represents the discount rate that individual decision-makers use. The program may also have other economic effects that are not included here.

13 Population growth will increase vehicles on the road and overall miles driven.

14 Mid-America Freight Coalition “The Economic Importance of Freight,” p. 2.

15 EIA, Monthly Energy Review, August 2015, Table 3.1.

16 Transportation and Economic Development Authors: Dr. Jean-Paul Rodriguez and Dr. Theo Notteboom, <http://people.hofstra.edu/geotrans/eng/ch7en/conc7en/ch7c1en.html> , A regional analysis reinforces this observation, Oregon, Transportation, Plan Update, Transportation and the Economy Manufacturing is dependent on transportation to receive raw materials and to deliver its products. Manufacturing is usually a highly competitive activity. Unless an area has other low cost attributes, high transportation costs will cause manufacturers to leave or avoid that area

17 Both surveys were conducted by ORC International, and in each poll ORC surveyed over a thousand Americans with an error rate of +/- 3%.

41 EPA/NHTSA, NPRM, p. 40482

42 EPA/NHTSA, NPRM, p. 40450, 40451.

**Organization:** Edison Solar Inc.

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

- Fuel savings will help bring down the costs of transporting goods, with the average household saving \$150 a year by 2030, assuming the savings and costs are passed through to consumers. [EPA-HQ-OAR-2014-0827-1176-A1 p.2]

**Organization:** Environmental Defense Fund (EDF)

Consumers also stand to benefit from a strong rule. The average United States household pays more than \$1,100 a year to fuel heavy trucks as companies pass some of their fuel costs on to customers.<sup>81</sup> The Consumer Federation of America found that more robust Phase 2 standards could deliver as much as \$400 in savings to an average household annually on services and goods by 2035.<sup>82</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.18]

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81 Consumer Federation of America (CFA), *Paying the Freight: The consumer benefits of increasing the fuel economy of medium and heavy-duty trucks*, (2014), available at <http://www.consumerfed.org/pdfs/Paying-the-Freight.pdf>.

82 Id.

**Organization:** Hoosier Environmental Council

Furthermore, such savings (at the aggregate) will inevitably translate into savings for Indiana residents in terms of the cost of their goods. [EPA-HQ-OAR-2014-0827-1245-A1 p.1]

**Organization:** Illinois Public Interest Research Group (PIRG)

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 254.]

Strong emission standards for heavy duty vehicles will save consumers money. According to the National Resource Defense Council and their partner organizations that have researched these standards, consumers will save more money by the decrease of the use of oil and the use of efficiency technology.

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

Importance of the Motor Vehicle Sector

The United States' motor vehicle sector is large, profitable and competitive. The domestic motor vehicle industry is vital to the U.S. economy and it is imperative that we remain strong and competitive. Nearly 900,000 people worked in auto and auto-parts manufacturing alone. When jobs from other sectors that are dependent on the industry are included, the auto industry is responsible for 7.25 million jobs nationwide, or about 3.8% of private-sector employment. The industry generates tens of billions in tax revenues across the country. [EPA-HQ-OAR-2014-0827-1248-A2 p.3]

The motor vehicle industry is in many ways the cornerstone of our manufacturing sector. The economic impact of the standards on the entire supply chain must be taken into account when analyzing the proposed regulations. [EPA-HQ-OAR-2014-0827-1248-A2 p.3]

The current proposal is expansive and complex. The impact of costs associated with development and production costs should be taken into account while drafting the final rule, including any costs associated with disruption of program and capital cycles. It also covers a lengthy period of time as the proposed regulations would be in effect until 2027. Regulatory certainty is an essential part of the industry's ability to develop and market new advanced technologies and maintain product cycles meeting stringency requirements. [EPA-HQ-OAR-2014-0827-1248-A2 p.7]

**Organization:** Investor Network on Climate Risk

Furthermore, strong standards would also benefit consumers and the economy; as operating costs come down due to more fuel-efficient trucks, consumers will see cost savings, which in turn will be reinvested in the broader economy. Under strong standards, the average U.S. household stands to save \$250 per year in lower-priced goods.<sup>3</sup> [NHTSA-2014-0132-0113-A1 p.2]

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3 Cooper, Mark Dr. and Gillis, Jack. "The Consumer Benefits of Increasing the Fuel Economy of Medium and Heavy Duty Trucks." The Consumer Federation of America. February 2014. Web. <http://www.consumerfed.org/pdfs/Paying-the-Freight.pdf>

**Organization:** Mass Comment Campaign sponsored by the Pew Charitable Trusts (web) - (4,452)

When businesses spend more on fuel, the cost is passed along to consumers through purchased goods and services. According to the Consumer Federation of America, goods and services delivered by medium- and heavy-duty trucks cost each U.S. household \$1,100 in 2010. Assuming the fuel savings from the new standards were passed along to consumers through the reduced cost of transported goods, American families could save an extra \$150 a year by 2030. [EPA-HQ-OAR-2014-0827-1252-A1 p.1]

**Organization:** Midwest Truckers Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 267.]

we look forward to the next step in this rulemaking process and have been encouraged to see a rule that can not only be an improvement for the environment, but also result in potential cost savings for these truck operators. And, of course, then that's passed onto the consumer, who could benefit from the fact that lower fuel consumption means less overhead costs. [This comment can also be found in section 1.1 of this comment summary]

**Organization:** National Ready Mixed Concrete Association (NRMCA)

NRMCA holds concerns with a number of specific issues in the joint EPA/NHTSA proposal. NRMCA believes more attention should be placed on costs that inevitably will filter to downstream consumers of new heavy-duty trucks. [EPA-HQ-OAR-2014-0827-1146-A1 p.2]

**Organization:** Quasar Energy Group

Because truck fuel consumption is so great (and growing), the benefits of improving truck fuel efficiency are also great (and growing): [EPA-HQ-OAR-2014-0827-1335-A1 p.1]

Fuel savings will help bring down the costs of transporting goods, with the average household saving \$150 a year by 2030, assuming the savings and costs are passed through to consumers. [EPA-HQ-OAR-2014-0827-1335-A1 p.2]

**Response:**

Most of these commenters (Amy's Kitchen et al., Business for Innovative Climate & Energy Policy (BICEP), CFO, CFA, Edison Solar, EDF, Hoosier Environmental Council, Illinois PIRG, Investor Network on Climate Risk (INCR), Mass Comment Campaign sponsored by the Pew Charitable Trusts (Pew), Midwest Truckers Association, Quasar Energy Group) state that the standards will save consumers money, with estimates ranging from \$150 per year by 2030 (DFO, Edison Solar, Pew, Quasar Energy Group), to \$250 per year in an unspecified year (BICEP, INCR) to \$400 in 2035 (EDF). CFA estimates that households spend about \$1,200 per year on freight vehicle fuel, but do not in their comments provide an estimate for the savings per household from implementation of the standards. The agencies have not estimated the per-household savings. Preamble Section IX.M. includes estimates of the payback period for MY 2027 vehicles. For HD pickups and vans, the payback period is in the third year of ownership; it is in the fourth year of ownership for vocational vehicles; and early in the second year for tractors/trailers.

CFA argues that the full net benefits of the standards will be passed along to households. As discussed in Preamble IX.L.3.c, the agencies do not take a position on whether the savings will be passed along fully to households, or whether some of those savings will instead either be retained by firms for investment, or distributed instead to firm owners. Regardless, the net savings will accrue to some segment of consumers, and we expect that there will be increased spending in other sectors of the economy. We agree with CFA that stronger GHG/fuel economy standards will reduce fuel consumption relative to the reference case.

CFA also notes the relatively high multiplier for transportation in California as a measure of the importance of transportation in economic activity. Multipliers, such as those used in input-output models, assume fixed relationships between inputs and outputs; they do not allow for substitution effects due to changes in prices, either for inputs or for outputs. They may provide a reasonable approximation of short-run effects for a small region or sector, where substitution effects may not be very large, but they may be less suited for national-scale policies over time, where market adjustments are more likely.<sup>228</sup>

As discussed in Preamble Section IX.L.2. and RIA Chapter 8.11.2.2, the agencies have used various factors to estimate the effects on employment specifically of the increased costs due to the new standards (employment due to substitution effects). As described there, these are the expected employment requirements in the directly regulated sector per \$1 million in expenditures in that sector; they do not include multiplier effects in other sectors. We focus on the directly regulated sector because it is likely to be the most strongly affected, and because other sectors typically are not solely reliant on the regulated sector, and thus are likely to be more difficult to model well.

The International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) notes the importance of the motor vehicle industry to the U.S. economy and asks for recognition of the effects on the supply chain, and investment cycles. The lead-time considerations in the standards are intended to facilitate feasibility throughout the supply chain and over investment

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<sup>228</sup> See, e.g., Berck, Peter, and Sandra Hoffman (2002). "Assessing the Employment Impacts of Environmental and Natural Resource Policy." Environmental and Resource Economics 22: 133-156.

cycles. As UAW recognizes, setting the standards through 2027 provides the industry with the regulatory certainty needed to plan for and achieve these requirements.

The National Ready Mixed Concrete Association (NRMCA) asks that more attention be placed on costs that will affect consumers of new heavy-duty vehicles. As other commenters observe, the fuel savings as well as the up-front vehicle costs will affect the expenses to users of heavy-duty vehicles. The specific impacts on costs to consumers of heavy-duty vehicles will depend on the time period over which the vehicle owners amortize costs and the pass-through of both benefits and costs. Both of these factors will depend on such factors as the market structure in the particular sector and the typical length of ownership of vehicles in that sector

## 12 Natural Gas Vehicles and Engines

This section addresses comments related to emission standards, test procedures, and other regulatory provisions as they relate to natural gas vehicles and engines. This section also addresses comments related to economic and environmental issues related to natural gas as a market fuel. Some of these issues may also relate to LPG or other alternative fuels. See the rest of this document for issues of general interest that also apply to natural gas and other alternative-fuel vehicles and engines.

### 12.1 General Comments on Natural Gas

**Organization:** American Trucking Associations (ATA)

#### **Natural Gas Vehicle Development and Deployment Must not be Stymied**

Natural gas still remains the most promising alternative fuel available to the trucking sector. The continued interest and investment in both vehicles and infrastructure, both in the public and private sectors, has clearly indicated the potential of natural gas as a transportation fuel. Continued research and improvements in both the efficiency and performance of such vehicles continues to grow. [EPA-HQ-OAR-2014-0827-1243-A1 p.22]

#### **In-Use Natural Gas Fuel Standards Should be Addressed Outside of the Rule**

Several standards organizations currently are in the process of reviewing fuel specifications for natural gas used as a motor fuel and may finalize such a standard in the future. SAE J1616 currently addresses fuel specifications for natural gas motor fuel but is a recommended practice, not a required standard. Based on the current level of discussion and level of usage of natural gas as a transportation fuel it is not clear whether the current discussions will result in any changes to J1616 or a new fuel standard for natural gas. Given that these discussions are currently ongoing, it would be premature for EPA to propose a standard. [EPA-HQ-OAR-2014-0827-1243-A1 p.22]

**Organization:** NGVAmerica

#### **A. In-Use Fuel Specification for Natural Gas. The proposal discusses but does not propose including an in-use fuel standard for natural gas.** [EPA-HQ-OAR-2014-0827-1270-A1 p.2]

NGVAmerica supports the decision by the agencies not to propose an in-use standard for natural gas that is used as a motor fuel. Several standards organizations currently are in the process of reviewing fuel specifications for natural gas used as a motor fuel and may finalize such a standard in the future. SAE J1616 currently addresses fuel specifications for natural gas motor fuel but is a recommended practice, not a required standard. Based on the current level of discussion and level of usage of natural gas as a transportation fuel it is not clear whether the current discussions will result in any changes to J1616 or a new fuel standard for natural gas. Furthermore, most, if not all, natural gas motor vehicle fuel is primarily transported by natural gas pipeline utilities which are subject to regulation by their respective state public utility agencies. Consequently, natural gas quality specifications almost always differ from state to state, and sometimes between gas utilities within the same state, depending upon the sources of the natural gas supplied to these utilities. Given the above circumstances and the lack of consensus on a proper in-use standard, it would be premature for EPA or NHTSA to propose a standard. [EPA-HQ-OAR-2014-0827-1270-A1 p.2]

## Response

and NGV America, this final rulemaking does not contain any natural gas fuel quality regulations for the natural gas consumed by the transportation sector. Such regulations were not proposed.

**Organization:** Autocar, LLC

Autocar has worked hard to support emissions reduction consistent with EPA's and NHTSA's objectives. Across all three of its product lines, Autocar has aggressively embraced next-generation clean engine technology. Over the past five years, 50-70% of Autocar's refuse trucks were assembled with compressed natural gas ("CNG") engines or hydrostatic hybrid drive units. No other refuse truck maker's product mix reflects a higher concentration of clean-burning vehicles. Autocar has built and sold more than 6,000 CNG vehicles. The Company has dedicated itself to assembling environmentally-sound products, which are then used in environmentally-sound processes such as recyclables collection and transport of waste to landfills harvesting methane gas, which reduces greenhouse gases and offers a source of renewable energy. [EPA-HQ-OAR-2014-0827-1233-A1 p.6]

4.4.1 CNG and Hybrid Power. As set forth in the introduction to this letter, Autocar is an industry leader in the integration of fuel-efficient CNG engines and hybrid power units<sup>11</sup> in refuse trucks and street sweepers. The positive effects of CNG and hybrid technology on fuel efficiency and pollutant emissions are widely recognized and are acknowledged in the Proposed Regulations. Autocar's applications may be more suited to CNG and hybrid power than other vocational applications. But these sophisticated technologies come with a significantly higher purchase price. Autocar and its customers actively participate in CNG and hybrid incentive programs from coast to coast. These programs have been successful in bridging the cost gap between diesel trucks and CNG or hybrid trucks and infrastructure. We encourage the agencies to build on that proven success and provide additional incentives for the purchase of CNG and hybrid trucks, for Low-speed/Frequent-stop Vehicles as well as other vocational and non-vocational vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.15][This comment can also be found in section 6.4 of this comment summary]

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11 As currently designed for use in refuse vehicles, hybrid technology captures normally-wasted energy from braking, converting that energy into available power to accelerate or drive the vehicle, thus reducing fuel consumption and emissions. Testing methodologies for this technology must accommodate the braking, load and terrain factors that are integral to measuring the gains derived from hybrid refuse vehicles. Dynamometer testing will not demonstrate actual improvements in GHG emissions and fuel consumption.

## Response

The agencies have adopted interim provisions that allow the potential for small manufacturers like Autocar to generate Phase 1 credits for producing natural gas vehicles. See Chapter 6.3 for responses to comments on applying hybrid technologies to vocational vehicles including refuse trucks.

**Organization:** American Gas Association (AGA) et al.

More specifically, our comments pertain to the components of the Proposal that relate to the use of natural gas in our nation's trucks and buses. While natural gas fuels only a small percentage of our



nation's new trucks, this clean, domestic, non-petroleum fuel powers a growing number of trucks and buses in key niches, such as sanitation and solid waste, school and transit buses, urban delivery, port drayage, and, where the fueling infrastructure supports it, long-haul trucking in certain locations. [EPA-HQ-OAR-2014-0827-1223-A1 p.1-2]

We believe our recommendations will have meaningful impacts on the future use of natural gas in the American trucking sector – a sector that delivers reduced greenhouse gas emissions, criteria air pollutants, and operating costs for the companies that deliver our goods and for the public fleets that serve our cities. [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

**Organization:** Clean Energy

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 248-249, 250-251.]

New territory is being blazed as the rule proposes to regulate additional aspects of natural gas vehicles, which will ensure NGBs are providing their lowest emissions possible. These include standards for LNG tank hold times and addressing possible methane emissions from open crank cases.

While we will ultimately defer to tank and engine manufacturers on how best to accomplish the aim of these new regulations, we applaud EPA and NHTSA for addressing these issues that will ensure the elimination of unnecessary methane leaks in engine systems.

Of course, the natural gas industry is not only a pioneer in eliminating the real impacts of mobile source criteria emissions. It is also a leader in finding solutions to reduce greenhouse gas emissions by investing heavily in renewable natural gas space. We would like to thank the EPA for updating the renewable fuel standards to provide an even greater incentive to produce renewable natural gas on par with other cellulosic fuels.

In conclusion, further greenhouse gas reductions from renewable natural gas, which is an ultra-low-carbon fuel, have proven to be the lowest carbon fuel source for heavy-duty class 7 and 8 trucks, outperforming both electric and fuel cell strategies. Combining both the advanced engine technology of natural gas with renewable natural gas blends, and you suddenly have a cost-effective alternative that can deliver power plant-equivalent criteria emissions and superior greenhouse gas performance for the medium- and heavy-duty truck space.

**Organization:** National Waste & Recycle Association

Alternate technology and alternate fuel refuse trucks: Vehicles powered by alternative fuels such as compressed natural gas (CNG) or liquefied natural gas (LNG) are becoming commonplace in our industry. The move toward further adoption of alternative fuel trucks is inexorable. These fuels can lower the fleet's carbon output because they are less carbon-dense. In addition, a very small number of vehicles are powered by methane biofuels produced from landfill gas. Expanded use of these alternative fuels is limited in part by the need to develop a new infrastructure for fuel delivery. All new technologies also face cost considerations. [NHTSA-2014-0132-0071-A1 p.4]

**Organization:** National Automobile Dealers Association (NADA)

The final Phase 2 rule must do more to incentivize the purchase of alternate fuel and new technology vocational trucks and tractors. Natural gas, propane, biofuel, hybrid, and/or plug-in electric vehicles each offer a significant potential for reducing fuel use and GHG's. However, each of these alternatives involves significant cost (\$20,000-150,000 per vehicle), performance, infrastructure, and other concerns. ATD supports the approach initiated in Phase 1 where an advanced technology credit scheme is utilized to promote and reward the in-use adoption of these alternative fuels and new technologies. In addition, the Phase 2 rule should strive to be fuel and technology "neutral," leaving it up to new vehicle customers to determine the technologies and fuels that work best for them. [EPA-HQ-OAR-2014-0827-1309-A1 p.9-10]

**Organization:** City of Lawrence, Indiana

A major beverage company in Lawrence has converted all of their semi-trailers to natural gas from diesel. The transition began in October of 2013 with one tractor. The first eight compressed natural gas tractors travel around 465,000 miles per year delivering beverages to 500 retail locations. The tractors reduce emissions of greenhouse gases by approximately 5 percent, or 266,561 pounds, annually and displace 75,000 gallons of diesel fuel. CNG is also nontoxic, which means the new tractors won't harm Indiana's vast farming lands. They now operate 79 CNG tractors throughout the State of Indiana. [EPA-HQ-OAR-2014-0827-1226-A1 p.1]

### **Response**

As acknowledged by the AGA, SAFE, Clean Energy, the National Waste and Recycle Association, NADA and the City of Lawrence, Indiana comments, natural gas is being used by a small portion of the heavy-duty fleet here in the U.S., and its use could increase in the future. Natural gas likely provides criteria pollutant emission reductions compared to conventional petroleum fuels. However, since the purpose of this rulemaking is to reduce greenhouse gas emissions and fuel consumption, the goal of the agencies is to set fuel-neutral, heavy-duty truck tailpipe greenhouse gas emissions standards which will neither encourage nor impede the possible use of natural gas. This way the market will decide the extent that natural gas will play a role in fueling heavy-duty trucks. In keeping with the tailpipe emissions approach, EPA is further regulating aspects of both the upstream and downstream methane emissions points of the natural gas system in other regulatory actions. Because methane gas from landfills is renewable, it receives a renewable fuel credit under the Renewable Fuels standard. See Chapter 6.3 for responses to comments on applying hybrid and electrification technologies to vocational vehicles. See Chapter 1.4 for responses to comments on advanced technology credits.

**Organization:** National Propane Gas Association (NPGA)

The NPRM proposes many standards regarding greenhouse gas emissions (GHG) and fuel efficiency for medium- and heavy-duty vehicles over 14,000 GVWR. Comments submitted herein are limited to GHG and fuel efficiency standards in relation to liquefied petroleum gas or propane as a vehicular fuel ("autogas"). [EPA-HQ-OAR-2014-0827-1272-A1 p.1]

Propane gas is used in millions of installations nationwide for home and commercial heating and cooking, in agriculture, in industrial processing and as a clean air alternative engine fuel for both over-the-road vehicles and industrial lift trucks. [EPA-HQ-OAR-2014-0827-1272-A1 p.1]

In the NPRM, the agencies detail extensive assessment of gasoline, diesel and natural gas fuels without inclusion of the progress and viability of autogas as an alternative fuel.<sup>1</sup> Autogas offers unique fueling possibilities with potentially substantial economic and environmental advantages. The low carbon

content and high octane rating present a low GHG emission fuel optimum for spark-ignited combustion engines.<sup>2</sup> Comparatively, autogas produces 80 percent less GHG emissions than diesel, which is the common fuel for medium- and heavy-duty vehicles.<sup>3</sup> In addition, the estimated infrastructure development is less expensive than diesel or gasoline.<sup>4</sup> As a by-product of natural gas production, the volume of autogas continues to increase with greater domestic availability of natural gas.<sup>5</sup> To this end, NPGA urges EPA to recognize autogas as an exceptional alternative fuel capable of dramatically improving the environmental impact of vehicle emissions. [EPA-HQ-OAR-2014-0827-1272-A1 p.1-2]

### **Autogas**

The NPRM presents considerable analysis of the features and future potential of natural gas; however, we believe the agencies are remiss in not acknowledging the progress and possibilities of autogas. The agencies recognize the small but developing proliferation of natural gas powered medium- and heavy-duty trucks.<sup>6</sup> The agencies also recognize the potential of natural gas to displace diesel, particularly in regards to heavy-duty trucks.<sup>7</sup> Moreover, the agencies detail and assess the varying infrastructure requirements, engine design and potential emissions concerns of compressed natural gas (CNG) and liquefied natural gas (LNG).<sup>8</sup> [EPA-HQ-OAR-2014-0827-1272-A1 p.2]

We believe that autogas is on a parallel path of expansion and, supported by the environmental and economic advantages,<sup>9</sup> earns equal consideration from the agencies. The absence of its acknowledgement among agencies' regulations and programs, in general, creates an unnecessary hindrance. Relatedly, the agencies recognize that without particular allowances the utilization of natural gas would be jeopardized.<sup>10</sup> We argue that autogas is similarly situated in need, possesses an emissions profile very similar to natural gas and should be treated with equal consideration as natural gas. Autogas serves as a complementary fuel to natural gas that present unique capabilities to displace diesel. [EPA-HQ-OAR-2014-0827-1272-A1 p.2]

The agencies rely on forecasts by the Energy Information Administration (EIA) to evaluate likely fuel trends<sup>11</sup> and, from there, prescribe GHG emissions and fuel efficiency standards that may be achievable beyond the next decade.<sup>12</sup> Review of the latest projections from EIA demonstrate that popularity of autogas is growing, "Consumption of ethane and propane . . . shows the largest increase of all petroleum products in the AEO2015 Reference Case from 2013 to 2040."<sup>13</sup> The Annual Energy Outlook (AEO2015) further predicts a 1.3 percent annual growth rate of autogas over the next twenty years.<sup>14</sup> The report also indicates that autogas use will largely parallel use of natural gas in the transportation field over the next fifteen years.<sup>15</sup> We request that the agencies review the latest data and estimations from EIA in AEO2015, which substantially adjusts trend predictions originally featured in the previous report, specifically in relation to the use of propane in the transportation industry.<sup>16</sup> [EPA-HQ-OAR-2014-0827-1272-A1 p.2]

We also believe that propane has particular characteristics that accentuate and may propel future utilization of dimethyl ether (DME). The agencies generally summarize the advantageous nature of DME as a potential alternative fuel,<sup>17</sup> but the possibilities are somewhat limited due to the lack of necessary infrastructure, engine design and the high costs to supply refueling stations.<sup>18</sup> However, research studies have discovered that blends of propane and DME at varying ratios could provide an optimum alternative fuel.<sup>19</sup> Blends of propane and DME are a marriage of high fuel economy, low emissions and high efficiency.<sup>20</sup> Moreover, only modest modifications of diesel engines are necessary for a DME/propane blend.<sup>21</sup> The agencies briefly summarize the potential benefits of DME in the NPRM,<sup>22</sup> but, in light of the evident advantages propane offers in combination with DME, we believe it is erroneous to omit discussion of incentives to encourage advancements in propane as an alternative fuel. Further to this, NPGA continues to actively pursue research and development for the expanded use

of autogas, particularly in regards to conventionally-fueled (gasoline or diesel) medium- and heavy-duty vehicles that are significant contributors to GHG emissions. [EPA-HQ-OAR-2014-0827-1272-A1 p.2-3]

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1 40 C.F.R. § 86.000-2 (definition of alternative fuel); see also 40 C.F.R. § 86.1803-01 (alternative fuel distinct from natural gas).

2 U.S. Department of Energy, Energy Efficiency & Renewable Energy, Alternative Fuels Data Center, Propane Fuel Basics, [http://www.afdc.energy.gov/fuels/propane\\_basics.html](http://www.afdc.energy.gov/fuels/propane_basics.html).

3 Propane Education & Research Council, Propane Autogas vs. Diesel (2014) <http://www.propane.com/on-road-fleets/case-studies-and-fact-sheets/>.

4 *Id.*; Propane Education & Research Council, Propane Autogas vs. Gasoline (2014) <http://www.propane.com/on-road-fleets/case-studies-and-fact-sheets/>.

5 See Propane Education & Research Council, Propane Autogas vs. Gasoline (2014) <http://www.propane.com/on-road-fleets/case-studies-and-fact-sheets/>.

6 Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2, Notice of Proposed Rulemaking, 80 Fed. Reg. 133, 40138, at 40502 (proposed July 13, 2015) (to be codified at 40 C.F.R. pt. 9, 22, 85, 86, 600).

7 *Id.*

8 *Id.* at 40505

9 *Infra* page 1.

10 *Supra* note 6, at 40510.

11 *Id.* at 40509.

12 *Id.* at 40138.

13 Energy Information Administration, 2015 Annual Energy Outlook 16 (2015).

14 *Id.* at A-4.

15 See *id.*, at Table B.2 Energy Consumption by Sector and Source.

16 *Id.* at E-9. “Jet fuel, motor gasoline and industrial propane use are each about 500 trillion Btu higher in 2040 in AEO2015 than in AEO2014, as a result of update and revisions made in the air transportation model and lower petroleum fuel prices.” *Id.*

17 *Supra* note 6, at 40512. Among the benefits the agencies identify are the ability to store DME in liquid form in ambient temperatures, minimal engine redesign, and much lower global warming potential than methane. *Id.*

18 Id.

19 International DME Association, Frequently Asked Questions, What are the benefits of DME's use as a transportation fuel? <https://www.aboutdme.org/index.asp?bid=234#Q5> (2013).

20 Id.

21 Id.

22 Supra note 6, at 40512

### **Response**

In response to the NPGA and Autogas comments, the focus on diesel fuel and gasoline in the rulemaking is, of course, due to the extent that these fuels are commonly used by heavy-duty trucks today. While there is little natural gas use by heavy-duty trucks today (less than 1 percent), several projections show a large increase in natural gas use because natural gas has been priced much lower than diesel fuel in recent years and is projected to be priced favorably low again in future years. This potentially is a concern because methane, the primary component of natural gas, is a very efficient heat trapping gas which has the potential to exacerbate climate change. For these reasons, we conducted a lifecycle analysis of natural gas trucks and reviewed projections of future use of natural gas use by trucks. See Preamble section XI.B. We concluded there that CNG trucks are estimated to emit less GHG emissions than diesel trucks and that LNG trucks with an average extent of boil-off emissions can have about the same greenhouse gas footprint as diesel trucks (both estimates being dependent on the assumed rate of thermal efficiency of the engines). Even though the Energy Information Administration (EIA) projects increased use of LPG by heavy-duty trucks in the future, because LPG poses a much smaller climate change risk compared to natural gas, we did not conduct a lifecycle analysis of LPG trucks.

### **Organization:** Siemens

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 252.]

And Siemens wishes to encourage the EPA to give high priority to implementing solutions that enable renewable energy, such as decarbonized electricity, to achieve a similar shift in freight emissions, as has been achieved for passenger transport.

### **Organization:** United Parcel Service (UPS)

The proposed rule should recognize the potential carbon advantage of natural gas, especially as renewable natural gas (bio-methane) from landfills and dairy facilities is becoming a viable means of reducing carbon emission of trucks to near zero. To be attractive as a truck fuel, this bio-methane must be 'drop-in' and pipeline quality, so there is no way for the OEM to distinguish which, and how much of each, fuel will be used in the future. Because the low carbon fuel standard is making renewable natural gas competitive in price with natural gas in some areas for transportation, UPS suggests that the natural gas vehicle be given a credit based on the average amount of renewable natural gas that is anticipated for future use. UPS is already using renewable natural gas in California and looking for opportunities in other areas of the nation. [EPA-HQ-OAR-2014-0827-1262-A1 p.12]

**Organization:** VNG

While RNG can be substituted for fossil natural gas in any end use, including heating and power generation, its strongest driver going forward will be the transportation sector. The reasons are two-fold. First, because RNG as a motor vehicle fuel competes primarily with gasoline and diesel prices, it has a greater economic advantage compared to competing against lower-cost coal and/or natural gas in the heating and power sectors. [EPA-HQ-OAR-2014-0827-1208-A1 p.1-2]

Perhaps more importantly, the economics of RNG in transportation are helped enormously by the generation and sale of credits under EPA's Renewable Fuel Standard (RFS) program – under which it is counted as a highly valued cellulosic biofuel – and the California Low Carbon Fuel Standard (LCFS) program, under which it has the lowest carbon intensity of any fuel.<sup>2</sup> These RFS and LCFS credit revenue streams make RNG competitive on a cost basis with fossil natural gas, and are unavailable to RNG used for non-transportation purposes. [EPA-HQ-OAR-2014-0827-1208-A1 p.2]

According to the RNG Coalition, the competitiveness of RNG with fossil CNG has enabled RNG to account for 25% of NGV fueling nationally and 35% of NGV fueling in California – and these shares could double by next year.<sup>3</sup> The problem is that overall NGV fueling volumes are small because of the relatively few NGVs currently on the road. In order to maximize the potential of RNG to deliver methane emission reductions, NGVs fueled on RNG need to be counted in the millions rather than the approximately 110,000 now on the road. [EPA-HQ-OAR-2014-0827-1208-A1 p.2]

Because the medium- and heavy-duty market is likely to provide the strongest demand driver for natural gas and RNG vehicle fuel in the near term, advanced technology multipliers for NGVs in the current rulemaking would help provide the demand growth needed to significantly accelerate the development of this ultra-low carbon renewable fuel. Moreover, because of the enormous GHG benefits of RNG on a lifecycle basis, these incentives would likely increase, not reduce, the overall benefits of this rule. [EPA-HQ-OAR-2014-0827-1208-A1 p.2]

Increasing demand for RNG will yield diverse economic benefits as well. Municipalities, wastewater treatment facilities, farms and other sources of methane emissions across the country will capture the economic value associated with the use of RNG in the transportation sector while creating jobs and fostering local energy independence and resilience in the process. Catalyzing these marketplace dynamics will allow EPA to reduce these potent GHG emissions in a cost-effective manner, creating a win-win-win-win scenario for methane sources, the transportation sector, consumers, and the climate. [EPA-HQ-OAR-2014-0827-1208-A1 p.2]

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2 California Air Resources Board. "Carbon Intensity Lookup Tables," Nov 2012. <http://www.arb.ca.gov/fuels/lcfs/lutables11282012.pdf>

3 Communications with David Cox, Director of Operations and General Counsel, RNG Coalition

**Response**

As pointed out by the Siemens, UPS and VNG comments, renewable natural gas (RNG) substantially reduces the Greenhouse Gas (GHG) emissions by heavy-duty trucks which use RNG. Use of RNG by heavy-duty trucks earns credits under the Renewable Fuels Standard (RFS) nationally, as well as the

Low Carbon Fuel Standard in California. Providing an additional credit for RNG under this rulemaking as suggested by some commenters would be redundant and thus would not be appropriate.

**Organization:** Waste Management (WM)

WM operates the largest natural gas-fueled, heavy-duty truck fleet in North America. Nearly 25 percent of our fleet comprises natural gas vehicles and greater than 90 percent of our new truck purchases each year are compressed natural gas (CNG) vehicles. We have found these trucks to be popular with our customers and communities where we operate, good for our business and good for the environment. Each natural gas truck eliminates the use of 8,000 gallons of diesel fuel per year. The cleaner-burning natural gas vehicles have nearly zero particulate emissions, lower emissions of smog-forming pollutants, and reduce GHG emissions by 20 percent. We are investing in new CNG fueling stations to support our fleet and currently operate 79 facilities of which, more than 36 percent are open to the public or municipal fleets. Our investment in fueling infrastructure has been an important step in promoting municipal adoption of CNG vehicles, as the cost of fueling facilities can present a major barrier for local governments. [EPA-HQ-OAR-2014-0827-1214-A2 p.1-2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.100.]]

While we view natural gas vehicles as a bridge to future, even cleaner vehicles, we expect CNG vehicles to be the predominant vehicle in our fleet for the near future, and quite possibly, into the scope of this rulemaking, which covers MY 2021 through MY 2027. We are therefore focusing many of our comments on the aspects of the rule that affect CNG, heavy-duty vocational trucks. [EPA-HQ-OAR-2014-0827-1214-A2 p.2]

**Response:**

We will highlight and discuss two different pieces of information in the Waste Management comment. First, the commenter stated that compressed natural gas (CNG) engines emit 20% less greenhouse gas emissions (GHG emissions) than diesel trucks. If the natural gas trucks emitted about the same amount of methane emissions as diesel engines, this might be the case. However, the certification data shows that natural gas trucks tend to emit about 1 gram per brake-horsepower-hour of methane, which is about an order of magnitude greater than diesel fuel trucks. We estimate that the higher natural gas truck methane tailpipe emissions combined with the lower thermal efficiency of spark-ignited natural gas trucks makes natural gas trucks about the same in terms of GHG emissions as diesel fuel trucks when assessed on a tailpipe basis. See Preamble Section XI.B.

Second, the commenter reinforced our observation that the installation of CNG and LNG refueling facilities can be a major barrier to the growth in natural gas usage by heavy-duty trucks. This is one reason why we believe that the growth in natural gas usage by heavy-duty trucks in the future will be modest even if natural gas prices return to their large discount to diesel fuel retail prices.

## **12.2 Natural Gas Engine and Vehicle Technology 1721**

### **12.2.1 General Technology Comments**

**Organization:** American Power Group Inc (APG)

Would the EPA consider allowing NG fuel engine/vehicles (either dedicated or Mixed-Fueled) to report only the NMHC values from the appropriate cert tests procedures similarly to how the ARB allows NRCI Mixed-Fuel Tier 1 converted engines to report THC for diesel fueled operation and NMHC for Mixed-Fuel operation? [EPA-HQ-OAR-2014-0827-1197 p.1]

**1) Quench volumes within the piston, bore, cylinder head deck configuration:** typical HHDD engines are designed to directly inject diesel fuel, aimed into a centrally located re-entrant bowl within the piston crown. Most (if not all), of the diesel fuel is combusted either in or very near this re-entrant bowl. In a Mixed-Fuel configuration, the NG fuel comes into the combustion chamber pre-mixed with the combustion air and this more homogenous NG fuel-air mixture gets compressed throughout the entire volume inside the bore, above the piston and below the cylinder head deck. The NG fuel typically will not compression ignite at compression ratios used by commercial HHDD engines and needs the diesel fuel ignition to act as a pilot ignition source. The further the NG-air mixture is from the diesel fuel pilot ignition source the less chance of complete NG combustion. As you move away from the re-entrant bowl combustion chamber, out near the cylinder bore, the volume between the piston crown edges and the cylinder bore which is above the top compression ring is a 'crevice volume' in which the NG fuel (or most any fuel) will not combust. These crevice volume effects are evident in current OEM HHDD NG engine CH<sub>4</sub> emission data that shows 1.04-1.95 g/bhp-h (Cummins 8.8L and 11.95L dedicated NG engines). Even the NG DI injected Westport HPDI technology suffers from 'crevice volume' effects as the NG fuel must be injected much earlier in the compression cycle than the liquid diesel fuel, allowing the NG fuel to mix with the combustion air well before the diesel fuel pilot ignition event. [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

Although S.I. engine OEM's have been studying and employing 'low crevice volume' piston designs to reduce feed-gas HC emissions, the C.I. engine OEM has no compelling reason to employ 'low crevice volume' piston designs for reasons already stated. It would be exorbitantly expensive for a Mixed-Fuel SVM to research 'low-crevice-piston' and top compression ring configurations for all potential HHDD engine applications, and change out all pistons, top rings and head gaskets during the Mixed-Fuel conversion (approx. \$10K-\$15K/engine incremental variable cost). Any such base engine change would also void the OEM's engine warranty. [EPA-HQ-OAR-2014-0827-1197-A1 p.1]

B. Would the EPA entertain the idea of having a CH<sub>4</sub> 0.1 g/bhp-h standard for converted Mixed-Fuel engines when running in diesel fuel only operation and report only the NMHC criteria pollutant (or a more flexible CH<sub>4</sub> standard) during Mixed-fuel operation? This is patterned after the ARB E.O. certification practice of allowing Mixed-Fuel converted NRCI Tier 1 engines of being certified to Tier 1 standards when running in diesel fuel operation and being certified to Tier 2 standards when running in Mixed-Fuel operation. Please see ARB E.O. Cert # B-59U-2. [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

**Organization:** Daimler Trucks North America LLC

## 8. NG Engines

**DFs for NG engines** - The agencies request comment on appropriate Deterioration Factors for NG tailpipe emissions. Although we do not have an engine in the US market from which we can measure the NG DF, the agencies' proposed diesel-based assigned deterioration factors seem reasonable. 80 FR 40511. [EPA-HQ-OAR-2014-0827-1164-A1 p.29]

**Organization:** National Propane Gas Association (NPGA)

### Extension of Phase I Standards to 2020

The NPRM permits the current, Phase 1 emission and fuel efficiency standards for natural gas compression ignition engines to continue until 2020.<sup>23</sup> The agencies argue that an extension of the current standards is necessary to allow natural gas engine manufacturers to develop and produce engines



capable of meeting the Phase 2 standards. Presumably, the additional time for such manufacturers is because the agencies seek to encourage production of alternatives. We find it inequitable for the agencies not to extend the same to other alternative fuels, like propane autogas. The rationale for the incongruent treatment is unclear, especially because the agencies' intend to apply the same emissions standards to all compression ignition engines within the decade.<sup>24</sup> [EPA-HQ-OAR-2014-0827-1272-A1 p.3]

**Organization:** NGVAmerica

### **Dual-Fuel Conversions**

NGVAmerica would like to raise several issues related to the application of the greenhouse gas regulations to dual-fuel conversions; specifically, we refer here to the conversion of diesel fueled engines modified to operate on a mixture of diesel and natural gas. It is our belief that compliance with the new greenhouse gas emissions for such engines could be extremely difficult, particularly as it relates to the limits on methane emissions. EPA's discussion of the methane cap does not indicate that there is technology available for natural gas vehicles to meet these very low limits. The compliance pathway is based on the averaging mechanism and the ability to offset methane emissions with lower carbon dioxide emissions. NGVAmerica and manufacturers of new natural gas engines (SI and CI) support this regulatory approach. [EPA-HQ-OAR-2014-0827-1270-A1 p.7]

Manufacturers of new engines have indicated that they expect to meet the tighter controls on methane through use of credits and averaging. However, natural gas/diesel dual-fuel conversions may not be able to meet the new standards since they are likely to have somewhat higher methane emissions than a fully optimized new natural gas engine. The current practice for converting such engines includes utilizing much of the original engine including the piston crowns. NGVAmerica asks that the EPA work with manufactures to understand the difficulties associated with dual-fuel conversions and develop a compliance strategy that continues to make this option available in the marketplace. The continued ability of small manufacturers to produce such engines, and for businesses to utilize them, is an important part of expanding the use of natural gas and demonstrating to fleets that natural gas is a viable option in heavy duty applications. These engines also may be able to demonstrate lower levels of certain criteria pollutants, with NOx emissions reduced by as much as 25 – 35 percent and therefore do provide environmental benefits that should be encouraged. [EPA-HQ-OAR-2014-0827-1270-A1 p.7]

One approach to regulating such engines might be to adopt a rule similar to CARB regulations for non-road compression ignition engines. CARB allows Dual Fuel (Mixed-Fuel, Bi-Fuel) converted Tier I engines to meet the Tier II NMHC standards when running on Dual Fuel (Diesel/NG), but meet the Tier I THC standard when running on diesel fuel only. We request that EPA allow mixed-fuel (Diesel/NG) applications to meet the proposed 0.1 g/bhp-hr methane standard when running in 'diesel fuel only' operation and allow a higher methane level when running in mixed-fuel (Diesel/NG) operation. [EPA-HQ-OAR-2014-0827-1270-A1 p.7-8]

**Organization:**

VNG is developing a nationwide retail compressed natural gas (CNG) fueling network for light-duty and medium-duty vehicles. In contrast to selling CNG at private depots, utility yards, airports, and other locations where drivers don't normally fuel, VNG collocates public-access CNG fueling facilities at existing gasoline stations in order to provide a convenient and familiar fueling experience. While initially focused on serving commercial fleets – and particularly fleets of the pickups and delivery vans covered by the present rulemaking – VNG's fueling facilities can also support the adoption of natural gas vehicles (NGVs) by mass-market consumers. [EPA-HQ-OAR-2014-0827-1208-A1 p.1]

NGVs are a critical technology for reducing greenhouse gas (GHG) emissions from medium- and heavy-duty trucks to near-zero levels today. As in the GHG rule for light-duty vehicles for model years 2017-2025, EPA should seek to accelerate NGV adoption by offering advanced technology incentives in the current rulemaking. To this end, an advanced technology multiplier of at least 1.5 should be applied in the Phase 2 program to NGVs as well as electric vehicles (EVs) and fuel cell vehicles (FCVs), and not for waste heat recovery and strong hybrid technologies (since EPA has based the Phase 2 standards on the assumption that these technologies will see widespread deployment). [EPA-HQ-OAR-2014-0827-1208-A1 p.1]

There are two key reasons why such incentives are justified for NGVs alongside EVs and FCVs: the ability of NGVs to achieve near-zero emissions through the use of renewable natural gas (RNG), which delivers GHG reductions of 90% or more compared to diesel and is now providing 25% of NGV fuel consumption nationally, as well as the ability of NGVs to accelerate the deployment of FCVs due to the numerous synergies between these technologies. [EPA-HQ-OAR-2014-0827-1208-A1 p.1]

### **Technological Synergies Will Accelerate Development of Hydrogen FCVs**

Natural gas is largely composed of hydrogen, with four hydrogen atoms for every carbon atom in a molecule of methane. Due to the chemical and physical similarities of hydrogen and methane, they share a number of technology synergies, so that the proliferation of NGVs and natural gas fueling infrastructure will facilitate and accelerate the deployment of FCVs. [EPA-HQ-OAR-2014-0827-1208-A1 p.2]

In its rulemaking for light-duty vehicles for model years 2017-2025, EPA acknowledged that “CNG investments have the potential to facilitate the introduction of hydrogen FCVs in several respects,”<sup>4</sup> including innovations in advanced storage materials, innovations in tube trailer designs, improved designs for compressors and fuel dispensers, and on-site production of hydrogen from natural gas feedstock. These and other synergies were discussed in the white paper “Natural Gas Vehicles: An Essential Bridge to Hydrogen,” commissioned by VNG and written by the consultancy Energy Futures, which found that “the synergies start with natural gas as the primary and cheapest feedstock for nearly all hydrogen production today and continue through every step in the fuel supply chain.”<sup>5</sup> [EPA-HQ-OAR-2014-0827-1208-A1 p.3-4]

Research into the link between NGVs and FCVs is ongoing at the Department of Energy, including a recent report by Sandia National Laboratories, *Transitioning the Transportation Sector: Exploring the Intersection of Hydrogen Fuel Cell and Natural Gas Vehicles*.<sup>6</sup> Synergies on the infrastructure side are especially strong, and the report includes a conceptual design for a multi-fuel station that utilizes a stationary fuel cell to produce both hydrogen and electricity from pipeline natural gas (which could be RNG), thus allowing for fueling of NGVs, EVs, and FCVs. [EPA-HQ-OAR-2014-0827-1208-A1 p.3]

[Figure, 'Conceptual Design for a multi-fuel station', can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1208-A1]

In a variety of ways, increasing adoption of NGVs and the development of CNG fueling infrastructure by companies like VNG will help ensure that the necessary vehicle technologies and fuels will be in place for FCVs, accelerating and lowering the costs of this transition. EPA recognized this linkage by awarding advanced technology multiplier incentives to NGVs in its light-duty rule, and a similar multiplier should be given to NGVs under the current medium- and heavy-duty rulemaking. [EPA-HQ-OAR-2014-0827-1208-A1 p.3]

## The Need for Incentives

While NGVs are a relatively established technology compared to EVs and FCVs, they are still a very small part of the market and face significant near-term barriers to adoption with many fleets due to less infrastructure availability and higher up-front costs than petroleum-fueled vehicles. The fall in petroleum-based fuel prices has also reduced the economic case for NGVs, which was expected to drive market development after the shale gas boom. And, from a regulatory perspective, the growing likelihood that NGVs will be fueled by RNG creates positive externalities that are not captured by a focus on tailpipe emissions alone. [EPA-HQ-OAR-2014-0827-1208-A1 p.3-4][This comment can also be found in section 1.4.1 of this comment summary]

While a lifecycle emissions focus could be a possible solution in theory, VNG agrees with Natural Gas Vehicles for America's (NGVA) position that the incorporation of full lifecycle emissions in the GHG rule would create enormous complications and uncertainty in the accounting for every fuel, including gasoline and diesel as well as alternatives like electricity, hydrogen, and natural gas. Keeping the regulation's primary focus on tailpipe emissions will greatly simplify compliance planning for OEMs and ensure that emissions are reduced across vehicles of all fuel types. [EPA-HQ-OAR-2014-0827-1208-A1 p.4][This comment can also be found in section 1.4.1 of this comment summary]

At the same time, the continued use of advanced technology incentives could play a distinct but important role in encouraging the development of technologies and fuels that will be able to provide more game-changing emissions benefits in the future. Moreover, because the majority of NGV fueling going forward can be expected to be RNG, the overall emission benefits of the rule are likely to increase instead of being reduced. Thus, it would be most effective – as well as most consistent with the precedent established by the Phase 1 regulation as well as the 2017-2025 light-duty vehicle regulations – to use a simple multiplier of at least 1.5 for NGVs, EVs, and FCVs. [EPA-HQ-OAR-2014-0827-1208-A1 p.4][This comment can also be found in section 1.4.1 of this comment summary]

Regulatory incentives to encourage manufacturers to continue pursuing this vital near-term, near-zero alternative could be critical to sustaining this market during this challenging economic time for non-petroleum fuels, allowing for the long-term investments needed to reduce vehicle costs through higher production volumes. And, beyond the benefits for EPA's GHG agenda, the promotion of RNG development through greater NGV demand will help EPA achieve its goals for the increase of cellulosic biofuel use under the RFS and the reduction of methane emissions. [EPA-HQ-OAR-2014-0827-1208-A1 p.4][This comment can also be found in section 1.4.1 of this comment summary]

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4 Federal Register, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule." 15 Oct 2012, p. 62815.  
<http://www.gpo.gov/fdsys/pkg/FR-2012-10-15/pdf/2012-21972.pdf>

5 Cannon, James S. "Natural Gas: An Essential Bridge to Hydrogen Fuel Cell Vehicles." 2012.  
<http://vng.co/wp-content/uploads/2012/05/Natural-Gas-An-Essential-Bridge-To-Hydrogen-Fuel-Cell-Vehicles.pdf>

6 Sandia National Laboratories. "Transitioning the Transportation Sector: Exploring the Intersection of Hydrogen Fuel Cell and Natural Gas Vehicles." 9 Sept 2014.  
<http://energy.gov/sites/prod/files/2015/02/f19/2015-01H2NG-Report-FINAL.pdf>

**Response:**

With respect to the APG and NGVAmerica comments on the methane standard, we are not allowing manufacturers to report only the NMHC values from the certification tests procedures. Nor are we relaxing the methane standards. As described in Section 12.3, methane is a significant greenhouse gas, and the CO<sub>2</sub> trading option provides sufficient flexibility for manufacturers unable to meet the methane standard.

The NPGA comment that the agencies are treating propane differently than natural gas appears to result from a misreading of text from the NPRM. The agencies did not propose to do, nor are we finalizing the type of change to which NPGA would object in this context.

Finally, with respect to the VNG comment, we are not adopting advanced technology multipliers for natural gas vehicles. Such vehicles are already available in the marketplace, and do not represent the kind of game-changing technology for which these Phase 2 multipliers are intended.

**12.2.2 Natural Gas Emission Control Measures**

**Organization:** California Air Resources Board (CARB)

**Oppose/Requested Change Comment****Comment – Tailpipe standards for natural gas vehicles**

U.S. EPA and NHTSA state: “For 2014 and later OEM compression ignition natural gas trucks or natural gas conversions of 2014 and later diesel trucks, the trucks must meet a 0.1 g/bhp-hr methane emission standard in the case of a larger truck engine tested with an engine dynamometer, and a 0.05 g/mi methane emission standard in the case of smaller trucks tested on a chassis dynamometer. For spark-ignited engines, the standards take effect in 2016. Natural gas truck manufacturers are allowed to offset methane emissions exceeding the methane emission standard by converting the methane emission exceedances into CO<sub>2</sub> equivalent emissions and using CO<sub>2</sub> credits. For the initial natural gas engine certifications that U.S. EPA received for 2014, the truck manufacturers chose to continue to emit high levels of methane (around 2 g/bhp-hr) and use CO<sub>2</sub> credits to offset those emissions. We don’t know if this practice of will continue in the future; however, for evaluating the lifecycle impacts of natural gas heavy-duty trucks, the 2014 and later natural gas heavy-duty trucks may in fact have an emissions profile more like the pre-2014 trucks and not like the 2014 and later trucks.” [EPA-HQ-OAR-2014-0827-1265-A1 p.163]

CARB staff suggests that U.S. EPA and NHTSA investigate the feasibility of more stringent tailpipe standards for methane and N<sub>2</sub>O. Considering the high-GWP of methane, a 0.1 g/bhp-hr methane standard is equivalent to 4 to 8 percent of the proposed CO<sub>2</sub> standards, depending on vehicle and vocation types. CARB staff also suggests that U.S. EPA and NHTSA consider eliminating or at least phasing out the use of CO<sub>2</sub> credits in lieu of compliance with tailpipe methane standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.163]

**Support Comment**

Also, in 40 CFR 1036.801 (page 40602 of the NPRM), CARB staff supports the clarification that a dual fuel engine can include 2 or more fuels as long as it does not operate on a continuous mixture of those

2+ fuels, and the expanded definition of manufacturer to include those who assemble an engine, vehicle, or piece of equipment. [EPA-HQ-OAR-2014-0827-1265-A1 p.188]

**Organization:** International Council on Clean Transportation (ICCT)

### **Natural gas**

Delgado and Muncrief (2015) determined that inadequate attention towards limiting methane leakage from heavy-duty natural gas vehicles (NGVs), could diminish the Phase 2 program benefits by as much as 38 percent in 2040, if there was a major breakthrough in NGV sales and using 20-year global warming potential for methane. We recommend that the agencies take every opportunity available within the purview of this regulation to minimize methane emissions throughout the value chain and to promote higher-efficiency natural gas engines. [EPA-HQ-OAR-2014-0827-1180-A4 p.17]

There are a large number of potential locations for methane leakage throughout the natural gas value chain (production, processing, transmission, distribution, storage and transfer, fueling station, refueling events, vehicle tailpipe, vehicle crankcase, vehicle storage tank, vehicle fueling system). The agencies' proposal addresses two of these by mandating closed engine crankcases and minimum LNG tank hold times for NGVs. We are supportive of these aspects of the proposal. The remainder of the leakage sources are not addressed in any way. One large potential source of methane emissions that would be very practical to address in this rule is the vehicle tailpipe. Emissions levels of methane from the tailpipe are significant, they could be in the range of 0.5% or more (of total fuel consumed) and can be controlled to much lower levels with known aftertreatment control technology (See Dunn et al 2013; Frazier, 2013). There is no incentive in the current proposal to place further controls on these emissions, which means it is likely that they will continue at the current level. In addition, we encourage the agencies to consider whether (a) CO<sub>2</sub>-CH<sub>4</sub> emission trading and (b) exclusion of engine CH<sub>4</sub> emissions within the GEM inputs may incentivize the increased deployment of higher-emitting natural gas engines with greater short-term climate forcing impacts in the market. [EPA-HQ-OAR-2014-0827-1180-A4 p.17]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **Methane and PM Emissions from Stoichiometric Natural Gas Engines**

Because methane is a potent climate forcing agent with Global Warming Potential (GWP) that is 25 times greater than CO<sub>2</sub> over a period of 100 years, we applaud the agencies consideration of both upstream and downstream methane emissions from the growing fleet of natural gas trucks. EPA's Greenhouse Gas Reporting Program (GHGRP) is an important source for updating the upstream GHG inventories from the production and transportation of this alternate fuel. As the interest in natural gas as a domestic energy source and transportation fuel grows, it leads to expansion of the fuel production and transportation infrastructure. We are encouraged with EPA's intentions to further regulate methane emissions from natural gas production facilities. The upstream production, distribution and transportation of methane may be a significant contributor to the overall GHG contribution from this fuel sector. [EPA-HQ-OAR-2014-0827-1210-A3 p.13]

MECA is a long supporter of technology and fuel neutral standards and we believe that the proposed provisions to control fugitive methane emissions from natural gas vehicles and engines represent a fair and balanced approach to addressing the CO<sub>2</sub>-equivalent emissions from the growing natural gas vehicle sector. Because of the low vapor pressure of this alternate fuel, the potential source of emissions

goes beyond just the tailpipe. Similar to the case of evaporative emissions from gasoline vehicles, it is important to control the non-combustion related emissions from natural gas engines and fuel systems. We support the EPA's inclusion of boil-off requirements for LNG vehicles in the Phase 2 proposal and to require closed crankcases on all natural gas vehicles. MECA supports the reclassification, starting in 2021 under Phase 2, of natural gas engines according to their primary intended service classes, similar to compression ignition engines. Although MECA lacks the expertise in suggesting the life cycle climate impacts, a number of ongoing studies by California, EPA and others may provide additional insight into how this may be done in the near future. California's Low Carbon Fuel Standard provides methodology that producers may employ to revise climate impacts of newly developed production pathways and this may serve as a model of how that may be done for upstream methane emissions. If natural gas truck applications continue to grow, as some market analysts predict, EPA should consider developing a separate set of engine efficiency standards that better reflect the full life cycle emissions of natural gas vehicles including leakage and upstream emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.13]

It is worth noting that stoichiometric, heavy-duty natural gas engines have been shown to emit large numbers of ultrafine particulates that are largely the result of the consumption of lubricant oil during the engine combustion process (see ARB's funded work published by West Virginia University on particle emissions from stoichiometric natural gas bus engines published in *Environmental Science & Technology* in June 2014). These stoichiometric heavy-duty engines are currently certified without filters due to their low particulate mass emissions. The mass of metal oxide ash particles from these natural gas engines were an order of magnitude greater than the mass of metal oxide ash emitted from a 2010 technology diesel engine equipped with a DPF and SCR system. The oxidative stress potential (OS) of the PM was also characterized in-vitro through DTT and ROS assays. High correlation coefficients were observed between the mass of lube oil-derived elemental species and both DTT and macrophage ROS, suggesting that the chemical species forcing oxidative stress are metallic in nature. The authors further suggest that, although the PM mass emissions from natural gas vehicles are low, the presence of nucleation mode solid metal particles could pose significant health risks in the alveolar regions of the respiratory system due to the higher surface area of these nanoparticles. Filters on these stoichiometric natural gas engines would significantly reduce the ultrafine particle emissions from these engines and provide additional climate and public health benefits. MECA encourages EPA to investigate the health and climate benefits of applying filters to these engines and enact appropriate policies that force the use of high efficiency filters on these engines to reduce ultrafine metal oxide exposure. [EPA-HQ-OAR-2014-0827-1210-A3 p.13-14]

#### **Response:**

The comments describe how natural gas heavy-duty trucks have higher methane emissions than their gasoline or diesel fueled heavy-duty trucks. To reduce the methane emissions from natural gas heavy-duty trucks, the commenters propose to end the CO<sub>2</sub> credit trading program and incorporate natural gas trucks into the GEM model. One of the commenters suggested increasing the stringency of the methane emission standard.

Before addressing the various comments, it is useful to review the past and present methane emissions from heavy-duty natural gas trucks, and then discuss what methane emissions might be from future natural gas trucks.

Prior to when the heavy-duty methane emission standards took effect in 2014 for engine compliance (0.1 gram per brake horsepower-hour) and in 2016 for chassis compliance (0.05 gram per mile), natural gas heavy-duty trucks, as well as diesel fuel and gasoline trucks, simply needed to meet a nonmethane hydrocarbon standard. Diesel fuel and gasoline heavy-duty trucks emitted low levels of methane as the

nonmethane hydrocarbon standard also controlled methane levels. In fact, the phase 1 heavy-duty methane emissions standards that took effect in 2014 and 2016 were set to essentially cap methane emissions at their current levels for diesel and gasoline heavy-duty trucks (the methane emissions standards were established to be two times higher than actual methane emissions). Since natural gas is mostly methane, complying with the nonmethane hydrocarbon standard was not difficult using readily-available aftertreatment technologies. However, methane emissions were high. Our certification data showed that natural gas trucks generally emitted from 2 – 5 gram of methane per brake horsepower-hour, which is approximately two orders of magnitude higher than diesel fuel and gasoline heavy-duty trucks.

A review of our certification data shows that natural gas trucks certified after the methane tailpipe standards took effect average about 1 gram per brake horsepower-hour. This is an improvement over the unregulated levels, but still much higher than the standard. However, when the engine manufacturer exceeds the methane emissions standard (providing that it is a large engine manufacturer, small engine manufacturers are exempt from the phase 1 GHG standards), it must offset the methane emissions above the methane emissions standard with excess carbon dioxide (CO<sub>2</sub>) emission credits. Because methane is a more potent heat trapping gas than CO<sub>2</sub>, the engine manufacture must retire more grams of CO<sub>2</sub> credits than grams of methane emissions. Under the phase 1 HD GHG standards, 25 grams of CO<sub>2</sub> must be used to offset 1 gram of methane emission above the methane emissions standard, and under the phase 2 HD GHG standards, 34 grams of CO<sub>2</sub> must be used to offset 1 gram of methane emissions. These CO<sub>2</sub> credit trading values are based on methane's GWP under IPCC's AR4 and AR5 reports, respectively, over 100 years. Thus, when evaluated over a 100 year timeline, trading CO<sub>2</sub> credits for methane emissions will be GHG-neutral based on IPCCs assessment of the relative GHG impacts of these two GHG gasses.

than today's trucks for several reasons. First, as the CO<sub>2</sub> emissions standards become more stringent, the cost of achieving CO<sub>2</sub> emission reductions will increase. Therefore, trading CO<sub>2</sub> emission credits against methane emissions above the methane emissions standard becomes more expensive. Second, as just explained, when the phase 2 HD GHG emissions standards take effect, the engine manufacturers will have to use even more CO<sub>2</sub> credits (34 vs 25) to offset higher methane emissions. This will further increase the cost of offsetting those noncompliant methane emissions and creates an incentive to lower the methane emissions from natural gas trucks. Third, over time, natural gas engine manufacturers will likely be able to dedicate engineering resources to engineer low-cost methods to lower the methane emissions of natural gas trucks. Combining new lower-cost means to achieve lower methane emissions with the higher cost, and higher amount, of CO<sub>2</sub> credits will provide an incentive for natural gas engine manufacturers to lower the methane emissions from their natural gas heavy-duty trucks.

One of the commenters suggested increasing the stringency of the methane emission standard for natural gas trucks. Since the methane emissions standard applies to all heavy-duty trucks, if we were to identify a cost-effective means to reduce methane emissions, we would likely consider increasing the stringency of the methane emissions standard for all heavy-duty trucks. For the phase 2 HD GHG rulemaking, we focused on achieving CO<sub>2</sub> emission reductions because CO<sub>2</sub> is the principal GHG gas and achieving CO<sub>2</sub> emission reductions are likely less costly than trying to achieve methane emission reductions. If there is a phase 3 HD GHG standard, we likely will reconsider the stringency of the HD methane tailpipe standard.

Another comment suggested phasing-out the CO<sub>2</sub> credit trading program altogether. The agencies typically find that allowing the regulated parties' flexibility on how to comply with emission control standards is effective for achieving the greatest emission reduction at the lowest cost. If, however, if the agencies makes a finding, or is provided information, that the greater flexibility provided by the CO<sub>2</sub> credit trading program is detrimental to achieving GHG emission standards, then EPA may rethink

its strategy. Since the volume of natural gas heavy-duty truck sales is so low at this point in time, EPA would likely wait to make this type of assessment until natural gas heavy-duty trucks begin to comprise a significant portion of the heavy-duty fleet. Based on our projected trend in methane emissions from heavy-duty natural gas trucks described earlier, we believe that some of the concern about high natural gas emissions will diminish.

### **12.2.3 Crankcase**

**Organization:** California Air Resources Board (CARB)

#### **Comment – Closed crankcase requirement for natural gas engines**

CARB staff supports the Phase 2 proposal to require closed crankcases for all natural gas engines, including those subject to compression ignition standards. An open crankcase has historically been allowed for diesel-fueled engines, as recirculating those crankcase emissions with their high PM levels could potentially foul turbochargers and aftercooler heat exchangers. Natural gas vehicles have low PM emissions, and requiring a closed crankcase is appropriate. The European Union standard currently compels the use of closed crankcase ventilation systems, and Cummins ISL G Euro V engines already have closed crankcase ventilation. [EPA-HQ-OAR-2014-0827-1265-A1 p.165]

**Organization:** Enovation Controls (ENC)

2.3 Crankcase Emissions - Crankcase emissions should be controlled based on system type rather than fuel type, maintaining harmonization with end user focus as specified elsewhere in the proposed rule. CCR Title 13, Section 1971.1 addresses crankcase emissions such that all engines, whether using compression ignition or spark ignition, are subject to monitoring crankcase ventilation (CV) systems depending on whether the engine was certified as an open CV or closed CV system. No delineation is made between fuel type, and we suggest that any crankcase emissions language in the Phase 2 proposal should take a similar fuel-agnostic approach. The current language appears to leave gaps for liquid-fueled engines that certify with a closed CV system. [EPA-HQ-OAR-2014-0827-1203-A1 p.2]

**Organization:** Environmental Defense Fund (EDF)

#### **Account for all on-vehicle methane and require efforts to reduce these emissions**

EDF supports the close-crankcase requirement contained in the proposal. This step can significantly reduce methane emissions, as evidenced by the recent CARB certification of the Cummins-Westport ISL G Near Zero engine.<sup>177</sup> With the closed-crankcase, methane emissions were cut 70% compared to the standard ISL G engine.<sup>178</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.42]

**Organization:** Optimus Technologies

In addition, Optimus applauds the EPA's provision to require that all natural gas-fueled vehicles have closed crankcases. [EPA-HQ-OAR-2014-0827-1276-A1 p.1]

**Organization:** Union of Concerned Scientists (UCS)

We strongly support the agencies inclusion of controls for crankcase emissions on natural gas vehicles and LNG tank hold times. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]



**Organization:** Securing America's Future Energy

... [W]e also generally support the addition of the closed crank case requirement and alterations to the agencies' principal model methodology for natural gas vehicles....

**Organization:** American Gas Association (AGA) et al.

Closed crankcases on HPDI natural gas engines would be ineffective for the following reasons: [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

The contribution of blow-by gases to exhaust methane emissions was measured by comparing the tailpipe out methane to the engine-out methane (measured upstream of the crankcase gases return). These tests were conducted on June 9 and 10, 2014, on an engine that had already accumulated 3340 hours of development, including some durability tests. The engine's age likely means that the measured blow-by gases were higher than for an average engine. (We note that there is some uncertainty, as the measurement method requires subtracting measurements of already low methane emissions from two different analyzers). [EPA-HQ-OAR-2014-0827-1223-A1 p.6]

[Table 1, 'Exhaust and crankcase methane emissions data', can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1223-A1]

Table 1 shows that the crankcase methane emissions account for approximately 1 percent of the total methane emissions from the engine. Thus, we believe that requiring a closed crankcase to mitigate such a marginal amount of emissions is superfluous. We note our support of the Phase 1 Rule's provisions on this issue, which allowed for compression-ignition natural gas engines to vent crankcase emissions to the atmosphere as long as the vented emissions were accounted for as part of the engine's tailpipe emissions. [EPA-HQ-OAR-2014-0827-1223-A1 p.6-7]

### **We Support the Proposed Requirement for Closed Crankcases on Natural Gas Engines, but Strongly Recommend that the Agencies Include an Alternative Compliance Pathway for HPDI Engines**

The Proposal includes a requirement that all natural gas-fueled engines have closed crankcases, beginning in model year 2021.<sup>24</sup> This modifies the requirements of the HD Phase 1 Rule, which allowed compression-ignition natural gas engines to vent crankcase emissions to the atmosphere as long as the vented emissions were accounted for as part of the engine's tailpipe emissions. [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

We understand and agree with the justification for this proposed change for spark-ignited stoichiometric engines, which are the most common engines on the market today. For these engines, returning the ventilation from the crankcase to the intake is an effective strategy to reduce overall methane emissions. We therefore support the agencies' proposed requirement for closed crankcases on spark-ignited stoichiometric natural gas engines. [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

However, requiring High Pressure Direct Injection (HPDI) natural gas engines to have closed crankcases would be an unnecessary and ultimately ineffective requirement. Further, it would introduce unwarranted complexity, cost, and failure modes. We recommend that the agencies take the following information and data into consideration, and we request the opportunity to discuss the potential for

creating an alternative compliance pathway for HPDI engines. [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

Closed crankcases on HPDI natural gas engines would be ineffective for the following reasons: [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

- During the compression stroke, the combustion chamber is predominantly filled with air.<sup>25</sup> As a result, the quantity of methane in the blow-by gases is very low, as can be seen in Table 1 below. We note that these levels are different from fumigated engines, which compress a mixture of fuel and air in the combustion chamber, and therefore have a more significant amount of fuel in the blow-by gases. [EPA-HQ-OAR-2014-0827-1223-A1 p.6]
- Because HPDI engines use late-cycle direct injection of the fuel, there is no air-fuel mixture in the combustion chamber crevices. This also reduces the amount of contact between the air-fuel mixture and the cylinder walls. As a result, the in-cylinder methane emissions are much lower than in fumigated engines. This also results in much lower methane in the blow-by gases. [EPA-HQ-OAR-2014-0827-1223-A1 p.6]
- Returning the blow-by gases to the intake is not effective in HPDI engines because these engines operate with excess air, which is similar to diesel engines. Operating with excess air means that returning crankcase emissions (which are already diluted to a great extent) to the intake would form a mixture well below the flammability limit. Thus, a significant fraction of the crankcase methane would simply go through the combustion chamber. Furthermore, the exhaust temperature of a diesel cycle engine is almost always below the catalytic oxidation temperature of methane, so this methane will not be significantly oxidized in the exhaust oxidation catalyst. [EPA-HQ-OAR-2014-0827-1223-A1 p.6]

In support of this, and as summarized in Table 1 below, Westport has extracted representative data from a pre-production HPDI 13L engine. The engine, which has mild EGR quantities, was calibrated for EURO 6 emissions, but was operated over a cold and hot Federal Test Procedure (FTP) drive cycle. In the drive cycle, the crankcase ventilation gas was piped to the exhaust pipe, downstream of the exhaust after-treatment systems (EATS) and upstream of the tailpipe analyzer port. [EPA-HQ-OAR-2014-0827-1223-A1 p.6]

[Table 1, 'Exhaust and crankcase methane emissions data', can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1223-A1]

Further, requiring closed crankcases in HPDI engines may create unintended impacts on safety because closed crankcases can impact the engine's failure modes. This could lead to unsafe engine operations or engine damage. For example, if a natural gas fuel injector malfunctions, sufficient levels of natural gas may be reintroduced to the cylinder intake air (through the crankcase ventilation system). This would increase the power output of the engine independently from the driver demand before the fault is detected and any mitigating action is taken. We note that stoichiometric engines are less susceptible to this because there is no excess air in the intake. [EPA-HQ-OAR-2014-0827-1223-A1 p.7]

Additionally, we recommend that the final Phase 2 Rule does not mandate specific engine designs or architectures. Notwithstanding the fact that closing the crankcases of spark-ignition natural gas engines resolves the issue of methane emissions from crankcases, we believe that the agencies should maintain their standard approach of setting performance-based emissions standards that allow OEMs to meet the standards in ways that meet their customer needs in the safest, most cost-effective manner possible. Doing otherwise burdens OEMs with potentially avoidable weight, costs, and safety impacts and complicates the task of bringing new products to market. [EPA-HQ-OAR-2014-0827-1223-A1 p.7]

The agencies applied similar reasoning in their assessment of transmission architectures.<sup>26</sup> Transmission improvements create opportunities for fuel consumption improvements and GHG reductions, especially in vocational vehicles' frequent start-stop operations. Though the agencies noted that "most vocational vehicles currently use torque converter automatic transmissions (AT),"<sup>27</sup> which increases fuel efficiency, the agencies are not requiring that all vocational vehicles use AT in order to meet the Proposal's emissions and fuel consumption standards. Rather, the agencies are allowing OEMs to bring other products to market that will meet the standards in ways that best meet their customer needs, noting that "other kinds of transmission architectures can meet customer needs, including automated manual transmissions (AMT) and even some manual transmissions (MT)."<sup>28</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.7]

For these reasons, we recommend that the agencies explore alternative or additional compliance mechanisms for HPDI engines. Doing so will help ensure that methane emissions from the crankcases of natural gas vehicles are safely and cost-effectively reduced. Towards that end, we request an opportunity to discuss this issue further with you, as well as to provide additional information and data, after the close of the public comment period to assist your efforts to reach the best approach to reducing crankcase emissions. [EPA-HQ-OAR-2014-0827-1223-A1 p.7]

**Organization:** NGVAmerica

**G. NG Crankcase Emissions. EPA has proposed requiring that natural gas engines have closed crankcases in order to reduce emissions. EPA requests comments on the feasibility and cost effectiveness of requiring closed crankcases.** [EPA-HQ-OAR-2014-0827-1270-A1 p.4]

We support the intent of further reducing emissions from natural gas engines and utilizing all available cost-effective, commercially available technologies to continue to improve upon the emissions of natural gas vehicles. We further support the use of closed crank case technology on spark-ignited engines (i.e., natural gas engines that utilize spark-ignition as part of the combustion process regardless of their classification). However, we have concerns with respect to the inclusion of a hard and fast rule that imposes this requirement in cases where it may not be necessary for regulatory compliance such as where other controls or strategies are able to show compliance with the regulations. We also are concerned that the use of closed crank case systems in some applications may impact the safe operation of natural gas vehicles. [EPA-HQ-OAR-2014-0827-1270-A1 p.4-5]

The comments submitted by GNA on behalf of AGA, Clean Energy, and Westport Innovations provide additional information relating to this issue. NGVAmerica supports their comments. [EPA-HQ-OAR-2014-0827-1270-A1 p.5]

**Organization:** Cummins, Inc.

*Cummins opposes forcing closed crankcase ventilation (CCV) on HD non-diesel fueled engines* [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

Current HD diesel-cycle engines may discharge emissions such as crankcase gases into the atmosphere as long as the emissions are measured and accounted for during certification and deterioration factor (DF) testing. Since the discharged emissions are accounted for during certification testing, proper technologies must be developed and applied to crankcase ventilation systems to ensure acceptable performance to meet certification and customer requirements. In contrast to diesels, the agencies are proposing to mandate natural gas fueled HD engines use a CCV system, regardless of emissions impact

of an open crankcase system. Cummins does not support this provision as it mandates a specific technology rather than setting a performance-based standard. Manufacturers should have the flexibility to choose the appropriate technologies to meet standards and customer needs. [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

Also, there is an inconsistency between the regulatory language and the Preamble on the implementation timing. The Preamble (80 FR 40208) indicates this requirement would start in MY2021, while the proposed rule would require “MY2007 and later non-diesel-fueled” engines to have CCV systems. Any regulatory change should provide adequate lead-time for manufacturers to design and validate a reliable system to meet any new requirement. [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

**Organization:** Daimler Trucks North America LLC

**Crankcase Emissions from Natural Gas Engines** – The agencies request comment on the costs and effectiveness of technologies that we have identified to comply with these provisions involving closing the crankcase and recirculating all crankcase gases for natural gas engines. (80 FR 40208). The EPA asserts that the agency will require closed crankcase on NG vehicles because this presents no problem due to low PM emissions from NG engines. This begs an important question: why is the EPA dictating a solution instead of just requiring a performance level? If the engine can meet the GHG limits with open breather emissions included in the measured results, there is no reason why the agency should require a closed breather. Moreover, we question the EPA’s assertion that closed breathers are not an issue. Aerosols may foul compressor wheels, and the entire discussion of the ease of implementing closed crankcase ventilation ignores the HPDI technology. [redacted] In short, we recommend a performance-based standard, measuring emissions and being required to hit a prescribed level. [EPA-HQ-OAR-2014-0827-1164-A1 p.29]

**Organization:** Securing America's Future Energy

#### Closed Crankcase Requirement

The Proposal requires that all natural gas-fueled engines, beginning in model year 2021, have closed crankcases. We support this requirement for spark-ignited stoichiometric engines, which are the most common on the market today. However, crankcase emissions from High Pressure Direct Injection (HPDI) engines account for approximately 1 percent of the total methane emissions from the engine.<sup>27</sup> Therefore, applying this requirement to HPDI engines is ineffective, unnecessarily adding cost and complexity. [EPA-HQ-OAR-2014-0827-1462-A1 p.9]

SAFE supports the policy of setting performance-based emissions standards, rather than requiring a particular technology approach. This approach creates an innovative environment and generally brings clean technologies to market in the safest, most cost-effective manner. [EPA-HQ-OAR-2014-0827-1462-A1 p.9]

For these reasons, we recommend that the agencies consider not requiring crankcase closure, but instead set equivalent performance standards that allow manufacturers to explore alternative or additional compliance mechanisms for HPDI engines. Doing so will help ensure that methane emissions from natural gas vehicles are safely and cost-effectively reduced. [EPA-HQ-OAR-2014-0827-1462-A1 p.9]

**Response:**

As described in the proposed rule, we believe that closed crankcases for compression-ignition and spark-ignition engines are both technologically feasible and important for achieving an additional level of emission control. However, we are aware that there are many instances in which secondary engine manufacturers design and certify their engine configurations based on an engine from a different engine manufacturer, and that closing the crankcase depends on proper designs for the engine block, valve cover, and other engine components. As such, this technology change for natural gas would likely require a substantial level of coordination with diesel engine manufacturers. We therefore plan to address this as part of a separate rulemaking, which could require closed crankcases for all compression-ignition engines (including diesel fueled engines) as early as model year 2021.

**12.2.4 Emerging Technologies/OBD**

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment****Comment – Liquid natural gas (LNG) boil-off warning systems**

The NPRM requests comment on the feasibility and appropriateness of a regulatory requirement that LNG-fueled vehicles include a warning system that would notify a driver of a pending boil-off event as one means of reducing the frequency of such events in an effort to limit methane releases to the atmosphere. U.S. EPA and NHTSA have suggested a warning light that would be illuminated once tank pressure exceeded a threshold in addition to an audible, periodic chime. In addition, the RIA notes that the components used as inputs to the boil-off warning system would be required to be monitored by OBD, and the number of boil-off events tracked and reported. CARB staff agrees that it seems valuable to have both a driver notification (so the operator can take action to prevent or mitigate a boil off) and tracking of boil offs that actually occur to help quantify the occurrences and guide development future requirements. However, CARB staff would like to note that tracking the history of boil-off events and the methods used for boil-off would require new communication messages to be defined in both SAE Standards J1939 and J1979 if the information is to be downloaded via scan tool. Because these data are currently not standardized, CARB staff suggests a simpler near term approach such as requiring installation of a dedicated light that would illuminate if the undesired boil-off to the atmosphere event occurred. This light could be designed to only be cleared by a dealership technician. Additionally, the light could provide the same information as the scan tool messages without implementation of new scan tool messages by blinking at key-on engine-off to indicate the exact number of undesired boil-off events that occurred on the vehicle since the memory was last cleared. As the necessary standardization required to obtain boil-off event information is developed, both driver notification and event tracking via OBD could be implemented. [EPA-HQ-OAR-2014-0827-1265-A1 p.106]

Note that if boil offs generally only occur when the vehicle is parked, a warning system would have to be active when the operator has shut down the vehicle. This means either the engine control module (or some other module on the vehicle) has to be kept alive during the vehicle shutdown period or some type of hardware (e.g., latching pressure-based, mechanical switches) has to be incorporated to sense the overpressure condition during the shutdown period. Both of these are feasible and have been done in OBD system implementations. However, it is not clear what the benefit is if the operator is not near the vehicle and is unable to respond. [EPA-HQ-OAR-2014-0827-1265-A1 p.106-107]

**Oppose/Requested Change Comment**

### **Comment – Methane leak detection**

While CARB staff supports the use of OBD to detect and provide a warning for when methane leaks from the CNG or LNG fuel system occur, staff is not certain if an actual methane leak check is required under the current requirements, or if rationality and functionality of sensors and components is required, or both. If a leak detection monitor is required, staff suggests that the leak size or leak rate be clearly defined. Additionally, it is important to note that simple rationality and functionality of sensors and components, which is what is required by comprehensive component monitoring, do not inherently indicate leaks in the system. A full system check would be required in order to ensure detection of CNG or LNG fuel system leaks. While feasibility of leak detection has not been determined, tank pressure profiles should follow predictable behavior and provide the basis for a monitoring strategy. In reality, the operator might notice a leak in many instances due to odor or a change in fuel level disproportionate to driving before the diagnostic system has adequate time to identify the leak and store a fault code. [EPA-HQ-OAR-2014-0827-1265-A1 p.107]

**Organization:** Environmental Defense Fund (EDF)

### **Account for all on-vehicle methane and require efforts to reduce these emissions**

Methane is emitted from natural gas trucks at the tailpipe and crankcase, and vented from liquefied natural gas (LNG) fuel tanks. The Phase 2 proposal makes important strides in reducing these emissions. [EPA-HQ-OAR-2014-0827-1312-A1 p.42]

The agencies also took an important step to recognize the significant potential for methane emissions from LNG fuel tanks.<sup>179</sup> EDF supports the agencies' decision to require a minimum hold time for these tanks. However, the proposed five-day requirement is insufficient. It reflects current industry practice, falling well short of the existing capacity of LNG tank technology. For example, Chart Industries, a leading producer of LNG tanks, brought to market a tank capable of a 10-day hold time in 2013.<sup>180</sup> Westport also claims a 10-day hold time with its existing Ice Pack tank.<sup>181</sup> Given that ten days is achievable today, the final rule should require at least this level of performance in 2021. The agency should consider further strengthening this standard in 2024 and 2027. [EPA-HQ-OAR-2014-0827-1312-A1 p.42]

### **G. Require on-board monitoring to track boil-off events**

The agencies requested comment on the use of on-board monitoring to track boil-off events as well as other methane discharges. EDF believes that requiring this data collection will enhance the ability of manufacturers, fleets, and refueling station owners to quantify the magnitude of methane emissions and take steps to minimize these emissions. Additionally, this data will provide the agencies with improved data quality on which to design effective future policies. [EPA-HQ-OAR-2014-0827-1312-A1 p.46]

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179 Preamble at 793-795; 817; 1020-1021.

180 Lockridge, D., "Chart Improves LNG Truck Fuel System," Heavy Duty Trucking, (April 8, 2013), available at <http://www.truckinginfo.com/channel/fuel-smarts/product/detail/2013/04/chart-improves-lng-truck-fuel-system.aspx>

181 Westport, “Leveraging the Benefits of Cold LNG,” available at <http://www.westport.com/products/fuel-storage-and-delivery/ice-pack-lng-tank-system/benefits> (last accessed September 23, 2015).

**Organization:** California Air Resources Board (CARB)

**Comment – More efficient natural gas storage**

The NPRM states that an adsorbent for natural gas (ANG), called metal organic framework (MOF) for storing CNG, has been developed and is being tested for large scale use. The substance stores the same quantity of natural gas in a smaller volume at the same pressure (about 60 percent of the energy density of diesel fuel), or stores the same density of natural gas at a lower pressure. [EPA-HQ-OAR-2014-0827-1265-A1 p.164]

CARB staff believes there is potential in the both adsorbent technology as well as conformable tanks. CARB staff suggests that to the extent that those technologies contribute to lighter weight tanks in the future, U.S. EPA and NHTSA should consider either revising the natural gas weight “penalties” or allow the manufacturers to get credit under the off-cycle technology credits (formerly referred to as “innovative technologies”). [EPA-HQ-OAR-2014-0827-1265-A1 p.164]

**Response:**

We asked for comment on requiring onboard diagnostic (OBD) systems on heavy-duty natural gas trucks to track methane leaks or boil-off events, or for other possible indicator systems to warn vehicle operators about potential impending methane releases to the environment. For a variety of reasons, we did not pursue these ideas for the final rulemaking.

One reason why we did not pursue OBD systems on natural gas heavy-duty trucks is that since the proposed rulemaking there has been a dramatic reduction in crude oil prices, and EIA projects continued low crude oil prices, which further reduces the chance that natural gas will make much headway displacing diesel fuel use by heavy-duty trucks. The low number of natural gas trucks would have an insignificant environmental impact even if there are some high methane emissions from natural gas trucks from time to time. Also it would be burdensome to manufacturers to require the addition of OBD systems on such a low production engine or truck.

Another reason why we did not pursue OBD systems on natural gas heavy-duty trucks is that we do not know the extent of the problem that we would be attempting to fix. We have no data on the number and quantity of methane that boils-off from LNG fueled natural gas trucks.<sup>229</sup> We also don’t have any data on the number of trucks which are leaking natural gas fuel and the magnitude of those leaks.

Without data for the number of boil-off events and the quantity of emissions per boil-off event, we still sought a simple, low cost method for detecting and registering a boil-off event with an OBD system. The simplest system we thought of would be to install a position sensor on the boil-off pressure relief valve (PRV) which would mechanically detect whether the PRV opened. If the PRV opened, the OBD

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<sup>229</sup> The lifecycle analysis contained a sensitivity analysis based on an assumption that a boil-off event occurs during each period between when the truck operator refuels his LNG truck with LNG. The sensitivity analysis, however, was not based on any specific emissions or truck operations data, although it did try to model the impact based on hearsay that some truck operators manually “boil-off” their LNG tanks prior to refueling to lower the tanks pressure to enable faster refueling.

system would register the opening and we could perhaps assume a quantity of methane released to the environment. We shared our idea with a PRV manufacturer which produces at least some of the PRVs used on natural gas trucks.<sup>230</sup> The manufacturer explained that PRV release events most likely would only be very small releases in which the PRV only opens a very small amount allowing the natural gas to only weep from the valve. The manufacturer explained that the very low heat intake in very well insulated LNG tanks would only allow a weeping of natural gas from the PRV for boil-offs from the LNG tank. For this type of release, a position sensor on the valve would likely not be sensitive enough to detect that the valve had in fact opened and had released natural gas as part of a boil-off event. Thus, a change of valve position to indicate boil-off events may not be a viable idea for detecting boil-off events.

We also sought a simple, low cost method for detecting leaks from CNG and LNG tanks that could be registered with the OBD system. For CNG systems, a pressure sensing device could measure whether there is a loss of pressure when the truck is not operating. This loss of pressure could be caused by a leak from the CNG system. The problem with the idea is that decrease in temperature could also cause a reduction in pressure which might be misinterpreted to be a reduction in pressure attributed to a leak. Thus, it would be necessary to measure both pressure and temperature to ensure that decrease in temperature is not responsible for the lowering pressure reading when the truck is not operating. When we ran through the calculations, only a very small change in temperature would be necessary to cause a sufficiently high loss in pressure that could indicate a possible leak. Thus, we would either have to resort to only sensing a fairly large leak, or abandon the idea of trying to detect a leak altogether to avoid indicating false positive leaks from CNG storage on heavy-duty trucks. However, natural gas has an odorant which may be detectable by the vehicle operator before this idea of a pressure/temperature sensors would, and the additional cost of the leak detection system would not be necessary. This sort of idea for detecting leaks from CNG trucks would require much more thought and analysis before being considered. A conceptually more realistic idea would be to set up a leak detecting system in the high pressure piping downstream of the CNG tanks, provided that the high pressure piping was isolated from the CNG tanks by a solenoid operating valve when the truck is not operating. This high pressure piping has a lot of pipe joints and is a more likely location for leaks than the CNG tanks. Again, this sort of idea would need some additional thinking and analysis before it were to be pursued.

The agencies note the ideas by CARB to incentivize the use of ANG as an innovative technology. As we describe in the proposed rulemaking, using ANG in an enclosed CNG system is one possible strategy for reducing the chance for boil-off events, but also have a similar storage density of LNG. As noted by CARB, this is a promising technology that if commercialized, then we will consider such incentives if the technology helps to reduce methane emissions and the industry does not voluntarily opt for the technology on its own. We went through a similar thought process when we considered pressure and temperature sensors for detecting leaks from LNG tanks. There are similar complications to this concept as well. Perhaps a more likely idea would be to measure whether the vacuum seal for the LNG tank has been compromised, which would cause a much faster heat influx into the LNG tank. The LNG tank manufacturer we spoke to stated that a complete loss of vacuum would cause frequent boil-off events to the point that the truck operator would likely immediately seek to have the problem remedied. The PRV manufacturer we spoke to said that there is not an off-the-shelf vacuum pressure detector that could be readily used for this service because of the ultra-cold temperatures involved. While leaks from CNG systems are likely to be detected from the odorant added to natural gas, LNG does not contain odorant after it has been liquefied. Thus, relying on the odorant to help find leaks is not a viable solution for LNG as CNG, unless if an odorant can be added to LNG after it was liquified. Again, these ideas require additional thought, analysis and perhaps some testing.

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<sup>230</sup> Conversation with Dino Dinafrio of Generant on March 31, 2016.



## **12.2.5 Aerodynamic Performance of Natural Gas Vehicles**

**Organization:** PACCAR, Inc.

It is difficult for PACCAR or any OEM to assess the aerodynamic impact of dealer / body builder installed natural gas fuel tanks. PACCAR conservatively places these vehicles in Bin I for aerodynamics and therefore cannot obtain credits.

**Organization:** Volvo Group

Natural Gas Aerodynamic Impact

Because of the high volume tanks required for on-board compressed natural gas (CNG) fuel storage and the cylindrical shape required to contain high pressure, we are unable to use conventional aerodynamic treatments for CNG fueled tractors. In addition, the extra space required for CNG tanks increases the trailer gap, further increasing the vehicle drag. Under the Phase 1 rule, this has resulted in loss of credits for every CNG tractor sold. With the engine included as part of the vehicle simulation in Phase 2, we expect the lower GHG emissions from the NG engine to help offset the poor aerodynamics, but there is still some risk that this regulation could be detrimental to expansion of natural gas utilization if engine efficiency and methane emissions cannot achieve sufficient GHG advantage over diesel. [EPA-HQ-OAR-2014-0827-1290-A1 p.48]

**Response:**

We do not believe that natural gas vehicles inherently have worse aerodynamic performance. Rather, we believe aerodynamic inefficiency for current vehicles is a result of non-optimized designs. As natural gas comprises a larger portion of the fuels used by the heavy-duty truck sector, we expect that tractor cabs will be optimized to accommodate storage of natural gas without harming aerodynamic performance.

## **12.3 GHG Lifecycle Analysis for Natural Gas Vehicles**

### **12.3.1 Methane GWP**

**Organization:** Center for Biological Diversity

#### **The EPA Must Promulgate Specific Lifecycle-Based Limits on Tailpipe Emissions from Natural Gas Vehicles and Engines**

Several groups have undertaken detailed “well-to-wheels” analyses of the climate cost-benefit tradeoff for switching from gasoline or diesel to natural gas in the transportation sector using the most recent, research-based estimates of methane’s global warming potential (“GWP”) and atmospheric lifetime, upstream leakage rates from natural gas operations, and efficiency differences between diesel and natural gas engines. The overarching message is that with current technology switching to natural gas heavy-duty trucks will cause net harm to the climate in the coming decades to centuries.<sup>80</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.15-16]

**Organization:** Environmental Defense Fund (EDF)

**A. A new, more comprehensive lifecycle analysis of NGVs is needed**

The agencies' attempt to quantify the climate impact of natural gas trucks should be strengthened in several ways. The agencies relied exclusively on data from the Greenhouse Gas Inventory (GHGI), leading to a lifecycle analysis (LCA) that likely underrepresents the amount of methane emitted into the atmosphere across the natural gas supply chain. The agencies also relied on outdated Global Warming Potentials (GWPs) for methane, which do not reflect the latest available science on methane's impact on the climate system. [EPA-HQ-OAR-2014-0827-1312-A1 p.39-40]

In the proposed Phase 2 standards, EPA takes critical steps in providing such an LCA. However, there are a number of areas for improvement, as highlighted in this paper, especially concerning sensitivity analyses related to upstream methane emissions, GWPs, and the carbon dioxide-credit program. [EPA-HQ-OAR-2014-0827-1312-A1 p.40]

#### **B. Use the current and appropriate GWP values for methane emissions**

Each greenhouse gas has its own potential to impact the climate, and those impacts can differ over time. To evaluate the climate impact of a non-CO<sub>2</sub> greenhouse gas, such as methane, one methodology is to convert those emissions to a unit equivalent to CO<sub>2</sub>, using the GWP of the gas at issue. GWP is a measure of the climate forcing potential of a gas (such as methane) relative to CO<sub>2</sub>. [EPA-HQ-OAR-2014-0827-1312-A1 p.41]

The most recent IPCC establishes the 100-year GWP for methane at a figure of at least 28, meaning that methane is 28 times more potent than CO<sub>2</sub> over a 100-year period.<sup>175</sup> However, because methane causes greater climate damage over shorter rather than longer time frames, choosing a 100-year GWP will undervalue the short-term impacts of methane. Accordingly, the benefits of methane reductions should also be valued using the most recent 20-year GWP for methane, which is at least 84. [EPA-HQ-OAR-2014-0827-1312-A1 p.41]

These GWP values for methane (28 over 100 years and 84 over 20 years) are conservative because they do not include climate-carbon ("cc") feedbacks (which are feedbacks between climate change and the carbon cycle). The latest IPCC report concludes that when cc is considered, methane has an even higher GWP on both 100- and 20-year timeframes of 34 and 86, respectively. Other scientific analyses have likewise determined that methane is an even more potent climate forcer. [EPA-HQ-OAR-2014-0827-1312-A1 p.41]

While EPA does consider both 20-year and 100-year GWPs in its LCA, the GWP values it uses should be updated to the estimates referenced above from the latest IPCC report. In addition, the shorter-term impacts of methane are important when comparing emissions from natural gas vehicles to that of diesel vehicles. In recent research, Camuzeaux et al. have found that switching from diesel to natural gas heavy-duty fleets could create damages to the climate for 50 to 90 years before the fuel switch would create any climate benefits, due to the short term impact of methane emitted to the atmosphere across the natural gas value chain. [EPA-HQ-OAR-2014-0827-1312-A1 p.41]

As a direct application of these considerations, we urge EPA to incorporate short-term GWPs when establishing the GHG equivalence value of methane within the rule's carbon dioxide credit program. [EPA-HQ-OAR-2014-0827-1312-A1 p.41]

**Organization:** NGVAmerica

**J. GWP Values for Methane (CH<sub>4</sub>) and N<sub>2</sub>O. EPA has proposed using the GWP values identified in the IPCC Fourth Assessment** [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

NGVAmerica strongly supports the continued use of the GWP values used under the Phase 1 rules. These GWP values have long-standing acceptance and are used for purposes of the greenhouse gas regulations covering light and medium duty passenger cars, and also for numerous other EPA rules. Using these values provides consistency and uniformity across a number of regulatory programs and allows efficient comparisons across these regulatory programs. Therefore, we strongly urge EPA to continue to use the GWP values adopted under Phase 1. [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

**Organization:** ICCT

Delgado and Muncrief (2015) determined that inadequate attention towards limiting methane leakage from heavy-duty natural gas vehicles (NGVs), could diminish the Phase 2 program benefits by as much as 38 percent in 2040, if there was a major breakthrough in NGV sales and using 20-year global warming potential for methane. We recommend that the agencies take every opportunity available within the purview of this regulation to minimize methane emissions throughout the value chain and to promote higher-efficiency natural gas engines. [EPA-HQ-OAR-2014-0827-1180-A4 p.17]

**Organization:** American Gas Association

Establishing a global warming potential (GWP) is a critical issue in any GHG program. EPA has wisely adopted a single GWP that it uses consistently in all of its programs and reporting obligations. More specifically, EPA consistently uses a 100-year GWP of 25 for methane. This GWP was established in the IPCC's Fourth Assessment Report (AR4), which was published in 2007. We strongly support maintaining this approach for the Phase 2 Rule. [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

Examples of EPA's use of the AR4 GWP include:[EPA-HQ-OAR-2014-0827-1223-A1 p.2]

\* The LD Phase 1 Rule, the LD Phase 2 Rule, and the HD Phase 1 Rule;5,6,7 [EPA-HQ-OAR-2014-0827-1223-A1 p.2]

\* EPA's Emissions Factors for Greenhouse Gas Inventories;8 [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

\* The recently-announced strategy to reduce methane from the oil and natural gas industry;9 [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

\* The Greenhouse Gas Reporting Rule;10 and [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

\* The national inventory of GHG emissions and sinks.11 [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

In addition to ensuring internal consistency among EPA's many greenhouse gas programs, maintaining the use of the AR4 GWP also enables EPA to coordinate its data with the data collected by EPA pursuant to its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). Doing so "improves EPA's ability to analyze corporate, national, and sub-national GHG data consistently, enhances communication of GHG information between programs, and gives outside stakeholders a consistent, predictable set of GWPs to avoid confusion and additional burden."12 [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

We strongly support the continued use of the AR4 GWP in this Proposal. Furthermore, we believe that changing the GWP should be an agency-wide decision, and not an outcome of any particular sector-specific rule. Anything else could result in a patchwork of inconsistent metrics being used across the array of EPA programs. [EPA-HQ-OAR-2014-0827-1223-A1 p.3]

**Organization:** Waste Management (WM)

### **WM Supports the Use of the Agency-wide GWP Value for Methane**

WM supports the use of the global warming potential (GWP) for methane that was published in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). In 2014 revisions to the Federal Greenhouse Gas Reporting Rule program (GHGRP), EPA adopted the IPCC's AR4 GWP values for selected GHGs and explained their adoption was to "increase the accuracy of the CO<sub>2</sub>e estimates collected under the GHGRP to better inform EPA policies. The AR4 GWPs will complement the reporting metrics used in other U.S. climate programs, including the Inventory that is submitted to the United Nations Framework Convention on Climate Change (UNFCCC)." [EPA-HQ-OAR-2014-0827-1214-A2 p.5]

Maintaining consistency across EPA climate programs and with the UNFCCC is essential to ensure the comparability and reliability of GHG measurement and reporting. Using consistent GWPs enables the agencies to review more efficiently data collected across multiple domestic climate programs, and to reduce the potential for errors. Use of consistent GWPs also reduce the burden for the regulated community and regulators that would need to track differing GWPs used across multiple federal programs. [EPA-HQ-OAR-2014-0827-1214-A2 p.6]

Parties to the UNFCCC, including the U.S., have agreed to submit annual reports in 2015 and future years using the GWP values from the IPCC AR4. The U.S. government has not agreed to change GWPs pursuant to subsequent IPCC assessment reports. We think it is wholly appropriate and consistent for OTAQ to continue using a methane GWP of 25, based on a 100-year timeframe. Should the Federal government determine that subsequent revisions to GWPs are appropriate; a broader rulemaking that encompasses all the domestic climate programs would be the appropriate mechanism to make that change – not the OTAQ rulemaking, which is narrowly focused on medium and heavy-duty truck emissions. [EPA-HQ-OAR-2014-0827-1214-A2 p.6]

**Organization:** Institute for Policy Integrity at NYU School of Law

***GWP Values for Credit Programs:*** The agencies ask whether they should continue using the IPCC 4th Assessment Report values for relative global warming potentials on a 100-year timescale to calculate the credits for non-carbon dioxide gases. They should not. Under Executive Orders 12,866 and 13,563, agencies are required to use the "best available science" in rulemaking.<sup>5</sup> The 4th Assessment Report is outdated and no longer reflects the global scientific consensus about relative global warming potentials. At a minimum, the agencies should update the values to reflect the IPCC 5th Assessment Report. Moreover, focusing solely on the 100-year timescale overlooks the more potent effects of some greenhouse gases, like methane, in the short term. The agencies should consider the 20-year timescale estimates. One option to consider might be averaging the 20-year and 100-year estimates.

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5 Exec. Order No. 13,563 §1(a) (Jan. 18, 2011).

### **Response**

The Phase 1 GHG rule included a compliance alternative allowing heavy-duty manufacturers and conversion companies to comply with the respective methane or nitrous oxide standards by means of over-complying with CO<sub>2</sub> standards (40 CFR 85.525). More specially, EPA allows manufacturers to use CO<sub>2</sub> credits (generated from the same averaging set) to comply with the methane and nitrous oxide

requirements after adjusting the CO<sub>2</sub> emission credits based on the relative GHG equivalents. To establish the GHG equivalents used by the CO<sub>2</sub> credits program, the Phase 1 heavy-duty vehicle rulemaking incorporated the IPCC Fourth Assessment Report GWP values of 25 for CH<sub>4</sub> and 298 for N<sub>2</sub>O, which are assessed over a 100 year lifetime. EPA is largely continuing this allowance for Phase 2.

Since the Phase 1 rule was finalized, a new IPCC report has been released with new GWP estimates. EPA asked for comment on whether the methane GWP used to establish the GHG equivalency value for the CO<sub>2</sub> Credit program should be updated to those established by IPCC in its Fifth Assessment Report (AR5). The IPCC AR5 presents four different potential values for the GWP of methane over a 100 year lifetime, ranging from 28 to 36. These values are the result of slightly different calculation methods. Therefore, we not only requested comment on whether to update the GWP for methane to that of the AR5, but also on which value to use from this report. The GWPs of 28 and 30 are both a result of using a carbon cycle approach consistent with that used in the Fourth Assessment Report. This carbon cycle approach included a climate-carbon feedback when calculating the lifetime of a pulse of carbon dioxide emissions, but did not include any climate-carbon feedback when calculating the impacts of a pulse of non-CO<sub>2</sub> greenhouse gas emissions. As the GWP is the ratio of the impact of a pulse of non-CO<sub>2</sub> GHG emissions relative to a pulse of carbon dioxide emissions, a second approach was presented where the non-CO<sub>2</sub> GHG pulse also included climate-carbon feedbacks. This second approach yields GWP values of 34 or 36. For the purposes of this rule, EPA is choosing the approach that includes climate-carbon feedbacks for both non-CO<sub>2</sub> and CO<sub>2</sub> pulses, as the agency considers this the approach most likely to be adopted by the international scientific community in future assessments on the timescale of this rule. The IPCC presents the value of 34 as the default value for the methane GWP, but also reports a value of 36 for “fossil” methane to take into account the atmospheric CO<sub>2</sub> that would result from the oxidation of methane in the atmosphere.

We received a number of comments on this issue. For the most part, the environmental community favored using the more recent GWP value and even some commented that EPA should use a methane GWP based on a 20 year timeframe. On the other hand, the natural gas industry and natural gas truck manufacturers commented that EPA should not update to the newer GWP values but continue to use the methane GWP value from the AR4 IPCC report because EPA is still using the methane GWP from the AR4 today in other contexts. Although EPA is currently using AR4 values in other contexts, it is unlikely that EPA will still be using AR4 values in 2021 when the Phase 2 requirements begin. Thus, commenters opposing the use the methane GWP from the later IPCC report are not persuasive. EPA will continue to base the credit adjustment on a 100 year timescale because it seems to best balance short-term versus long-term effects of climate change.

Of the possible 100 year methane GWP values presented in the IPCC AR5 report, EPA is choosing to use the value of 34 because it is the primary value presented by the IPCC and because the approach of not accounting for the CO<sub>2</sub> oxidation product within the GWP for methane is consistent with prior IPCC practice.<sup>231</sup> The use of this GWP for credit adjustments will not begin until 2021, when the Phase 2 engine standards go into effect. The choice of this GWP value for future rules on this timescale does not prejudice the choice of other GWP values for use in regulations and other purposes in the near term.

To be consistent across all its programs and reporting, EPA is using the global warming potentials (GWP) based on the AR4 IPCC report for our analyses in this rulemaking. An important driver for using the AR4 values for GWPs is the United Nations which requires that individual nations report their GHG emissions to the United Nations Framework Convention for Climate Change (UNFCCC) using

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<sup>231</sup> The corresponding N<sub>2</sub>O value from the AR5 report is 298, which is the same as the value used in Phase 1.

GWP values from the AR4 IPCC report and based on 100 year time period. EPA updated to the GWP values in IPCCs AR4 report when the UNFCCC decided to use the GWP values from that report.

The agencies understand that methane's GWP varies based on the time periods over which the heat trapping impact of methane is evaluated. EPA uses 100 years as the timeframe for evaluating GHG impacts in unity with the reporting requirements to the UN and because it seems to provide the best compromise between the short term and the long term effects of climate change. To show the effect that different GWPs based on different timeframes have on the lifecycle impact, the agencies also provided lifecycle comparisons between natural gas heavy-duty trucks and diesel fuel heavy-duty trucks when methane and nitrous oxide are evaluated over 20 year and 500 year timeframes. See RIA 13.1.4.

## 12.4 Other Lifecycle Comments1744

**Organization:** American Gas Association (AGA) et al.

We recommend that the agencies remove the GHG Lifecycle Analysis for Natural Gas Vehicles

Since the first Clean Air Act regulations were adopted more than forty years ago, EPA has adopted emissions standards for vehicles without considering the upstream impacts of the fuels used in those vehicles. Instead, EPA's approach has been to regulate upstream emissions at the source. [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

In this Proposal, the agencies have stated that "compliance is based on vehicle fuel consumption and GHG emission reductions, and does not reflect any so-called lifecycle emission properties."<sup>30</sup> We strongly agree with this approach. [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

Nevertheless, the agencies have asked for comments on including a GHG lifecycle analysis for natural gas vehicles in the Proposal as well as the Draft Regulatory Impact Analysis (DRIA).<sup>31</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

We recommend that the agencies remove the GHG lifecycle analysis for natural gas vehicles from both the Proposal and DRIA unless they include a GHG lifecycle analysis for all fuels used by trucks to be regulated by the final rule, i.e., gasoline, diesel, natural gas, electric, and fuel cells. We believe that either approach would enable the agencies and the general public to more accurately compare fuels being used in the truck and bus sectors. Including a GHG lifecycle analysis only for natural gas vehicles will be prejudicial to the use of natural gas vehicles in those settings where it is cost-effective to do so, and incorrectly implies that other fuels do not have upstream emissions impacts or other lifecycle impacts that should be considered. [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

If the agencies decide to include a lifecycle analysis in the Proposal and DRIA, we request the opportunity to provide additional data or other materials to the agencies after the close of the comment period, and to continue the dialogue about this issue thereafter. [EPA-HQ-OAR-2014-0827-1223-A1 p.8]

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25 Methane may be present in very small amounts if exhaust gas recirculation (EGR) is used.

30 Phase 2 Proposal, page 40159.

31 Phase 2 Proposal, pages 40389, 40506-40514; “Draft Regulatory Impact Analysis.” Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles–Phase 2, June 2015.  
<http://www.epa.gov/oms/climate/documents/420d15900.pdf>.

**Organization:** American Iron and Steel Institute

### **B. EPA Must Take a Coherent Approach to Regulating Upstream Emissions from Vehicles**

The Proposed Rule extensively analyzes upstream and downstream emissions related to natural gas vehicles. EPA utilizes 2012 methane emission estimates from the most recent GHG Inventory report and '[r]ather than attempt to disaggregate [specific emissions from different equipment used in natural gas production] from the rest of process emissions in the GHG Inventory . . . used the estimated emissions for these sources provided by GREET.' EPA also totaled CO<sub>2</sub> and nitrous oxide emissions for the upstream and downstream portions of the natural gas system and converted these values into CO<sub>2</sub> equivalents. EPA then compared the life cycle emissions of natural gas against the base fuel it was replacing, diesel. Additional analysis was completed as between different types of natural gas vehicles. Although EPA does not propose provisions to address or account for such emissions, the agency does ask for comment as to '[w]ould it be appropriate to adjust the tailpipe GHG emission standard for natural gas vehicles by a factor to reflect the life cycle emissions of natural gas vehicles relative to diesel vehicles?' [EPA-HQ-OAR-2014-0827-1275-A1 p.12]

The treatment of natural gas vehicles in the Proposed Rule demonstrates two things. First, EPA believes that it is entirely capable of assessing complex information regarding upstream emissions. The agency examined various technologies and made use of existing inventory information and other assessments of the GHG impacts of producing, transporting and using natural gas in medium- and heavy-duty vehicles. Second, EPA believes that the information contained in the Proposed Rule is sufficient to allow for a final rule that addresses such life cycle emissions. Specifically, EPA indicates that 'we may consider adopting such provisions in the final rule . . .' [EPA-HQ-OAR-2014-0827-1275-A1 p.12-13]

While AISI takes no position on whether EPA should promulgate such natural gas standards in the final rule, it would be arbitrary for EPA to address some life cycle emissions while ignoring information submitted in our comments and elsewhere regarding the benefits of addressing the life cycle emissions of materials. Such a disparate treatment could not be justified on the basis of the available information. Information regarding energy used (and other life cycle impacts) to produce steel is of high quality and compares favorably with the information that EPA relies on to assess GHG emissions associated with upstream natural gas production. Similar high quality information about other heavy truck materials is available. [EPA-HQ-OAR-2014-0827-1275-A1 p.13]

**Organization:** American Trucking Associations (ATA)

### **Natural Gas Carbon Footprint Should Exclude Upstream Emissions**

ATA supports the long-standing practice of only regulating tailpipe emissions as opposed to accounting for the life-cycle carbon footprint associated with natural gas combustion. Assessing and determining upstream emissions is an extremely complicated undertaking. State and federal regulations are, or will soon, address upstream carbon emissions both at production and distribution networks. Therefore, we support the decision not to include upstream emissions in the standards used to regulate motor vehicles and engines. [EPA-HQ-OAR-2014-0827-1243-A1 p.22]

**Organization:** California Air Resources Board (CARB)

**Neutral/Provide Additional Information Comment**

**Comment – Phase 2 standards apply exclusively at the vehicle tailpipe and do not reflect lifecycle emissions**

CARB staff understands the reasoning behind U.S.EPA and NHTSA’s proposal to apply Phase 2 standards exclusively at the vehicle tailpipe (rather than reflecting full lifecycle emissions), in order to better harmonize the fuel efficiency and GHG emission standards. CARB staff also appreciates the inclusion of a lifecycle analysis for natural gas and diesel trucks, even though the proposed standards are tailpipe only, as it illustrates the relative GHG benefits of different vehicle/fuel combinations and the potential reduction in the tailpipe GHG benefits of CNG due to methane leakage during refueling or LNG boil-off as the vehicle sits idle. [EPA-HQ-OAR-2014-0827-1265-A1 p.160]

CARB staff suggests including BEVs and FCEVs in the lifecycle analysis. Those technologies are extremely efficient at utilizing energy for motive power and the lifecycle results are compelling. GVWR are expected to produce significantly less GHG emissions than similar MY conventional diesel fueled trucks on a WTW basis. [EPA-HQ-OAR-2014-0827-1265-A1 p.160]

**Oppose/Requested Change Comment**

**Comment – Natural gas engines must meet the Phase 2 diesel or gasoline tailpipe CO2 standards**

According to the NPRM, natural gas engines must meet the Phase 2 diesel or gasoline standards (depending on the service application) and fuel consumption is then calculated according to their tailpipe CO2 emissions. This would likely create a small balanced incentive for natural gas use. A natural gas vehicle that achieves approximately the same fuel efficiency as a diesel powered vehicle would emit 20 percent less CO2; a natural gas vehicle with the same fuel efficiency as a gasoline vehicle would emit 30 percent less CO2.<sup>65</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.160-161]

CARB staff believes that future natural gas engines, if certified to one of CARB’s optional NOx standards and operated on renewable natural gas,<sup>66</sup> would reduce both NOx and GHG emissions. Many stakeholders are advocating for broad use of natural gas vehicles in California, particularly in the South Coast Air Basin and other areas that need near-term NOx reductions to meet federal ozone ambient air quality standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.161]

However, as shown in U.S. EPA and NHTSA’s lifecycle analysis, if methane emissions from the vehicle and from upstream production and distribution are not well controlled (for example, boil-off from LNG vehicles that are parked for multiple days), natural gas engines have the potential to actually increase GHG emissions. It is important to strengthen natural gas engine and vehicle requirements to ensure we maximize the benefits of the cleaner fuel as well as the most efficient vehicle technology. CARB staff will continue to work with U.S. EPA and NHTSA as well as engine and vehicle manufacturers to require the use of efficient engine and vehicle technology, reduce NOx emissions, and minimize fugitive methane emissions. Additional comments on requirements are also included. [EPA-HQ-OAR-2014-0827-1265-A1 p.161]

**Oppose/Requested Change Comment**



### **Comment – Lifecycle emissions incorporated into the certification level**

Based on U.S. EPA and NHTSA’s lifecycle analysis, the impact of leaks and other methane emissions that occur upstream of the vehicle can potentially be large enough to more than offset the CO<sub>2</sub> benefit of natural gas vehicles as measured at the vehicle tailpipe. U.S. EPA and NHTSA are considering separate action to control these upstream emissions. U.S. EPA and NHTSA are concerned that the high-GWP of methane makes even small leaks of natural gas of concern. The NPRM requests comment on whether it would be appropriate to adjust the tailpipe GHG emission standard for natural gas vehicles to reflect the relative lifecycle emissions relative to diesel. [EPA-HQ-OAR-2014-0827-1265-A1 p.161-162]

U.S. EPA and NHTSA state that if, for example, they were to determine that the lifecycle climate impacts of natural gas vehicles were 150 percent of the tailpipe GHG emissions, while the lifecycle climate impacts of diesel vehicles were 135 percent of the tailpipe GHG emissions, they could approximate the relative climate impacts by setting the natural gas tailpipe emission standard 10 percent lower than the diesel tailpipe standard. U.S. EPA and NHTSA state “We recognize that there is significant uncertainty in assessing these relative climate impacts, and that they could change as new production methods and/or regulations go into effect. Thus commenters supporting making such an adjustment are encouraged to address this uncertainty. Commenters are also encouraged to address how such an adjustment for GHG emissions would impact the closely coordinated EPA and NHTSA heavy-duty Phase 2 program including how a potential adjustment for upstream methane emissions for natural gas fueled vehicles would impact the coordination of EPA GHG regulations with the NHTSA fuel consumption regulations.” [EPA-HQ-OAR-2014-0827-1265-A1 p.162]

CARB staff believes that future natural gas engines, if certified to one of CARB’s optional NO<sub>x</sub> standards and operated on renewable fuels, have the potential to reduce both NO<sub>x</sub> and GHGs and provide needed near term reductions. To ensure those reductions are realized, it is important to strengthen natural gas engine and vehicle requirements to maximize the benefits of the cleaner fuel as well as the most efficient vehicle technology. CARB staff believes it is appropriate to have separate standards for natural gas engines and also important that actions be taken to minimize methane emissions from both the vehicle and the upstream natural gas production and distribution system. Steps to minimize emissions from the vehicle should include requiring a closed crankcase, limiting boil-off from LNG vehicles, and limiting tailpipe methane and N<sub>2</sub>O. Additional comments on requirements are also included. [EPA-HQ-OAR-2014-0827-1265-A1 p.162]

As for adjusting tailpipe standards to account for upstream emissions, the ICCT in their “Assessment of Heavy-Duty Natural Gas Vehicle Emissions: Implications and Policy Recommendations,” July 2015, recommends an approach that would phase-in the inclusion of upstream emissions in the certification for natural gas heavy-duty vehicles. CARB supports phasing-in inclusion of upstream emissions in the certification for natural gas heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.162]

### **Neutral/Provide Additional Information Comment**

#### **Comment – Supplemental and clarifying information regarding WTW analysis of CNG and LNG and comparison to CARB results.**

CARB staff has four main comments regarding the WTW analysis presented in the NPRM: [EPA-HQ-OAR-2014-0827-1265-A1 p.167]

1. **The analysis should use GREET's U.S. diesel result, and should identify the version of GREET used.** U.S. EPA and NHTSA use a 2005 NETL analysis to determine the carbon intensity of U.S. diesel. Given that a version of Argonne National Laboratory's GREET model was used for the majority of U.S. EPA and NHTSA's WTW natural gas analysis, CARB staff recommends using the result from the same version of GREET for diesel. If they are based on a different baseline, the results should not be expressed in percent reduction from diesel; it would be preferable to use the same U.S. diesel baseline, or just report the carbon intensity directly.<sup>67</sup> Also, the NPRM does not identify the version of the GREET model used in U.S. EPA and NHTSA's WTW analysis of natural gas fuels (first mention of the use of the GREET model occurs on page 40404). Argonne National Laboratory releases an update nearly every year and 2013/2014 versions included changes to natural gas systems, so it is important to note the model year. [EPA-HQ-OAR-2014-0827-1265-A1 p.167]
2. **USEPA accurately portrays CARB's August 2014 WTW analysis, but we would like to share some updated information based on our work since then.** On page 40508-40509, the NPRM presents draft results from CARB's August 2014 WTW analysis. CARB staff has since finalized its estimates of WTW carbon intensity for CNG and LNG: without adjusting for natural gas vehicle fuel economy, the carbon intensity of CARB's North American natural gas to CNG pathway is 78.36 gCO<sub>2</sub>e/MJ, or 76.82 percent of CARB-ULSD WTW emissions and the carbon intensity of CARB's North American natural gas to LNG pathway is 84.55 gCO<sub>2</sub>e/MJ, or 82.89 percent of CARB- Ultra Low Sulfur Diesel (ULSD) WTW emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.167-168]
3. **U.S. EPA and NHTSA's WTW analysis results in the NPRM are similar to CARB's and where they differ, the differences are primarily due to unique California circumstances.** CARB staff agrees that the U.S. EPA and NHTSA's results "are very similar to those estimated by CARB and when there are differences, the differences are as expected." [EPA-HQ-OAR-2014-0827-1265-A1 p.168]

CARB staff believes that the carbon intensity of CNG determined by U.S. EPA and NHTSA is lower than the result in CARB's analysis primarily because the transmission distance from Western U.S. natural gas sources to end users in California is greater than the national average. [EPA-HQ-OAR-2014-0827-1265-A1 p.168]

CARB staff estimates the carbon intensity of LNG to be lower than U.S. EPA and NHTSA's analysis, due to the following factors: [EPA-HQ-OAR-2014-0827-1265-A1 p.168]

- CARB staff assumes a typical liquefaction stage thermal efficiency of 90 percent (resulting in 8.44 gCO<sub>2</sub>e/MJ for the liquefaction stage), rather than 80 percent (which would result in 18.29 gCO<sub>2</sub>e/MJ using California grid electricity), reflecting an assumption that most LNG used in California is produced at large centralized facilities. Under the LCFS, each LNG producer must demonstrate the actual efficiency, meaning some individual LNG pathways will result in higher WTW emissions than given in CARB's illustrative scenario;
- CARB staff does not quantify any venting from the refueling or the vehicle operation stages due to lack of data, but does not disagree with the sensitivity analysis used by U.S. EPA and NHTSA; and
- There may be differences in the mode and distance of LNG transport; the U.S. EPA and NHTSA document does not provide sufficient information to determine the transportation and distribution assumptions or their resulting impacts.

4. **CARB staff does not recommend U.S. EPA and NHTSA rely on the U.C. Davis study referenced on page 40509 of the NPRM, as we believe that study is flawed.**<sup>68</sup> The U.C. Davis study

used GREET 2014 to explore the role of natural gas in the U.S. trucking industry, and reported that: [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

(A) CNG has higher WTW GHG emissions than LNG, and [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

(B) CNG and LNG have higher WTW GHG emissions relative to diesel when used in spark-ignited engines (with EER=0.9). [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

CARB staff disagrees with this analysis and finds that under most scenarios, when a methane GWP of 25 is used, both CNG and LNG have a life cycle GHG benefit over diesel. CARB staff believes the UC Davis report reached incorrect conclusions due to using flawed assumptions, including inappropriately using default transport parameters in GREET 2014 (which tend to reduce assumed LNG transport emissions), incorrect assumptions regarding the efficiency of LNG-fueled heavy-duty pilot ignition engines, and not quantifying losses from the LNG vehicle tanks, among others. [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

### **Oppose/Requested Change Comment**

#### **Comment – Supplemental and clarifying information regarding CARB analysis**

There is a misprint/typo on page 13-22: [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

For the CARB emissions estimates, we used the estimates made for what it terms purposes” using the 2013 version of the CARB GREET model as published in August, 2014. [EPA-HQ-OAR-2014-0827-1265-A1 p.169]

CARB staff believes this should read: [EPA-HQ-OAR-2014-0827-1265-A1 p.170]

For the CARB emissions estimates, we used the estimates made for what it terms “illustrative purposes” using the 2013 draft version of the CA-GREET2.0 model as published in August, 2014. [EPA-HQ-OAR-2014-0827-1265-A1 p.170]

Regarding the statement comparing CARB and U.S. EPA results on page 13-22, “CARB estimates that CNG engines emit 76 percent of the CO<sub>2</sub>eq emissions as a diesel truck, while our analysis estimates that CNG engines emit 81 percent of the CO<sub>2</sub>eq emissions as a diesel truck,” the “percent of diesel emissions” basis does not provide a direct comparison of the CNG results, as CARB and U.S. EPA do not use the same diesel emissions as baseline. In the CA-GREET2.0 analysis, CARB-ULSD was determined to have a carbon intensity of 102.01 gCO<sub>2</sub>e/MJ, while U.S. EPA and NHTSA appear to use approximately 93 gCO<sub>2</sub>e/MJ as a baseline (98,000 g/MMBtu, estimated from Figure 13-2 of the RIA). [EPA-HQ-OAR-2014-0827-1265-A1 p.170]

While CARB staff does not object to the value used as a diesel baseline (this value is meant to reflect the national average WTW emissions of diesel fuel and CARB staff can provide no insight on the accuracy of results outside of California), we suggest that CNG, LNG and diesel should be compared using the same model in order to obtain the most robust results. Given that a version of Argonne National Laboratory’s GREET model was used for the majority of U.S. EPA and NHTSA’s WTW natural gas analysis, we recommend using the result from the same version of GREET for diesel. [EPA-HQ-OAR-2014-0827-1267 p.170]

The parameters used to determine methane leakage, LNG boil-off, process energy demand, and the impacts of these inputs are presented clearly and comprehensively; however, the NPRM do not provide information on the transportation and distribution assumptions or resulting impacts modeled for the CNG or LNG pathways. These transport modes and distances are a major driver of the difference between the GREET and CA-GREET2.0 model results. If default transport parameters from GREET 2014 were used in U.S. EPA and NHTSA's analysis, the following table provides a breakdown and contrast of the differences in the two models. [EPA-HQ-OAR-2014-0827-1265-A1 p.170]

[Table 17 can be found on p.171 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

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65 This is because natural gas has lower carbon content than either diesel or gasoline.

<sup>66</sup> See [http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins\\_mhdd\\_a0210630\\_8d9\\_0d20-0d01\\_ng.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins_mhdd_a0210630_8d9_0d20-0d01_ng.pdf) and [http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins\\_ub\\_a0210629\\_8d9\\_0d20-0d01\\_ng.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins_ub_a0210629_8d9_0d20-0d01_ng.pdf) for Cummins natural gas certification on 8.9L engines to 0.02 g/bhp-hr NOx standard, September 2015.

67 CARB staff finds the WTW emissions of California ULSD to be 102 g CO<sub>2</sub>e/MJ, approximately 9 gCO<sub>2</sub>e/MJ higher than the value U.S. EPA uses to represent the WTW emissions of average U.S. diesel (approximately 93 gCO<sub>2</sub>e/MJ or 98,000 g/MMBtu, which we estimate from Figure 13-2 of the RIA). This lack of common baseline confounds the comparison between the NPRM's and CARB's results for natural gas fuels.

<sup>68</sup> (Jaffe, 2015) Jaffe, Amy Myers, "Exploring the role of Natural Gas in U.S. Trucking," NextSTEPS Program, UC Davis Institute of Transportation Studies, February 18, 2015.

**Organization:** Center for Biological Diversity

### **The EPA Must Promulgate Specific Lifecycle-Based Limits on Tailpipe Emissions from Natural Gas Vehicles and Engines**

As currently proposed, the Phase 2 standards tailpipe methane would be maintained at Phase 1 levels (0.1 g/bhp-hr or 0.5 g/mi) and CO<sub>2</sub> emissions limits for natural gas vehicles and engines would be the same as those that apply to diesel engines. The only difference would be the requirement for closed crankcases on natural gas engines. This is an important step as it can reduce the amount of methane that is emitted during operation of the engine. But closure of crankcases is only one of a number of technology options that should be considered to reduce methane emissions during operation, including more effective methane catalysts and elimination of dynamic venting.<sup>76</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.15]

The EPA is proposing to require manufacturers to follow the industry standard of a 5-day or less holding limit for LNG vehicles, which we support. The EPA also requested comment regarding other measures to limit boil-off events and associated emissions from LNG vehicles. The Center urges the EPA to require on-board monitoring and warning systems. In addition, we support the EPA in its intention to reduce fugitive methane emissions during refueling. [EPA-HQ-OAR-2014-0827-1460-A1 p.15]

On the other hand, we have grave concerns with the EPA's proposal to allow natural gas vehicles to be treated as diesel engines for the purpose of tailpipe emissions. The EPA notes that per unit of fuel consumed, natural gas vehicles are able to meet the same tailpipe efficiency standard more easily than a gasoline or diesel engine, creating an "incentive" for natural gas vehicles. The Proposed Rule asserts that this is an "appropriate" balance between climate and energy security,<sup>79</sup> but the Center strenuously disagrees. [EPA-HQ-OAR-2014-0827-1460-A1 p.15]

A single tailpipe standard does not account for the difference in upstream emissions between natural gas and diesel; nor does it account for the reduced work efficiency of natural gas as opposed to diesel engines. The large difference in upstream emissions and the potency of methane as a global warming pollutant necessitates a separate natural-gas specific standard. [EPA-HQ-OAR-2014-0827-1460-A1 p.15]

The Proposed Rule and Draft Regulatory Impacts Analysis ("RIA") also include a lifecycle analysis for natural gas and diesel engines. The EPA performed a sensitivity analysis for differing thermal (work) efficiencies as well as for different methane global warming potentials. One of the largest influences comes from choice of GWP, which we address below. Another key predictor is whether the vehicle is in compliance with the 2014 and beyond methane tailpipe standards. [EPA-HQ-OAR-2014-0827-1460-A1 p.16]

The question of compliance with methane tailpipe standards is particularly relevant to the Proposed Rule. Post-2014 vehicles theoretically must comply with the Phase 1 methane tailpipe standards, although over 90 percent of vehicles on the road are older vehicles that do not have to comply with the standard. Furthermore, due to credits and trading provisions, manufacturers of new engines can – and do – avoid complying with the standard by applying credits generated from conventional engines. As the Proposed Rule indicates, manufacturers to date are solely applying credits and continuing to build natural gas engines that have high methane emissions: 2 g/bhp-hr as opposed to the 0.1 g/bhp-hr 2014 standard. This is a massive and unacceptable volume of excess methane. As such, the trading provisions that allow the application of CO<sub>2</sub> credits to methane should be abolished, or in the alternative, credits should be translated using an accurate 20-year methane GWP that includes carbon cycle feedbacks (see discussion below). [EPA-HQ-OAR-2014-0827-1460-A1 p.16]

The EPA's sensitivity analysis for lifecycle methane emissions also failed to include a key parameter: natural gas methane leakage rates. The recent literature indicates that the leakage rates assumed by the EPA are significant underestimates. If the leakage rates were appropriately adjusted to reflect current data, the lifecycle emissions for natural gas vehicles would be well above those of diesel engines. These data are reviewed below. [EPA-HQ-OAR-2014-0827-1460-A1 p.16]

The Proposed Rule does raise the possibility of a standard that is weighted by the difference between upstream and downstream emissions for natural gas as opposed to diesel vehicles. We support a weighted standard so long as the most current research findings are used to assess the life-cycle emissions for each fuel. In the sections below we review the current research. [EPA-HQ-OAR-2014-0827-1460-A1 p.16]

### **The Upstream Methane Emissions from Natural Gas Are Larger than Current EPA Emission Factors**

The other key factor in determining climate impacts from the use of natural gas is upstream methane emissions, i.e., leaking and venting during extraction, processing, storage and transmission of natural gas. The EPA has standard emission factors of 1.14 percent for conventional gas and 1.2 percent for

shale gas. These are based on “bottom up” estimates of leakage and venting. The recent literature, however, is rife with top down and analytical studies of methane leakage that show significantly higher levels of methane leakage from natural gas operations – two-fold or more. [EPA-HQ-OAR-2014-0827-1460-A1 p.17-18]

For instance, Miller and colleagues recently used atmospheric measurements to estimate that actual methane emissions are about 1.5 times larger than EPA estimates.<sup>87</sup> Observations from oil and gas operations in Colorado indicate that inventories underestimate methane emissions by at least a factor of two.<sup>88</sup> Leakage rates over a Utah gas field were recently estimated at 6.2 to 11.7%, well above the rates assumed by national inventories.<sup>89</sup> A study of leakage rates in the Barnett Shale region of Texas indicated that leakage rates were 1.5 to over 4 fold higher than EPA estimates, especially at gathering compressor stations.<sup>90</sup> A more detailed study of methane emissions from natural gas gathering and processing found that methane leakage rates were double the rate EPA assumes for the U.S. Greenhouse Gas Inventory, resulting in a volume of methane that is one-third the total emissions estimated for all natural gas operations.<sup>91</sup> This discrepancy was due primarily to large rates of leakage from gathering stations, which are not subject to separate emissions quantification for the purposes of the EPA’s U.S. Greenhouse Gas Inventory. [EPA-HQ-OAR-2014-0827-1460-A1 p.18]

Moreover, EPA’s data for oil and combined oil/gas wells omit the impact of hydraulic fracturing. A recent white paper from Environmental Defense Fund summarizes findings from a number of studies to conclude that emissions factors used in EPA’s current inventory underestimate methane emissions from oil wells that employ hydraulic fracturing.<sup>92</sup> Hydraulic fracturing and associated techniques are widespread and continue to expand at a rapid pace, making it all the more necessary that EPA update its emission factors, which were developed for conventional wells. [EPA-HQ-OAR-2014-0827-1460-A1 p.18]

Another major source of methane emissions from the oil and gas sector is leaks from pneumatic devices. A recent study calculated emission factors for pneumatic devices to find that national emissions from this source are likely at least twice the amount predicted using the emission factors in the U.S. Greenhouse Gas Inventory.<sup>93</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.18-19]

Recent reports have also substantiated an alarming rate of leaks from decaying gas pipeline systems across the country, creating the need for systematic, on-the-ground data collection to obtain an accurate quantification of emissions from this source. For example, according to a recent study, the two distributors of natural gas in New York City and Westchester County reported 9,906 leaks in their combined system for 2012 alone, and gas distributors nationwide reported an average of 12 leaks per 100 miles of the 1.2 million miles of gas main pipes across the country.<sup>94</sup> More than 5,800 leaks were detected from aging gas pipelines underneath the streets of Washington, D.C.<sup>95</sup> These samples indicate that EPA’s data are incomplete, and we urge the EPA to note this fact. [EPA-HQ-OAR-2014-0827-1460-A1 p.19]

Finally, a recent study raised the possibility that sensors used to measure methane leakage for the purpose of “bottom-up” inventories, such as those compiled by the EPA, may have fundamental flaws such that methane will be consistently under-estimated.<sup>96</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.19]

The EPA has requested input regarding the treatment of uncertainty related to methane emissions. At the outset, it should be noted that there is now such a large body of evidence that EPA’s emission factors underestimate actual fugitive methane from natural gas operations that the “uncertainty” surrounds not the discrepancy between the emission factors and actual leakage, but the magnitude of said discrepancy. With regard to selecting new emission factors, the Center advocates for an approach that raises the

emission factors by a multiplier that harmonizes the *peer-reviewed* literature, giving particular emphasis to top-down studies and selecting a multiplier in the range most often reported in the literature. On a longer-term basis, we recommend that the EPA undertake an independent, detailed and reliable study of methane leakage rates that could be used to modify and verify the current best available values. [EPA-HQ-OAR-2014-0827-1460-A1 p.19]

In sum, a complete and accurate well-to-wheels analysis is absolutely crucial to ensure that natural gas engines, which are increasing in market share, do not undermine the potential benefits of the proposed standards. Multiple studies have come to the conclusion that switching to natural gas transportation can hasten climate change, especially in the near term. One study found that climate benefits could be eroded by as much as 39 percent.<sup>97</sup> This robust result underscores the need to ensure that from this point forward natural gas engines are not incentivized, but rather placed on an even playing field with conventional diesel engines. [EPA-HQ-OAR-2014-0827-1460-A1 p.19]

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<sup>76</sup> See INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION, ASSESSMENT OF HEAVY-DUTY NATURAL GAS VEHICLE EMISSIONS: IMPLICATIONS AND POLICY RECOMMENDATIONS 23-24 (July 2015) (“ICCT Natural Gas Truck Report”), available at <http://theicct.org/assessment-heavy-duty-natural-gas-vehicle-emissions-implications-and-policy-recommendations>.

<sup>79</sup> *Id.*

<sup>80</sup> R. A. Alvarez et al., *Greater focus needed on methane leakage from Natural Gas Infrastructure*, 109 PROC. NATL. ACAD. SCI. 6435 (2012), available at <http://www.pnas.org/content/109/17/6435.full.pdf>; J. R. Camuzeaux et al., *Influence of Methane Emissions and Vehicle Efficiency on the Climate Implications of Heavy-Duty Natural Gas Trucks*, 49 ENVIRON. SCI. TECHNOL. 6402 (2015), available at <http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b00412>; ICCT Natural Gas Truck Report, *supra* note 76.

<sup>87</sup> S. M. Miller et al., *Anthropogenic emissions of methane in the United States*, 100 PROC. NATL. ACAD. SCI. 20018 (2013).

<sup>88</sup> G. Pétron et al., *Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study*, 117 J. GEOPHYS. RES. D04304 (2012).

<sup>89</sup> A. Karion et al., *Methane emissions estimate from airborne measurements over a western United States natural gas field*, 40 GEOPHYS. RES. LETT. 4393 (2013).

<sup>90</sup> D. R. Lyon et al., *Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region*, 49 ENVIRON. SCI. TECHNOL. 8147 (2015), available at <http://pubs.acs.org/doi/pdf/10.1021/es506359c>.

<sup>91</sup> A. J. Marchese et al., *Methane Emissions from United States Natural Gas Gathering and Processing*, ENVIRON. SCI. TECHNOL. DOI: 10.1021/acs.est.5b02275 (2015), available at <http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b02275>.

<sup>92</sup> Environmental Defense Fund, CO-PRODUCING WELLS AS A MAJOR SOURCE OF METHANE EMISSIONS: A REVIEW OF RECENT ANALYSES (Mar. 2014) available at

<http://blogs.edf.org/energyexchange/files/2014/03/EDF-Co-producing-Wells-Whitepaper.pdf>; see also blog post by David Lyon available at <http://blogs.edf.org/energyexchange/2014/03/13/latest-epa-greenhouse-gas-inventory-may-not-reflect-full-scope-of-oil-and-gas-emissions/>. We note that the recently released proposed updates to the NSPS for oil and gas operations would extend the green completion requirement to oil and oil/gas wells, but would not apply to existing wells.

<sup>93</sup> D. Allen et al., *Measurements of methane emissions at natural gas production sites in the United States*, 110 PROC. NATL. ACAD. SCI. 17768 (2013).

<sup>94</sup> Patrick McGeehan et al., *Beneath Cities, a Decaying Tangle of Gas Pipes*, N.Y. TIMES (Mar. 24, 2014), available at [http://www.nytimes.com/2014/03/24/nyregion/beneath-cities-a-decaying-tangle-of-gas-pipes.html?hp&\\_r=0](http://www.nytimes.com/2014/03/24/nyregion/beneath-cities-a-decaying-tangle-of-gas-pipes.html?hp&_r=0).

<sup>95</sup> Robert B. Jackson et al., *Natural Gas Pipeline Leaks Across Washington, D.C.*, 48 , ENVIRON. SCI. TECHNOL. 2051-2058 (Jan.16, 2014), available at <http://pubs.acs.org/doi/abs/10.1021/es404474x>.

<sup>96</sup> T. Howard, *University of Texas study underestimates national methane emissions at natural gas production sites due to instrument sensor failure*, ENERGY SCIENCE AND ENGINEERING doi: 10.1002/ese3.81 (2015).

<sup>97</sup> ICCT Natural Gas Truck Report, *supra* note 76 at 17.

**Organization:** Clean Energy

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p.251.]

Lastly, we appreciate the scope of the rule, which looks more at the tailpipe emissions, rather than lifecycle emissions, which we believe should be addressed but in other regulatory frameworks.

**Organization:** Enovation Controls (ENC)

2.1 Lifecycle Analysis for GHG - It is inaccurate to suggest any significant impact to the overall GHG impact of Natural Gas production resulting from use in on-highway vehicles. First, natural gas combustion results in less CO<sub>2</sub> than traditional fossil fuel per unit of usable energy. The chemical makeup of natural gas, which is mostly CH<sub>4</sub>, readily lends itself to producing more water and less CO<sub>2</sub> as a result of the combustion process when compared to diesel and gasoline. Second, fugitive methane emissions result from both oil and natural gas production process from well to end user - excluding any naturally-occurring methane production. [EPA-HQ-OAR-2014-0827-1203-A1 p.1]

Considering only natural gas production, vehicle-specific natural gas usage is a small fraction of total US natural gas use. As of 31-July-2015, the US Energy Information Administration tracked that in 2014, 0.12% of natural gas consumption in the US is consumed in vehicle power (32,850 Mmcf for vehicle power compared to total consumption of 26,818,618 Mmcf). Figure 1 shows the trend of vehicle-related natural gas consumption in the US. Even the most aggressive extrapolation of the trend would result in minor impact to overall natural gas consumption by vehicles. [EPA-HQ-OAR-2014-0827-1203-A1 p.1-2]

[Figure 1 can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1203-A1]



ENC submits that lifecycle analysis for GHG focused on methane emissions does not belong in the Phase 2 proposal. It is sufficiently and appropriately addressed in EPA-HQ-OAR-2010-0505-4776 with a holistic approach to all fugitive methane emissions. [EPA-HQ-OAR-2014-0827-1203-A1 p.2]

**Organization:** Environmental Defense Fund (EDF)

Based on evaluation of these options against the guiding principles stated above, the best overall options appear to be Option 1 or 2 (without refueling and boil-off emissions), in conjunction with Option 5 (to account for refueling and boil-off emissions). Option 1 or 2 can be implemented based on the precedent of the EV compliance factor used in the LD GHG rules. Following this precedent provides a lot of benefits in considering an upstream compliance approach for the Phase 2 rule. Under Options 1 or 2, an upstream compliance factor would be established as part of the compliance framework, providing regulatory stability to manufacturers for product planning. The tailpipe standard would be left intact, preserving consistency with the NHTSA fuel economy rule. These options can be applied to any of the fuels, and provide incentive to reduce upstream emissions where higher than those for conventional diesel. The primary difference between Options 1 and 2 is the focus on natural gas; Option 1 would consider only methane, and while applying to all fuels it would clearly be most stringent for natural gas trucks, out of concern that upstream methane emissions will undercut lower tailpipe CO<sub>2</sub> emissions. Option 2 provides a more fuel-neutral option, in that upstream emissions for all GHGs would be assessed, allowing more tradeoff between CH<sub>4</sub>, CO<sub>2</sub> and N<sub>2</sub>O, which will help level the playing field more across different fuels.[EPA-HQ-OAR-2014-0827-1312-A3 p.9]

In conjunction with Options 1 or 2, Option 5 then provides a means to incentivize reductions in refueling and boil-off emissions on LNG trucks. This option can be designed off of the A/C credit program used for LD vehicles, which provides a template for successful implementation. A challenge will be establishing a test procedure or model to determine credits for emission reduction technologies, and verify these emission reductions. Test procedures in place for evaporative and refueling emissions from gasoline vehicles may be adaptable to natural gas vehicles. The physical nature of vapor emissions also lends itself well to development of a compliance model, similar to GEM.[EPA-HQ-OAR-2014-0827-1312-A3 p.9]

Overall, our assessment finds that upstream emissions can be accounted for in the Phase 2 rule, following the precedents established in the LD GHG rules. Concerns with the potential magnitude of GHG emissions in lifecycle emissions, especially for natural gas trucks, suggests that these emissions should be directly accounted for in some way in the Phase 2 rule.[EPA-HQ-OAR-2014-0827-1312-A3 p.9][See EPA-HQ-OAR-2014-0827-1312-A2]

## **B. EDF supports accounting for upstream methane emissions from natural gas**

The agencies have requested comment on accounting for upstream emissions in the standards for natural gas and other trucks, and we urge the agencies to finalize a rule that includes such accounting. Reducing upstream emissions from natural gas trucks is integral to ensure the final program delivers on its climate protection goals. A recent ICCT study found that “inadequate attention to technologies designed to limit methane leakage ... would diminish the program benefits by as much as 38 percent.”<sup>73</sup> By including the upstream emissions from natural gas trucks in the final program, the agencies will strengthen the integrity of the program. We provide recommendations for improving the methodology in Section VII below. [EPA-HQ-OAR-2014-0827-1312-A1 p.16]

## **Final rule must ensure fuel savings and greenhouse gas reductions from natural gas vehicles**

Diesel is the current dominant fuel for heavy trucks. While it is likely to remain the most widely used fuel throughout the Phase 2 proposal, gasoline and natural gas are each making inroads in different market segments. EPA should ensure that these other technologies are likewise subject to rigorous environmental standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.39]

EDF is particularly concerned about the ability of natural gas trucks to deliver real-world greenhouse gas reductions. Given the significant impact of upstream methane emissions, a recent ICCT study found that “inadequate attention to technologies designed to limit methane leakage ... would diminish the program benefits by as much as 38 percent.”<sup>168</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.39]

The finding from ICCT is consistent with other leading research. A recent study by Camuzeaux et al in Environmental Science & Technology found that switching heavy-duty truck fleets from diesel to natural gas could lead to worse climate impacts over the next 50 to 90 years than remaining with diesel because of the powerful effect that methane has on global warming in the near-term.<sup>169</sup> (Attachment 1) [EPA-HQ-OAR-2014-0827-1312-A1 p.39][Attachment 1 can be found in docket number EPA-HQ-OAR-2014-0827-1312-A2]

While natural gas trucks lead to increased climate damage for decades compared to diesel trucks today, over the course of the Phase 2 program these vehicles have the potential to provide immediate, sizable climate benefits. Camuzeaux et al found that – with improvements to the vehicles and the natural gas supply chain – “fuel switches have the potential to produce climate benefits on all time frames.” Similarly, ICCT found that natural gas trucks could “increase the Phase 2 regulatory program’s 2040 benefits by 11 million tons of CO<sub>2</sub>e, or 7 percent”<sup>170</sup> if best practices to reduce methane emissions on-vehicle and across the supply chain are adopted. With improvements to the proposal, the final Phase 2 program could avoid an unintended consequence of additional climate damage from a switch to natural gas trucks and instead enhance the climate benefits of the program by enabling natural gas trucks to deliver on their climate potential. [EPA-HQ-OAR-2014-0827-1312-A1 p.39]

#### **A. A new, more comprehensive lifecycle analysis of NGVs is needed**

The agencies’ attempt to quantify the climate impact of natural gas trucks should be strengthened in several ways. The agencies relied exclusively on data from the Greenhouse Gas Inventory (GHGI), leading to a lifecycle analysis (LCA) that likely underrepresents the amount of methane emitted into the atmosphere across the natural gas supply chain. The agencies also relied on outdated Global Warming Potentials (GWPs) for methane, which do not reflect the latest available science on methane’s impact on the climate system. [EPA-HQ-OAR-2014-0827-1312-A1 p.39-40]

The GHGI estimates U.S. natural gas methane emissions based mainly on bottom-up estimates of methane emissions. It is based heavily on data collected in the 1990s and recent data suggest that the Inventory likely underestimates actual emissions and does not fully include important sources like those found in the gathering and boosting segment. For example, new research conducted in Texas’ Barnett Shale, one of the country’s largest production areas, finds methane emissions are 50% higher than GHGI estimates.<sup>171</sup> Other recent studies have made similar conclusions, predicting the underestimation is in the range of 25-75% below actual emissions.<sup>172</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.40]

In addition, the LCA in the proposal predicts that methane emissions will only rise by 4% from 2012 levels by the year 2025, while natural gas production is expected to increase by about 22%. However, the most recent GHGI, which was not available for this LCA, shows a 3% increase in methane emissions over 2012-2013, which suggests these projections may be understated. Accordingly, we recommend EPA develop a sensitivity analysis to the existing LCA using the numerous recent field

studies conducted over the past few years aimed at better characterizing national methane emissions from the oil and natural gas sector. [EPA-HQ-OAR-2014-0827-1312-A1 p.40]

EPA recognizes a number of other gaps in the LCA that have not been addressed. For compressed natural gas (CNG) trucks, due to lack of quantifiable data, EPA does not estimate emissions from refueling or small leaks in the CNG fuel storage system. The LCA also does not include estimations for fugitive emissions from fuel piping for either CNG or LNG trucks. Furthermore, there is a significant amount of uncertainty in the estimation for the quantity of boil-off and venting emissions from LNG trucks. [EPA-HQ-OAR-2014-0827-1312-A1 p.40]

In the proposed Phase 2 standards, EPA takes critical steps in providing such an LCA. However, there are a number of areas for improvement, as highlighted in this paper, especially concerning sensitivity analyses related to upstream methane emissions, GWPs, and the carbon dioxide-credit program. [EPA-HQ-OAR-2014-0827-1312-A1 p.40]

#### **E. Adopt a full fuel cycle accounting approach for alternative fuels**

While on-vehicle methane emissions are an important factor, it is the methane emissions associated with the production, processing and distribution of natural gas that largely determine the amount of climate damage natural gas fleets cause compared to diesel fleets.<sup>183</sup> In order for the Phase 2 program to accurately reflect the climate impact of natural gas trucks, the final standards must reflect the full lifecycle impact of using these and other trucks. Therefore, an upstream emissions analysis should be incorporated into efficiency standards in some capacity. [EPA-HQ-OAR-2014-0827-1312-A1 p.43]

The agencies have used this approach before. In the historic light-duty standards, the agencies developed an upstream compliance factor to reflect the upstream impact of electric vehicles. While these vehicles emit much less CO<sub>2</sub> at the tailpipe, the compliance factor takes into account the generation or production of the fuel source upstream of the tailpipe.<sup>184</sup> This strategy could be applied in a parallel manner to NGVs to account for the full impact of their CO<sub>2</sub> and methane emissions. An upstream compliance factor could be calculated given current estimates of the upstream impact for a respective NGV, and later adjusted accordingly based on improved GHGI estimates. [EPA-HQ-OAR-2014-0827-1312-A1 p.43]

The agencies asked for comments about including lifecycle emissions in the final program, as well as the feasibility of doing so while maintaining the linkage between the EPA standards and the NHTSA standards. Eastern Research Group has examined the options (Attachment 2), concluding "...upstream emissions can be accounted for in the Phase 2 rule, following the precedents established in the LD GHG rules. Concerns with the potential magnitude of GHG emissions in lifecycle emissions, especially for natural gas trucks, suggests that these emissions should be directly accounted for in some way in the Phase 2 rule." Given the viability of this pathway, EDF urges the agencies to adopt full lifecycle accounting in the final standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.43]

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73 Delgado and Muncrief, Assessment of Heavy-Duty Natural Gas Vehicle Emissions: Implications and Policy Recommendations, International Council for Clean Transportation (July 2015).

168 Delgado and Muncrief, Assessment of Heavy-Duty Natural Gas Vehicle Emissions: Implications and Policy Recommendations, International Council for Clean Transportation, (July 2015).

169 Camuzeaux, et al., Influence of Methane Emissions and Vehicle Efficiency on the Climate Implications of Heavy-Duty Natural Gas Trucks, Environmental Science & Technology, (May 2015).

170 Delgado and Muncrief, Assessment of Heavy-Duty Natural Gas Vehicle Emissions: Implications and Policy Recommendations, International Council for Clean Transportation, (July 2015).

171 Hamburg, S., “New Research Finds Higher Methane Emissions Reduction Opportunities in Texas’ Barnett Shale Region,” EDF Blogs: Energy Exchange, (July 7, 2015), available at <http://blogs.edf.org/energyexchange/2015/07/07/new-research-finds-higher-methane-emissions-reduction-opportunities-in-texas-barnett-shale-region/>.

172 Pétron, G. et al., Hydrocarbon emissions characterization in the Colorado front range: A pilot study, J. Geophys. Res.: Atmos., 117, (2012).

175 Joussaume, et al., eds., Climate Change 2013: the Physical Science Basis, Contribution of Working Group I to the Fifth Assessment report of the Intergovernmental Panel on Climate Change, Table 8.A.1 (2013), available at [http://www.climatechange2013.org/images/uploads/WGIAR5\\_WGI-12Doc2b\\_FinalDraft\\_All.pdf](http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_All.pdf).

183 Camuzeaux, et al., Influence of Methane Emissions and Vehicle Efficiency on the Climate Implications of Heavy-Duty Natural Gas Trucks, Environ. Sci. Technol., (2015).

184 Center for Climate and Energy Solutions, Federal Vehicle Standards, Arlington, VA, (2015), available at [www.c2es.org/federal/executive/vehicle-standards](http://www.c2es.org/federal/executive/vehicle-standards).

**Organization:** Institute for Policy Integrity at NYU School of Law

***Upstream Emissions and Electric and Natural Gas Vehicles:*** The agencies propose phasing-out the advanced technology credits. In our comments on the Phase 1 rulemaking, Policy Integrity explained the problems of treating advanced electric vehicles as if they had zero emissions, especially in combination with applying a 1.5 multiplier to electric vehicle credits. Phasing out the credits partly addresses this concern. However, the agencies continue to treat electric vehicles as if they have zero emissions, focusing only on the tailpipe and ignoring upstream emissions from electricity generation. Somewhat contradictorily, the agencies are also considering a lifecycle approach to natural gas vehicles that would count upstream emissions. [EPA-HQ-OAR-2014-0827-1195-A1 p.2]

To accurately compare the greenhouse gas emissions associated with different vehicle types, the agencies must consider lifecycle emissions for all power sources. By contrast, limiting the analysis to downstream emissions or considering upstream emissions for only some power sources will undermine the efficacy of the standards by irrationally favoring vehicles whose climate impacts occur upstream. See our previous comments on lifecycle emissions analysis in the context of efficiency standards.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1195-A1 p.2]

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4 See [http://policyintegrity.org/documents/10.19\\_10\\_Comments\\_on\\_DOE\\_Full\\_Fuel\\_Cycle\\_.pdf](http://policyintegrity.org/documents/10.19_10_Comments_on_DOE_Full_Fuel_Cycle_.pdf). at 4 (arguing that ignoring upstream emissions “arbitrarily tips the scales in favor of power sources with superior downstream efficiency over those with superior upstream efficiency”).

**Organization:** National Waste & Recycle Association

We are pleased that the agencies declined to propose any provisions that would adjust the compressed natural gas or the liquid natural gas vehicle standard to account for upstream emissions of methane that occur from natural gas production, processing, transmission and distribution. We wholeheartedly support this approach. [NHTSA-2014-0132-0071-A1 p.4]

**Organization:** NGVAmerica

**E. Consideration of Upstream Emissions. The proposal includes an extensive discussion of upstream emissions and full fuel cycle energy use and emissions. However, the proposal leaves in place a regulatory approach that applies the long-standing practice of only regulating tailpipe emissions and those emissions immediately associated with the vehicle.** [EPA-HQ-OAR-2014-0827-1270-A1 p.3]

NGVAmerica supports the agencies' approach to regulating vehicle and engine emissions. Assessing and determining upstream emissions is highly complicated, a moving target subject to changes as new upstream emission rules and voluntary efforts are implemented. Including upstream emissions would greatly complicate the adoption of final rules for this program. As EPA has noted, upstream emissions are addressed by a host of other statutory-mandated programs and are best addressed by regulations that focus on, and control the source of emissions. We further believe that it is inefficient to require manufactures to address emissions through vehicle controls that will soon be reduced or even eliminated by new regulatory controls. Therefore, we support the decision not to include upstream emissions in the standards used to regulate motor vehicles and engines. [EPA-HQ-OAR-2014-0827-1270-A1 p.3-4]

With respect to upstream emissions, the Preamble includes an extensive discussion related to natural gas vehicles. We respectfully request that this information not be included in the final rule given that similar attention to, and discussion of, other fuels has not been provided in the rule. If the full fuel cycle benefits and attributes of natural gas are to be included, a detailed discussion of the emissions of other fuels should also be included and commenters should be provided an opportunity to review this information and comment on the attributes of all fuels. In addition, any discussion of upstream emissions should carefully consider what percentage of natural gas in each state is or would be used as motor vehicle fuel, so that the total upstream emissions associated with the production and transportation of natural gas are discounted and adjusted accordingly when calculating upstream emissions for natural gas as a motor vehicle fuel. Finally, the introduction of renewable natural gas (RNG) into the motor-vehicle fuel market should also be included as many pathways for production of RNG have very low carbon intensity values and some are actually carbon-negative. An example of use of RNG for transportation fuel is California's Low-Carbon Fuel Standard. As of 2014, RNG accounts for up to twenty-five percent of California's natural gas transportation fuel. [EPA-HQ-OAR-2014-0827-1270-A1 p.4]

**Organization:** Optimus Technologies

With respect to upstream emissions, the Preamble includes an extensive discussion related to natural gas vehicles. We respectfully request that this information not be included in the final rule given that similar attention to, and discussion of, other fuels has not been provided in the rule. If the full fuel cycle benefits and attributes of natural gas are to be included, a detailed discussion of the emissions of other fuels should also be included and commenters should be provided an opportunity to review this information and comment on the attributes

**Lifecycle Emissions**

From Optimus' review of the proposed rule as well as discussion with employees at the EPA, the EPA does not currently incorporate lifecycle emissions into the process of engine/vehicle certification. One of the bases for this decision seems to be the assumption that EV HD vehicles will not enter the market during the regulatory period; "we project very limited adoption of all-electric vehicles into the [heavy-duty] market" (see 80 FR 40159, Column 1). This assumption seems to neglect the fact that other alternative fuel technologies (besides EV) exist. Optimus Technologies believes that the EPA should begin to evaluate engines/vehicles on a lifecycle emissions basis, especially when evaluating technologies that allow engines/vehicles utilize alternative fuels. For instance, a natural-gas engine may show reduced CO<sub>2</sub> tailpipe emissions when compared to its diesel counterpart. However, the same natural-gas engine may show increase CO<sub>2</sub> lifecycle emissions. One example of this is a recent Argonne National Laboratory study completed on transit buses.<sup>5</sup> An excerpt and chart from that study are below: [EPA-HQ-OAR-2014-0827-1276-A1 p.1-2]

““The GHG emissions per VMT for transit buses are illustrated in Figure 5. The emissions per VMT for CNG transit buses are not statistically different from those of diesel buses with a 100-year GWP horizon. However, when considering a 20-year GWP horizon, CNG buses emit significantly more GHGs than do their petroleum-fueled counterparts, with emissions that are 34% higher for conventional NG and 20% higher for shale NG. To reduce GHG emissions, CNG buses will need to exceed our Base Case fuel economy assumptions.” [EPA-HQ-OAR-2014-0827-1276-A1 p.2]

[Figure 5, 'Well-to-wheels life-cycle GHG emissions per VMT - Transit Bus. Two time horizons - 100-year and 20-year - are considered', can be found on p.2 of docket number EPA-HQ-OAR-2014-0827-1276-A1]

The already excellent GREET model should serve as a way to evaluate various engines/vehicles/fuels in a non-biased and consistent manner. For instance, using unmodified GREET 2014 data, a car fueled with ultra-low sulfur diesel emits (on a well-to-wheel basis) 391.276 g/mi. A dedicated CNG car emits (again on a well-to-wheel basis) 406.277 g/mi (an increase of 14.951 g/mi).<sup>6</sup> [EPA-HQ-OAR-2014-0827-1276-A1 p.2-3]

The EPA has objected to a lifecycle emissions approach in the past for multiple reasons including the belief that including lifecycle GHG emissions would disrupt the harmonization of EPA and NHTSA rulings and the belief that the RFS properly incentivizes alternative fuels (see 77 FR 51701).<sup>7</sup> [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

On the first belief, Optimus sees no reason why the addition of lifecycle GHG emissions would upset or go against the dual goals outlined in Phase I (see 76 FR 57109, Column 2) of reduction of dependence on oil, achievement of energy security, and amelioration of global climate change. [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

Regarding the second belief, RFS does an excellent job of incentivizing the production alternative fuels but fails to directly incentivize the use of alternative fuels and associated technologies by engine/vehicle OEMs. The regulatory environment surrounding the RFS (including the RIN program and tax credits) has been in constant flux recently so that producers of alternative fuels rarely pass those incentives on to consumers. RINs and tax credits essentially assist in holding alternative fuel producers above water during periods of regulatory uncertainty and low petroleum prices. The proposed rule should consider incentivizing technologies that integrate alternative fuels at the OEM level and push the market towards a low carbon fuel economy in a way that RFS cannot. [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

The EPA argues (in 77 FR 51701) that “the tailpipe performance measurement of alternative fuels provides sufficient incentives for their use” and integration with engine/vehicle OEMs. Optimus Technologies argues that the full lifecycle emissions and the use of the off-cycle technology credit (see section below) should be used by the EPA to further incentivize, or in some cases, disincentivize the use of alternative fuels and their associated technologies by vehicle/engine OEMs (in the event that they produce vehicles with higher lifecycle GHG emissions). [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

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5 <http://www.transportation.anl.gov/pdfs/EE/813.PDF>

6 GREET model downloaded from: <https://greet.es.anl.gov/greet/index.htm>

7 <https://federalregister.gov/a/2010-8159>

**Organization:** Securing America's Future Energy

Specifically, we recommend that EPA and NHTSA equilibrate the treatment of non-petroleum fuels across the light- and heavy-duty sectors by: (1) extending 49 USC §32905 manufacturing incentives into the medium- and heavy-duty sector and (2) implementing advanced technology credits for medium- and heavy-duty natural gas vehicles. We also provide comments on the agency's considerations related to upstream natural gas vehicle emissions below. [EPA-HQ-OAR-2014-0827-1282-A1 p.1-2]

At the same time, SAFE believes the regulation of upstream emissions is more appropriately addressed under separate regulatory frameworks that hold those upstream entities directly accountable. [EPA-HQ-OAR-2014-0827-1462-A1 p.4]

Specifically, SAFE recommends that the agencies equilibrate the treatment of non-petroleum fuels across the light- and heavy-duty sectors by: (1) extending 49 USC §32905 manufacturing incentives into the medium- and heavy-duty sector and (2) implementing advanced technology credits for medium- and heavy-duty natural gas vehicles and reinstating them for technologies that qualify for the credit under Phase I. Finally, comments on the considerations related to upstream natural gas vehicle emissions (as requested in the proposed Phase 2 rule) are offered. [EPA-HQ-OAR-2014-0827-1282-A1 p.6]

Treatment of Upstream Natural Gas Emissions

Traditionally, with the limited exception of vehicles powered by energy sources that are recharged through off-board fuel combustion, emissions associated with the upstream production and distribution of vehicular fuels have been regulated independently of established motor vehicle GHG and fuel economy standards.<sup>27</sup> There is fundamentally sound rationale behind such an approach since vehicle manufacturers have no authority over the production and distribution of vehicular fuels. Fuel producers and distributors are separately regulated entities subject to controls established for their respective industries. [EPA-HQ-OAR-2014-0827-1282-A1 p.9]

Nevertheless, the EPA and NHTSA have requested comment on whether it would be appropriate to adjust the tailpipe GHG emission (and, by extension, fuel consumption) standards for natural gas vehicles by a factor to reflect the lifecycle emissions of natural gas vehicles relative to diesel-powered vehicles. While the benefits of such an approach might possibly be rationalized in a more static and certain world, it is difficult to envision any type of a practical and equitable system. [EPA-HQ-OAR-2014-0827-1282-A1 p.9]

Vehicle manufacturers have no control over upstream fuel production and distribution, yet under a lifecycle approach vehicle manufacturers would be required to discount motor vehicle technology impacts for the actions (or inactions) of independently regulated entities or the agencies that regulate them, even as they vary across time or regions. Would vehicle manufacturers suffer the consequences of upstream regulatory stringency decisions over which they have no control? Given that production methods and associated controls are continually evolving, how would upstream evolutionary impacts be reflected in regulated downstream adjustments in a timely fashion? Lifecycle adjustments would have to be dynamically applied to previously certified vehicles since the upstream emissions performance of fuels being utilized in both new and existing vehicles would be equally affected. Further, since any adjustment would be based on the ratio of upstream performance for two fuels, how would differences in the uncertainty of a generalized lifecycle estimate for each fuel be resolved? Clearly, there are a number of complex issues that would need to be address before equitable upstream adjustments could even be practically considered. [EPA-HQ-OAR-2014-0827-1282-A1 p.10]

Even ignoring practicalities, a lifecycle approach would, at a minimum, require an adjustment factor to be developed for all fuels, not simply natural gas, as well as for all vehicle sectors. Adopted standards applicable to light-duty natural gas (or any other alternatively-fueled) vehicles are not subject to lifecycle adjustment. Given that such adjustments would be fuel, not vehicle, specific, there is no basis for establishing an adjustment that is isolated to the heavy-duty sector. In recognition of these various issues, and given the diversity of fuel portfolios and carbon emissions at utilities around the country (which will also change over time), SAFE believes that the appropriate approach to regulating carbon emissions throughout the economy is to regulate them at the point of combustion and not at the point where the power is consumed. SAFE recommends that the EPA and NHTSA abandon any potential lifecycle approach and focus on adopting cost effective control strategies for regulating vehicle and upstream entities separately. [EPA-HQ-OAR-2014-0827-1282-A1 p.10]

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27 Note: Generally, vehicles powered by energy sources that are recharged through off-board fuel combustion are all-electric or plug-in electric hybrid vehicles whose batteries are recharged using energy generated through upstream fuel combustion. Upstream combustion and distribution losses for such vehicles are considered in determining *light-duty* vehicle fuel economy and will be considered beginning as early as model year 2020 in determining *light-duty* vehicle CO<sub>2</sub> emissions. Prior to model year 2020 and for some period thereafter until a specified vehicle production threshold is exceeded, all-electric vehicle operation is assumed to emit zero CO<sub>2</sub>. Upstream emissions for all-electric *heavy-duty* vehicles are not considered throughout the proposed Phase 2 period (i.e., CO<sub>2</sub> emissions and fuel consumption for such vehicles are assumed to be zero).

**Organization:** Union of Concerned Scientists (UCS)

#### Alternative fuels

While diesel and gasoline vehicles currently represent the vast majority of new heavy-duty vehicles sold today, advances in technology, favorable differences in alternative fuel prices, and state and national policies supporting alternative fuel trucks will lead to a growing number of alternative fueled vehicles being deployed during the timeframe of the rule. However, evaluating only tailpipe emissions from natural gas and electric vehicles underestimates the climate impacts of these vehicles compared to gasoline and diesel vehicles raising concerns about the real benefits of the standards under different market projections. For example, analysis by the ICCT shows that natural gas fueled trucks could represent as much as 20 percent of the new truck sales under favorable market conditions. In that case,



they found as a result of methane leakage both on the vehicle and upstream of the vehicle, the climate benefits of the proposed rule could be diminished by as much as 38% in 2040 using a 20-year global warming potential for methane (Delgado and Muncrief 2015). While the likelihood of this scenario is uncertain, it illustrates the importance of looking beyond simply tailpipe emissions in evaluating vehicle emissions. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]

We strongly support the agencies inclusion of controls for crankcase emissions on natural gas vehicles and LNG tank hold times. [EPA-HQ-OAR-2014-0827-1329-A2 p.26] [This comment can also be found in section 12.5, 12.7 and 13.2.3 of this comment summary.]

However, these do not fully capture the sources of methane emissions from natural gas trucks. In addition, electric trucks are evaluated as have 0 g/mile emissions, which does not fully reflect this vehicle technology's actual climate impact. While the current low volumes of electric trucks do not present a significant concern, the market for these vehicles will likely increase over the time frame of the regulation, and when they make up a substantial part of the market, real benefit erosion will occur. [EPA-HQ-OAR-2014-0827-1329-A2 p.26-27]

To ensure the program produces the estimated benefits and to accurately capture the climate impact of vehicles regulated under the standards, the agencies should consider a phase-in of requirements to include the upstream emissions for natural gas and electric trucks, relative to diesel and gasoline vehicles, in vehicle certification. [EPA-HQ-OAR-2014-0827-1329-A2 p.27]

**Organization:** VNG

### **NGVs are the Primary Driver of Renewable Natural Gas Development**

Renewable natural gas (RNG) is methane captured from renewable sources like landfills, dairy farms, and sewage treatment plants, then processed to be chemically identical to fossil natural gas and transported through the same pipeline system. Because methane is a powerful greenhouse gas and RNG captures methane that would otherwise escape into the atmosphere, its use achieves lifecycle GHG reductions of 90% or more compared to diesel in CO<sub>2</sub>-equivalent terms<sup>1</sup> – and even greater positive impacts in the near term since methane is a potent short-lived climate pollutant (SLCP) that both EPA and the California Air Resources Board are beginning to target more aggressively in their climate policies. [EPA-HQ-OAR-2014-0827-1208-A1 p.1]

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<sup>1</sup> National Petroleum Council. “Renewable Natural Gas for Transportation: An Overview of the Feedstock Capacity, Economics, and GHG Emission Reduction Benefits of RNG as a Low-Carbon Fuel.” 1 Aug 2012. [http://www.npc.org/reports/FTF Topic papers/22-RNG.pdf](http://www.npc.org/reports/FTF%20Topic%20papers/22-RNG.pdf)

**Organization:** Waste Management (WM)

### **WM Supports Maintaining the Phase 1 Compliance Flexibility Framework in Phase 2**

In the Phase 1 rule, EPA provided a compliance approach, which allows OEMs to certify their engines, using carbon dioxide (CO<sub>2</sub>) credits to meet the nitrous oxide (N<sub>2</sub>O) and methane standards. OEMs may convert all measured emissions to CO<sub>2</sub> equivalent credits using the global warming potentials (GWP) of

N2O and methane. An OEM may offset excess methane or N2O emissions with the appropriate number of CO2 reduction credits. [EPA-HQ-OAR-2014-0827-1214-A2 p.2]

Continuing this compliance framework in the Phase 2 rule is particularly important to the future compliance of natural gas (NG) vehicles. Since NG vehicles generate higher methane emissions, but lower CO2 emissions, the flexibility afforded by continuing the Phase 1 offset provisions will allow their continued compliance under Phase 2. We support the agencies' inclusion of this flexibility allowing OEMs to balance emissions among the three GHGs in the proposed Phase 2 rule. [EPA-HQ-OAR-2014-0827-1214-A2 p.2]

WM works closely with our manufacturing partners and over the last decade, we have seen steady improvements in heavy-duty natural gas technology. Our OEM partners are already working on technologies for future model years that will enable significant reduction of fugitive emissions from NG vehicles – making an already clean technology even more environmentally beneficial. Extension of the Phase 1 compliance framework into Phase 2 will also support further adoption and use of vehicles fueled with renewable natural gas (RNG). NG vehicles may employ RNG with no changes to either the vehicle or fueling infrastructure. Use of RNG results in even greater GHG reductions on a lifecycle basis (upwards of 90%) than the already significant GHG reductions achieved with use of fossil NG. A flexible Phase 2 compliance framework will allow EPA to achieve lower GHG emissions from medium and heavy-duty trucks while also supporting continued growth of in production and use of renewable transportation fuel. [EPA-HQ-OAR-2014-0827-1214-A2 p.2-3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.101.]]

We note that the agencies are taking comment on adoption of provisions that would “adjust the GHG emission standard for NG vehicles by a factor to reflect lifecycle emissions of NG vehicles relative to diesel vehicles.” However, there is no explanation or fully formed regulatory concept describing how those provisions might be applied, how lifecycle emission factors would be established, or how lifecycle accounting would affect other vehicle fuels. We find that the language is not sufficiently descriptive to enable commenters to understand the “adjustment factor” that the agencies are contemplating and provide meaningful comments and information. As a result, the agencies have no basis for using any input on this topic in a final rule. Should the agencies determine that lifecycle emission factors are appropriate, we believe it would be incumbent upon the agencies to issue a new proposal to ensure the regulated and affected stakeholders are afforded appropriate notice and an opportunity to provide comment. [EPA-HQ-OAR-2014-0827-1214-A2 p.3]

Were the agencies to consider developing regulatory provisions featuring a “lifecycle approach” for natural gas, they would completely upend the basic architecture of the Phase 1 rule. Furthermore, the EPA would be forced, under this new framework, to develop lifecycle analyses of all vehicle fuels, as all vehicle fuels – including gasoline, diesel and electricity –have upstream emissions. Undertaking such an analysis would significantly complicate and delay final promulgation of the Phase 2 rule with no additional GHG benefits beyond those that are, or will be accomplished through other EPA programs. [EPA-HQ-OAR-2014-0827-1214-A2 p.3]

As a next step to further reducing the GHG footprint of our NG fleet, we are using the gas produced by our landfills to power our trucks with biomethane. We fuel 380 refuse trucks in California with RNG from our Altamont Landfill and we will be fueling several hundred more vehicles with RNG produced at our Milam, Illinois landfill. We are also working with other landfill owners to purchase RNG to fuel additional vehicles. WM plans to fuel as many of its NG trucks with renewable fuel as we can. The RFS program has helped facilitate this switch to even lower GHG emitting fuels than fossil natural gas. NG vehicles are also a technology pathway to lower NOx emissions. While this rule is focused on fuel

efficiency and GHG reductions, EPA should think holistically and recognize co-benefits of other pollutant reductions that a technology can offer. [EPA-HQ-OAR-2014-0827-1214-A2 p.4-5] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.101.]]

The recent proposals complement the Agency's 2012 standards. In addition to reducing both VOCs and methane from hydraulically fractured oil wells, the new proposals extend emission reduction requirements further downstream, covering equipment in the natural gas transmission segment of the industry not regulated by the 2012 rule. EPA has also proposed to require owner/operators to find and repair leaks, a significant source of VOC and methane emissions. These new standards are expected to achieve additional reductions of up to 400,000 short tons of methane in 2025, the equivalent of reducing 7.7 to 9 million metric tons of CO<sub>2</sub> equivalent. These rules, along with the Agency's proposed voluntary Natural Gas STAR Methane Challenge Program, and upcoming actions from the Department of Interior's Bureau of Land Management, will help ensure significant methane reductions from the oil and gas sector. Given the significant work already underway to reduce lifecycle emissions of fossil fuel and methane and VOC emissions from the natural gas sector, there is no reason for EPA's Office of Transportation and Air Quality to use the Phase 2 rule to require methane reductions from vehicles to offset upstream NG sources. [EPA-HQ-OAR-2014-0827-1214-A2 p.5]

**Organization:** Waste Management (WM)

WM, therefore, strongly recommends the agencies abstain from incorporating lifecycle GHG emissions accounting in the Phase 2 rule. [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

#### ***EPA's Renewable Fuel Standard Already Addresses Lifecycle Emissions of Fossil Fuel***

EPA already implements a regulatory program, the Renewable Fuel Standard (RFS), the goal of which is to achieve reductions in lifecycle GHG emissions associated with replacing transportation diesel with increasing volumes of certain renewable fuels. Further, the Administration and EPA are addressing upstream methane emissions associated with natural gas through a host of regulatory programs that will significantly reduce methane emissions from the oil and gas sector. Any attempt to regulate trucks with the goal of mitigating upstream emissions would be redundant and far less effective. [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

The EPA Renewable Fuel Standard (RFS) program is designed to ensure that transportation fuel sold in the U.S. contains a minimum volume of renewable fuel, and thus achieves a lower fossil carbon content. The RFS program requires EPA to evaluate the GHG lifecycle emissions associated with each category of renewable fuel to assess the GHG reductions that will be realized from its use as a replacement for diesel fuel. The transportation fuels market is required to increase its use of renewable fuels over time to both reduce sector GHG emissions, and to promote production and use of homegrown, clean fuel alternatives to imported petroleum fuels. [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

The RFS program has helped stimulate the production and use of renewable natural gas (RNG) as a transportation fuel. Historically, RNG from landfills, wastewater treatment plants and anaerobic digesters has been beneficially used to produce electricity. On a GHG lifecycle basis, RNG as a cellulosic biofuel is among the lowest carbon intensive renewable fuels available, with GHG reductions of nearly 90% as compared to the diesel fuel it replaces. Due in large part to the RFS program and the California Low Carbon Fuel Standard, WM is increasing its production and use of RNG as a transportation fuel. [EPA-HQ-OAR-2014-0827-1214-A2 p.4]

***The Administration's Methane Strategy Will Achieve Significant Upstream Methane Reductions from the Oil & Gas Sector***

The Administration's Methane Strategy is a key component of the President's Climate Action Plan, with a goal of achieving reductions in methane emissions from the oil and gas sector of 40 to 45 percent below 2012 levels by 2025. EPA began with an April 17, 2012 New Source Performance Standard (NSPS) for natural gas wells, along with requirements for several other sources of volatile organic compounds (VOCs) from storage tanks and other gas production equipment. A key component of the 2012 rules was a requirement to capture emissions from hydraulically fractured and re-fractured natural gas wells – a step estimated to yield a 95 percent reduction in VOCs, and a similar methane reduction co-benefit. Although VOCs are the regulated pollutant, EPA estimated significant reductions of 1.0 to 1.7 million short tons of methane (about 19 to 33 million tons of CO<sub>2</sub> equivalent). Following upon this first rule, EPA proposed a suite of rules August 18, 2015 to reduce further methane emissions from a broader array of sources within the oil and gas industry. [EPA-HQ-OAR-2014-0827-1214-A2 p.5]

**Organization:** Center for Biological Diversity

**NATURAL GAS ENGINES MUST BE HELD TO A MEANINGFUL STANDARD THAT PREVENTS METHANE EMISSIONS FROM UNDERMINING CLIMATE BENEFITS**

It is essential that the EPA use its full authority to address “well-to-wheels” methane emissions associated with natural gas vehicles and engines. Methane is a potent greenhouse gas with a radiative forcing of approximately 0.48 W/m<sup>2</sup>,<sup>69</sup> and, at least as importantly, its comparatively short atmospheric lifetime means that its emissions over the next few decades will exert an even larger warming influence than will CO<sub>2</sub> emissions over this period. This dual nature of methane's influence mean that aggressive methane mitigation will be critical in slowing the near-term rate of climate change, avoiding climatic tipping points, and moderating current climate impacts such as Arctic sea-ice loss, ice sheet melt, permafrost thaw, and declining seasonal snowpack.<sup>70</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.14]

The extraction, processing, storage and transmission of natural gas is the second largest source of fugitive methane emissions in the United States according to the EPA's U.S. Greenhouse Gas Inventory,<sup>71</sup> and may be the largest source if updated leakage factors are used. The Obama Administration has targeted methane emissions as an important component of climate mitigation and meeting international climate commitments.<sup>72</sup> [EPA-HQ-OAR-2014-0827-1460-A1 p.14]

It is important to address methane emissions from heavy duty natural gas vehicles and engines due to the potential for market expansion. Natural gas vehicles are currently a small part of the medium- and heavy-duty engine fleet: about one percent. But the EIA expects this market share to rise rapidly, with growth rates up to 14 percent per year. One report placed market share for new tractors at 50 percent in 2025. Overall heavy-duty fleet expectations have been placed around 20 percent by both the National Resource Council and the National Petroleum Council. All of these forecasts underline the importance of setting meaningful standards for natural gas vehicles in this rulemaking as the impacts will be much multiplied relative to the existing fleet. [EPA-HQ-OAR-2014-0827-1460-A1 p.14]

As proposed, the Phase 2 standards for natural gas vehicles and engines could result in significant and unintended climate harm. The Center appreciates that the EPA recognizes the potential for methane leakage from natural gas systems and vehicles to offset the CO<sub>2</sub> reductions of the standards. We respond below to a number of EPA's requests for comment related to the treatment of methane from natural gas vehicles. [EPA-HQ-OAR-2014-0827-1460-A1 p.14]

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<sup>2</sup> Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles— Phase 2; Proposed Rule, 80 Fed. Reg. 40,138, 40,141 (July 13, 2015) (“Proposed Rule”).

<sup>69</sup> G. Myhre et al., *Anthropogenic and Natural Radiative Forcing*, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE IPCC Table 8.2 at 678 (Cambridge Univ. Press 2013) (“Myhre 2013”).

<sup>70</sup> Drew Shindell et al., *Simultaneously Mitigating Near-term Climate Change and Improving Human Health and Food Security*, 335 SCIENCE 183 (2012); J. J. West et al., *Scenarios of methane emission reductions to 2030: abatement costs and co-benefits to ozone air quality and human mortality*, 114 CLIMATIC CHANGE 441 (2012).

<sup>71</sup> See, e.g., US EPA, GHG INVENTORY, *supra* note 3 at ES-6.

<sup>72</sup> Obama Climate Action Plan: *Strategy to Reduce Methane Emissions* (Mar. 2014), available at [https://www.whitehouse.gov/sites/default/files/strategy\\_to\\_reduce\\_methane\\_emissions\\_2014-03-28\\_final.pdf](https://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf).

**Organization:** Mass Comment Campaign sponsored by Center for Biological Diversity (web) - (4,429)

The proposed free pass for natural gas engines must also be eliminated. Natural gas engines currently make up a small portion of the truck-engine market, but that market share is predicted to rise rapidly. We simply can't afford the methane leakage from natural gas production and transmission, nor the harm to our communities and wildlife if the standards incentivize more fracking for natural gas. [EPA-HQ-OAR-2014-0827-1167-A1 p.1]

**Organization:** Optimus Technologies

However, as Optimus has stated above, the company believes that the proposed rule is lacking and requires additional consideration to achieve the goals the EPA set out to do. If the intended rule was written to address climate change, lifecycle greenhouse gas emissions must be taken into account. The proposed rule is intended to be fuel-neutral, but Optimus believes the standards do not reflect that intention. The effects of the proposed rule on alternative fuel technologies (especially small volume alternative fuel engine converters) needs additional clarification and consideration. [EPA-HQ-OAR-2014-0827-1276-A1 p.4]

**Response:**

The agencies are aware of methane's potency as a heat trapping gas. The heat trapping potency of methane, coupled with several projections which showed rapid penetration of natural gas fuel into the heavy-duty truck sector, are the primary reasons why, for this rulemaking, the agencies conducted a lifecycle analysis comparing natural gas heavy-duty trucks to diesel heavy-duty trucks and projected the growth of natural gas use by heavy-duty trucks.

Substantial amounts of new information on methane emissions from oil and gas systems have become available recently from a number of channels, including EPA's GHG Reporting Program, industry organizations, and research studies by government, academic, and industry researchers. Separate from this analysis, as part of the annual development process for EPA's GHG Inventory, this year EPA reviewed the substantial body of new studies, and conducted early and extensive engagement and communication with stakeholders on updates to oil and gas sector emission estimates. Based on this review of new information and stakeholder input, EPA revised its estimates of methane emissions from natural gas and petroleum wells, natural gas processing plants and the natural gas transmission, storage and distribution systems for the 2016 U.S. GHG Inventory report to the United Nations Framework Convention for Climate Change (UNFCCC). Comparing the most recent GHG Inventory estimate for 2013 to the previous GHG Inventory estimate for 2012, methane emissions are about one-third higher for the aggregated natural gas systems than the previous estimate. These revised methane emissions estimates are incorporated in the final rule natural gas heavy-duty truck lifecycle analysis.

Recognizing the contribution of U.S. methane emissions to climate change, in 2015, the Obama Administration announced a goal of reducing methane emissions from the oil and gas sectors by 40 to 45 percent from 2012 levels by 2025. EPA has been taking steps, and intends on taking additional steps, to reduce the methane emissions from the natural gas and petroleum sectors. In 2012, EPA finalized New Source Performance Standards (NSPS) which require that emissions from natural gas wells that are hydraulically fractured be controlled using flaring or reduced emission completions (RECs). Starting in 2015, RECs are required for natural gas well completions and workovers. The NSPS also regulates the emissions from certain new petroleum and natural gas production, processing, and transmission and storage equipment. EPA continues to promote Natural Gas Star, a flexible voluntary partnership that encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce methane emissions. Further, EPA launched the Methane Challenge program in March of 2016 in which oil and gas companies make and track ambitious commitments to reduce emissions. On May 12, 2016, EPA finalized regulations (2016 NSPS OOOOa) which, among other things, include methane emission standards for oil and gas equipment used across oil and gas sources previously regulated in the 2012 NSPS OOOO for VOCs, and require the use of RECs at hydraulically fractured oil wells. In addition, in March of 2016, EPA and Canadian Environment and Climate Change Canada (ECCC) announced plans to align with the US goal for 40 to 45 percent reductions of methane from the oil and gas sector relative to 2012 emissions. The goal of the various actions is to achieve an aggregated 40 to 45 percent reduction in methane emissions relative to methane emissions in 2012.

The agencies are also taking action to further limit the GHG emissions from natural gas heavy-duty trucks. Starting with the 2021 model year, if a heavy-duty truck manufacturer uses carbon dioxide (CO<sub>2</sub>) credits to offset methane emissions above the methane tailpipe emissions standard, EPA is requiring that the truck manufacturer must use 34 grams of CO<sub>2</sub> to offset 1 gram of methane emissions (based on the relative GWPs from IPCC AR5) which is increased from today's CO<sub>2</sub> credits standard which is 25 grams of CO<sub>2</sub> to offset 1 gram of methane emissions (based on the relative GWPs from IPCC AR4). While the EPA is continuing the flexibility of the CO<sub>2</sub> credit trading program, the EPA is taking appropriate action to update the credit trading program to reflect the recent update to the methane GWP. The agencies are also putting in place a 5 year hold time requirement for liquefied natural gas (LNG) storage tanks on LNG-fueled heavy-duty trucks which must be met throughout the truck's useful life. A warranty requirement applies to LNG heavy-duty storage tanks as well.

The various upstream and vehicle emission standards being pursued by EPA is expected to improve the lifecycle performance of natural gas trucks.

Some commenters stated that the agencies should use a full lifecycle assessment of the greenhouse gas emissions of natural gas heavy-duty trucks for this rulemaking. Other commenters stated that only the tailpipe emissions of heavy-duty natural gas trucks should be considered and actions to limit methane emissions from the upstream sector should be pursued separately. As our analysis in the Preamble and RIA shows, the sales volume of natural gas trucks is projected to be very low during the period that the Phase 2 HD GHG standard apply; thus, it is not important to assess and regulate the GHG performance of natural gas heavy-duty trucks on a full lifecycle basis because any impact on GHG emissions, whether natural gas trucks are higher or lower emitting in GHG emissions, would be very small. However, if we ignore the projected sales volume of natural gas heavy-duty trucks and review the full lifecycle performance of natural gas heavy-duty trucks compared to diesel heavy-duty trucks on their face value, the lifecycle analyses leads us to conclude that natural gas heavy-duty trucks may in fact have about the same lifecycle impact as diesel heavy-duty trucks. See Preamble section XI.B. Therefore, evaluating GHG emissions of natural gas heavy-duty trucks based solely on their tailpipe emissions would be adequate. Finally, EPA regards it as a rational strategy to control upstream emissions by directly regulating upstream emission sources, rather than by attempting indirect control through lifecycle-based standards for natural gas heavy duty vehicles. EPA also takes the commenters' point that it would be arbitrary to establish lifecycle-based standards for only one vehicle fuel, and not all of the others. See also 77 FR 51702 (Aug. 27, 2012) and Section 1.8 of this RTC further explaining various reasons why it is reasonable for the heavy duty standards to be tailpipe based.

Reviewing Figure 13.2 of the RIA which is based on GWPs evaluated over a 100 year time period, our assessment of CNG heavy-duty trucks show them to be lower emitting in CO<sub>2</sub>-equivalent emissions than diesel fuel heavy-duty trucks, while our analysis shows LNG heavy-duty trucks to be higher emitting in CO<sub>2</sub>-equivalent emissions. The primary reason why LNG trucks are higher emitting in GHG emissions is because we assume that LNG will be produced by smaller, less efficient liquefaction plants. If LNG trucks source their LNG from a much more efficient LNG export facility (which is the case in California), the lifecycle emissions of LNG heavy-duty trucks is much like that of CNG heavy-duty trucks. If our boil-off sensitivity analysis for LNG trucks is reflective of actual natural emissions, then LNG trucks would be much higher emitting than diesel fuel trucks, although we would not base a lifecycle analysis on a sensitivity analysis – we would need actual boil-off emissions data which we do not have. See also the similar analysis in Preamble section XI.B and Figure 1 to that chapter.

Some commenters stated that we should conduct our lifecycle analysis using methane's global warming potential based on 20 years. While EPA continues to use 100 year GWPs as the primary metric to evaluate the relative climate impact of different greenhouse gas emissions, EPA has also used 20 year GWPs in sensitivity analysis in the RIA. Reviewing Figure 13.4 of the RIA which is based on 20 year GWPs, our lifecycle assessment shows CNG heavy-duty trucks to be higher emitting in CO<sub>2</sub>-equivalent emissions than diesels, and LNG heavy-duty trucks even higher emitting (based on a low-efficiency LNG liquefaction plant). However, there are two large uncertainties in our lifecycle analysis which makes our lifecycle GHG emissions analysis of natural gas versus diesel fuel heavy-duty trucks tentative. First, there is uncertainty in the diesel fuel lifecycle analysis. As noted above, EPA reassessed GHG emissions from the petroleum sector as part of the 2016 GHG inventory and EPA's updated methane emissions from the sector are estimated to be much higher than previous estimates. However, the updated GHG emissions analysis of the petroleum sector are not yet integrated into the GREET model which converts aggregated GHG emissions to fuel-specific emissions (this sort of fuel-specific analysis cannot be easily determined from the GHG Inventory; thus, we were not able to revise the diesel fuel lifecycle GHG analysis ourselves). This change will likely increase the calculated lifecycle GHG emissions of diesel fuel heavy-duty trucks which would make natural gas- fueled heavy duty vehicles look relatively better. However, the 2016 NSPS requires emissions reducing activities at new and modified petroleum production sites including reduced emission completions (RECs) of new oil wells completed with hydraulic fracturing which will then reduce those higher diesel fuel-associated

GHG emissions. We don't know the net effect of these two changes. Second, EPA has committed to further regulate the methane emissions from existing natural gas and petroleum sources. Assuming that these future regulations are put into place, it would improve the relative lifecycle GHG impacts of natural gas heavy-duty trucks. However, since these rules have not yet even been proposed, it is virtually impossible to project the lifecycle GHG emissions of natural gas heavy-duty trucks relative to that of diesel heavy-duty trucks.

The identified uncertainties in the GHG emission profile of both natural gas and diesel fuel would make establishing a full lifecycle assessment for natural gas heavy-duty trucks uncertain and speculative. In the future, the agencies may pursue additional steps to reduce lifecycle methane emissions from natural gas heavy-duty trucks, or choose to assess the GHG performance of natural gas heavy-duty trucks on a full lifecycle basis, for example, it becomes clear that natural gas truck sales begin to increase significantly above today's levels, or if new data and analyses related to natural gas and diesel fuel lifecycle emissions indicate a need for further action, and it proves possible to rationally develop lifecycle-based standards for gasoline, diesel, and other heavy duty vehicle fuels. The Energy Information Administration's (EIA's) most recent Annual Energy Outlook (AEO 2015) projects that crude oil prices will remain relatively low compared to natural gas prices for the next 15 years. Thus, natural gas heavy-duty truck fuel consumption is not projected by EIA to exceed 1 percent of total heavy-duty trucks fuel consumption until after 2035 which is well after the phase 2 GHG standards are phased-in. Thus, even if the GHG emissions impact of natural gas heavy-duty trucks is higher or lower than diesel heavy-duty trucks, if natural gas truck sales remain very low as forecasted by EIA, then there would be little impact on the US GHG inventory.

## 12.5 Projected Use of LNG and CNG

**Organization:** Environmental Defense Fund (EDF)

### F. Revisit projected growth of natural gas vehicles in heavy-duty sector

The agencies improperly characterize the potential use of natural gas trucks in its proposal and draft regulatory impact assessment. Specifically, the agencies concluded, [EPA-HQ-OAR-2014-0827-1312-A1 p.43]

*“ ... based on our review of the literature and external projections we believe that the use of natural gas is unlikely to become a major fuel source for medium and heavy-duty vehicles during the Phase 2 time frame. Thus, since we project natural gas vehicles to have little impact on both overall GHG emissions and fuel consumption during the Phase 2 time frame, the agencies see no need to propose fundamental changes to the Phase 1 approach for natural gas engines and vehicles.”* [EPA-HQ-OAR-2014-0827-1312-A1 p.43-44]

Both findings are incorrect and could undermine the benefits of the final Phase 2 standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.44]

The agencies' finding that “natural gas is unlikely to become a major fuel source for medium and heavy-duty vehicles during the Phase 2 time frame” is based on U.S. Energy Information Administration (EIA) market projections.<sup>186</sup> As EPA notes, the EIA projections are an outlier among other projections<sup>187</sup> and are flawed. Most significantly, the projections account only for high-pressure direct injection engines (HPDI).<sup>188</sup> Yet, in 2013, the only manufacturer of HPDI engines discontinued their production, citing high-costs compared to spark-ignited natural gas engines.<sup>189</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.44]



Moreover, the EIA projections fail to accurately reflect current sales. The market for natural gas-fueled heavy-duty trucks expanded by 20% in 2014 with 10,480 units sold.<sup>190</sup> These trucks are Class 8 heavy trucks including tractor-trailers, transit buses, and refuse trucks. Transit buses and refuse trucks saw the highest levels of natural gas adoption at 30% and 43% respectfully.<sup>191</sup> The significant increase in market share for natural gas trucks is consistent with industry forecasts by ACT research<sup>192</sup> and the National Petroleum Council (“NPC”).<sup>193</sup> Current sales volumes are 4.5 times greater than recent projections of sales from the EIA.<sup>194</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.44]

The discrepancy between market data and EIA projections continue in 2015. Recent industry data suggest total sale volumes of on-highway applications are expected to be 3,300 units in 2015.<sup>195</sup> These numbers, which do not include the refuse trucks and transit buses units that are leading NGV sales, are triple EIA projections.<sup>196</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.44]

The agencies discount ACT, NPC and others by noting, [EPA-HQ-OAR-2014-0827-1312-A1 p.44]

“[t]he first observation we can make about all these reports is that they start out assuming that natural gas use is 2 percent of the Class 8 heavy duty truck fleet in 2012. However, that level of natural gas vehicle penetration of the heavy-duty fleet is not supported by other data sources.”<sup>197</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.45]

This is a misreading of the projections, which represent new vehicle sales and not total penetration of the existing fleet. As we note above, new trucks sales in 2014 were consistent with NPC projections. [EPA-HQ-OAR-2014-0827-1312-A1 p.45]

The agencies also claim that NGVs are likely to drive less than diesel trucks, citing dated information from the Vehicle Inventory and Use Survey (VIUS) comparing light and medium heavy-duty trucks with diesel heavy trucks.<sup>198</sup> Given the fact that the agencies failed to break out low-mileage duty cycles, such as refuse trucks and transit buses that have significantly embraced natural gas engines, it is not surprising the agencies found that NGVs travel fewer miles than heavy diesel trucks. [EPA-HQ-OAR-2014-0827-1312-A1 p.45]

This conclusion is counter to how fleets operate over-the-road trucks. Palmer Trucks puts over 200,000 a year on its natural gas trucks.<sup>199</sup> In reference to its NGVs, Dillon Transport recently noted “we want to run those trucks 1,000 miles per day if we can.”<sup>200</sup> Saddle Creek has run its NGV trucks 34 million miles since 2012 while growing fleet size from 40 to 175 trucks.<sup>201</sup> Companies that buy NGVs for over-the-road duty maximize the mileage on these vehicles. It is core to the business case for choosing these trucks. [EPA-HQ-OAR-2014-0827-1312-A1 p.45]

The conservative EIA projections fail to account for another critical market development: new natural gas trucks are increasingly able to offer significant NOx reduction benefits compared to diesel trucks. The California Air Resources Board certified the Cummins-Westport 8.9-liter ISL G engine at 0.02 grams NOx per brake horsepower-hour.<sup>202</sup> Given the ability of this engine to deliver lower NOx, its adoption is likely to benefit from the deployment of public funds to mitigate local air pollution concerns.<sup>203</sup> [EPA-HQ-OAR-2014-0827-1312-A1 p.45-46]

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186 RIA at 955.

187 RIA at 953.

188 Chase, N. (U.S. Energy Information Administration), correspondence with EDF, (August 2015).

189 Clevenger, S., “Westport to End 15-Liter LNG Engine, Citing High Cost of Building Power Plant,” Transport Topics, (November 11, 2013).

190 Tita, B., “Slow Going for Natural-Gas Powered Trucks,” Wall Street Journal, (August 25, 2014), available at <http://www.wsj.com/articles/natural-gas-trucks-struggle-to-gain-traction-1408995745>.

191 Act Research, “NG Reality Check: Moving from Infancy to Adolescence,” (September 2014).

192 Id.

193 National Petroleum Council, Advancing Technology for America’s Transportation Future, (August 2012).

194 EIA, Annual Energy Outlook 2014: Freight Transportation Energy Use, Reference case, (May 2014).

195 “Westport, Fuel Systems Announce Merger,” Transport Topics, (September 1, 2015), available at <http://www.ttnews.com/articles/basetemplate.aspx?storyid=39327&t=Westport-Fuel-Systems-Announce-Merger>

196 EIA, Annual Energy Outlook 2015: Supertab 68, New Vehicle Sales, Heavy, Compressed/Liquefied Natural Gas, (April 2015).

197 RIA at 952.

198 RIA at 958.

199 “Palmer Trucks CNG Industry Leaders,” available at [www.palmertrucks.com/cng/](http://www.palmertrucks.com/cng/) (last accessed September 23, 2015).

200 Crissey, J., “Natural gas reality check, Part 2: Early adopters are staying the course,” Commercial Carrier Journal, (June 1, 2015), available at <http://www.ccjdigital.com/natural-gas-reality-check-part-2-early-adopter-are-staying-the-course/#sthash.isB4oevF.8eerS1b9.dpuf>.

201 Saddle Creek Logistics, “Growth of CNG at Saddle Creek Fuels Interest in Natural Gas,” (February 2015), available at <http://www.sclogistics.com/news-resources/press-releases-news/growth-of-cng-at-saddle-creek-fuels-interest-in-natural-gas#sthash.wlOKaezV.wUjshuev.dpuf>.

202 California Air Resources Board, On-Road Certification for Cummins-Westport ISLG 8.9L, (September 2015), available at [http://www.arb.ca.gov/msprog/onroad/cert/mdehdhdv/2016/cummins\\_mhdd\\_a0210630\\_8d9\\_0d20-0d01\\_ng.pdf](http://www.arb.ca.gov/msprog/onroad/cert/mdehdhdv/2016/cummins_mhdd_a0210630_8d9_0d20-0d01_ng.pdf)

203 Nemec, R., “NGV Market Penetration Still Small Despite Bullish Advocates,” Natural Gas Intelligence, (September 21, 2015), available at <http://www.naturalgasintel.com/articles/103730-ngv-market-penetration-still-small-despite-bullish-advocates>.

**Response:**

For the final rulemaking, the agencies further reviewed the economics of purchasing and using natural gas trucks. Based on this additional review, the agencies have the following responses to the comments raised by EDF.

First, we continue to support the conclusion we reached for the proposed rulemaking which is that it is unlikely that natural gas will become a major (major defined as 5% of the total fuel consumed) fuel source for medium and heavy-duty vehicles during the Phase 2 timeframe. This is further supported by the fact that crude oil prices started to decline during 2014 and continued their decline during 2015. While crude oil prices increased during the spring of 2016, as of early summer of 2016 they are still about half of what they were during the first part of 2014 when crude oil prices averaged at or above \$100 per barrel. Speaking to one LNG station owner, they explained that they shut down one LNG retail station because the LNG trucks that normally refuel at that LNG retail station were "parked" because LNG was priced relatively higher than diesel fuel.<sup>232</sup> EIA projects that crude oil prices will remain low for the foreseeable future, and at these crude oil prices, purchasing natural gas-fueled heavy-duty trucks is not a cost-effective option for most fleet operators. Another factor influencing low natural gas usage by heavy-duty trucks is that natural gas prices are projected to be higher in the latest Annual Energy Outlook (AEO 2015) compared to AEO 2014.

Despite the lower crude oil prices, natural gas truck sales are continuing. We believe that this does not raise serious questions about our payback analysis, but instead reflects upon certain special circumstances for truck fleets for the use of natural gas. For example, a fleet owner that signed a contract to purchase the natural gas trucks based on earlier fuel prices

There are likely special cases where the purchase of natural gas trucks make sense, even in today's poor pricing environment. For example, some states offer subsidies for the purchase of natural gas trucks, or for the construction of CNG or LNG refueling facilities. These subsidies explain why EIA fuel sales data shows such high natural gas sales to the transportation sector for those states which offer these subsidies. However, states may have little tolerance for continuing these subsidies over the long term, particularly if the sales of natural gas trucks begin to increase.

Another favorable market for using natural gas trucks are the trucks which transport petroleum or natural gas liquids out from a fossil-fuel producing region. For example, the Eagle Ford shale play produces natural gas liquids and also produces a significant amount of natural gas. Providing that the natural gas can be made clean enough out in the field, it could be compressed and distributed to CNG trucks at a much lower price point than the natural gas which must be moved into and out of storage and be transported through both the natural gas transmission and distribution systems.

Some natural gas trucks and urban buses are purchased because of their desirable emissions profile, such as low NOx emissions, and these purchases are more likely to continue for air quality issues and not just for economic reasons. These trucks purchased for low NOx are likely urban buses purchased by municipalities which likely are driven short distances in stop-and-go driving consuming only a modest amount of natural gas.

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<sup>232</sup> Conversation with Jon Wadsworth of BLU on May 2, 2016.

Another category worth mentioning are the refuse trucks which use landfill gas, which may be quite cheap since it is available free at landfills and it receives a renewable fuels credit. See the comments of Waste Management. But landfill gas poses almost no greenhouse gas risk to the environment.

Finally, there are trucks which driven an ultra-high mileage, such as the 200,000 mile per year class 8 trucks referred to by EDF. These trucks likely could pay down the higher purchase price of natural gas trucks more quickly. The problem with this argument is that these trucks are estimated to comprise less than 1% of the total population of heavy-duty trucks, and other trucks cannot simply be driven more -- their driving profile (i.e., stop-and-go urban driving and limited use) limits their mileage accumulation and increases the time it takes to pay-off the higher cost of purchasing a natural gas truck.

While these various situations can provide sales opportunities for natural gas trucks, their sales are likely to comprise a very small fraction of the heavy-duty truck fleet. Unless natural gas prices are substantially lower than diesel fuel prices the longer pay off of the higher upfront purchase cost of a natural gas truck is likely to slow the adoption of natural gas as a heavy-duty truck fuel.

### **12.5.1 Applying Standards to Natural Gas Vehicles**

**Organization:** NGVAmerica

**F. NG Fuel Economy Measurement. The agencies intend to continue the practice of measuring the fuel economy of natural gas engines and vehicles based on measurement of CO2 emissions.** [EPA-HQ-OAR-2014-0827-1270-A1 p.4]

NGVAmerica supports the decision to continue the practice of measuring the fuel economy of all fuel types based on CO2 emissions. The Preamble states that fuel consumption is based on a “one-to-one relationship between fuel efficiency and tailpipe CO 2 emissions.” This practice provides regulatory certainty for all fuel types and is consistent with previous rules for light and heavy duty motor vehicles. Moreover, it provides a reasonable incentive for natural gas manufacturers, since natural gas vehicles with the same efficiency as gasoline or diesel fueled vehicles produce less CO2 emissions. EPA indicates that this benefit is about 20 – 30 percent, which we believe is a reasonable incentive given that natural gas powered vehicles in most cases offset 100 percent of the petroleum that would otherwise be used and one of the goals of the fuel economy rules is to reduce petroleum reliance. [EPA-HQ-OAR-2014-0827-1270-A1 p.4]

**Organization:** Enovation Controls (ENC)

3.1 Contradictory Statement - Section XI on Natural Gas Vehicles and Engines states that .”..since we project natural gas vehicles to have little impact on both overall GHG emissions and fuel consumption during the Phase 2 time frame, the agencies see no need to propose fundamental changes to the Phase 1 approach for natural gas engines and vehicles.” (P. 775, EPA Phase 2 Proposal) It is unclear if this statement supersedes all discussion of natural gas regulation proposals for Phase 2. We respectfully request clarification on whether or not Phase 1 carryover for natural gas engines and vehicles is indeed the approach proposed by the document. [EPA-HQ-OAR-2014-0827-1203-A1 p.3]

3.2 Lean-Burn vs Stoichiometric Combustion - Also within Section XI on Natural Gas Vehicles and Engines, the statement that a diesel-fueled engine converted “to run on natural gas by adding a spark plug and changing calibration strategy to rely on stoichiometric combustion” implies that stoichiometric combustion is required to run a natural gas engine using spark ignition. (P. 776, EPA Phase 2 Proposal) This statement is misguided because, absent of emissions requirements, the spark-ignited natural gas engine can indeed run lean-burn combustion, and does so in EU4 and lower

emissions levels for heavy-duty applications. At EU6 and US standards for 2018, the decision to use Stoichiometric combustion with EGR is driven by cost and the likely desire to use a three-way catalyst rather than using a diesel aftertreatment solution. It is technically feasible to use a lean-burn solution with SCR, but at significantly higher system cost and with higher end-customer maintenance. [EPA-HQ-OAR-2014-0827-1203-A1 p.3]

**Organization:** Securing America's Future Energy

Reconsider Application of 49 USC §32905 Manufacturing Incentives

The manufacture of non-petroleum fueled light-duty vehicles is incentivized through the application of volumetric adjustment factors under 49 U.S.C. §32905. Generally one gallon of non-petroleum fuel consumption is treated as 15 percent of one gallon, so that regulatory fuel economy is 6.67 times higher than measured fuel economy.<sup>18</sup> This incentive, originally established under the Alternative Motor Fuels Act of 1988, has been renewed and expanded many times over the intervening years, including as recently as 2014 when expanded allowances for dual fuel natural gas vehicles were added. In short, there is a long legislative history that affirmatively demonstrates congressional intent to facilitate the production and widespread use of alternative fuel vehicles (AFVs).<sup>19</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.6]

In the absence of similarly explicit statutory requirements for heavy-duty vehicles, EPA and NHTSA elected not to extend the §32905 allowances to such vehicles when the Phase 1 GHG and fuel economy rules were developed, and to maintain this restriction in the Phase 2 proposal.<sup>20</sup> Although there is no supporting discussion in the Phase 2 proposal, it is clear from discussion included in the final Phase 1 rule that both EPA and NHTSA understand quite clearly the implications of this decision—both in terms of promoting alternative fuels and decreasing manufacturer flexibility—affirmatively stating that the adopted approach of not applying light-duty-equivalent incentives 'could have the disadvantage of not doing more to encourage some cost-effective means of reducing petroleum consumption by trucks, and the accompanying energy security costs' and that adopting distinct GHG and fuel economy standard incentives 'might enable manufacturers to achieve the twin goals of reducing greenhouse gas emissions and decreasing consumption of petroleum-based fuels in a more cost-effective manner.'<sup>21</sup> The Phase 1 discussion also affirms that EPA and NHTSA will reconsider the non-expansion of the light-duty-equivalent incentives in establishing future heavy-duty requirements (76 FR 57125). [EPA-HQ-OAR-2014-0827-1282-A1 p.6]

SAFE is specifically requesting that EPA and NHTSA undertake such reconsideration and formally expand the §32905 incentives to heavy-duty vehicles. Such expansion will make available to heavy-duty vehicle manufacturers the same incentives that are available to their light-duty counterparts, as well as introduce provisions into the heavy-duty rule that are fully consistent with the statutorily established goal of promoting non-petroleum fuels. From a fueling perspective, there is no rational reason to treat heavy-duty manufacturers differently than their light-duty counterparts. If introducing an AFV into the light-duty fleet is deemed important for national and economic security, and explicit incentives are provided to promote such introduction, introduction of an AFV into the heavy-duty fleet should contribute to the same goal and be worthy of the same incentives. Any other determination is arbitrary, as it effectively results in differential treatment of the same fuel.<sup>22</sup> [EPA-HQ-OAR-2014-0827-1282-A1 p.6-7]

We recognize that EPA and NHTSA are proposing a fuel economy determination for heavy-duty AFVs that takes advantage of the differential carbon contents of such fuels relative to gasoline and diesel. However, the resulting fuel economy benefit for a fuel such as natural gas is equivalent to a multiplier of 1.25 to 1.5, versus the 6.67 multiplier available to light-duty natural gas vehicle manufacturers. EPA and NHTSA should adopt the same fuel economy incentives for alternative fuels across both sectors. [EPA-HQ-OAR-2014-0827-1282-A1 p.7]

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<sup>18</sup> Note: Since fuel economy is measured as X miles per Y gallons, adjusting Y gallons to 0.15Y gallons effectively increases fuel economy by 1 divided by 0.15 (i.e., by a factor of 6.66).

<sup>19</sup> Note: Intent of legislative action derived from the 'Purpose' clause of the Alternative Motor Fuels Act of 1988.

<sup>20</sup> Note: As used in these comments, the terminology 'heavy-duty' is intended to include both medium and heavy-duty vehicles as included in the EPA and NHTSA Phase 2 GHG and fuel economy proposal.

<sup>21</sup> See, e.g., Phase 1 discussion at 76 FR 57123 through 76 FR 57125.

<sup>22</sup> Note: EPA and NHTSA 'justify' such differential treatment in their discussion of the Phase 1 rule by citing the benefits of reduced reporting and compliance determination requirements, coupled with the possibility that providing the § 32905 incentives might lead to little increased production of alternative fueled vehicles or that alternative fuels may be imported. However, all of these 'justifications' are independent of market sector and would apply equally to light- and heavy-duty manufacturers. Clearly, such rationales were rejected when statutory requirements were established to provide incentives in the light-duty sector so it is not at all clear why they would carry more weight in rejecting these same incentives for the heavy-duty sector.

**Response:**

We continue to believe that a CO<sub>2</sub> standard is the most effective way for EPA to set efficiency standards for heavy-duty engines and vehicles under the Clean Air Act. With respect to SAFE's comments, EPA notes that we are adopting our Phase 2 standards to control greenhouse gas emission as allowed under the Clean Air Act, including the authority to set fuel-neutral performance standards.

The agencies noted in the NPRM Preamble that we are not adopting fundamental changes to the Phase 1 program, but noted elsewhere that we are adopting Phase 2 standards for all engines in this rule, including those fueled by natural gas. Readers are encouraged to read the regulatory text to fully understand the requirements being adopted.

We agree that spark-ignition natural gas engines can rely on lean-burn fueling strategies and have revised the Preamble accordingly.

## **12.5.2 Converters and Dual-Fuel Conversions 1776**

**Organization:** NGVAmerica

### **H. Alternative Fuel Converters [EPA-HQ-OAR-2014-0827-1270-A1 p.5]**

The Preamble provides little discussion of the coverage of aftermarket alternative fuel conversions. In communications with EPA staff, however, NGVAmerica has learned that EPA is proposing to regulate all alternative fuel conversions as part of these Phase 2 regulations. This is noteworthy because it is a change from the Phase 1 rules that according to EPA exempted small businesses from having to comply with the medium and heavy duty greenhouse gas emission standards. Since most alternative fuel conversions are produced by small businesses, this change is expected to impact most of the businesses that produce alternative fuel conversions for medium and heavy duty vehicles, and it will have a major impact on this industry segment. [EPA-HQ-OAR-2014-0827-1270-A1 p.5]

NGVAmerica supports EPA's efforts to ensure that alternative fuel conversions are clean and efficient and comply with the Clean Air Act. NGVAmerica members are committed to complying with

certification and compliance requirements for aftermarket conversion systems, and are on record as advocating that federal and state incentives such as tax credits and grant programs only go to systems that comply with EPA regulations. NGVAmerica members are sometimes placed at an economic disadvantage and lose out on business to companies that opt not to comply with the current EPA regulations for aftermarket systems. Adding another layer of regulatory compliance will only exacerbate this situation for those companies that are committed to following the law. [EPA-HQ-OAR-2014-0827-1270-A1 p.6]

NGVAmerica appreciates that EPA over the years has recognized the unique status of aftermarket conversion companies and has adopted compliance pathways that include regulatory flexibility and exemptions where appropriate. We therefore support the proposed flexibilities and delayed compliance schedule for aftermarket converters proposed in the Phase 2 proposal. We would urge EPA however to go further and provide several additional changes and clarifications to the proposal as indicated here. [EPA-HQ-OAR-2014-0827-1270-A1 p.6]

NGVAmerica requests that EPA clarify that compliance for alternative fuel conversion systems manufactured by small businesses under Phase 2 is not mandatory until 2023. It is our understanding that this was intended, and that the reference to 2019 in section 1819-14 was not. In any case, we would urge EPA to amend the regulatory text so that compliance for conversion manufactures under Phase 2 starts no sooner than it does for new engines produced by small manufactures (i.e., 2022), and provides the additional year indicated for alternative fuel systems (i.e. 2023). It would be helpful if this were expressly stated in Part 85 Subpart F which includes specific requirements for alternative fuel conversions. We also urge EPA to clarify that for small business manufacturers, who produce alternative fuel aftermarket conversion systems, regulatory coverage shall only extend to the modification of engines that were originally manufactured in 2022 or later. This additional clarification is necessary to ensure that aftermarket systems installed on 2021 and earlier engines, or vehicles by small manufacturers, are not covered when they occur post-2021. Since those engines were covered under Phase 1 and not Phase 2, the regulation of conversions on such systems should continue to be regulated under Phase 1 rules. [EPA-HQ-OAR-2014-0827-1270-A1 p.6]

**Organization:** Optimus Technologies

### **Effect on Small Volume Alternative Fuel Engine Converters**

Optimus Technologies requests clarity regarding how the proposed rule will affect small volume alternative fuel engine converters that install alternative fuel conversion systems into vehicles after the first retail sale (or introduction into retail commerce). Optimus is aware of the one-year delays available for increases in stringency. Clarity around what those increases are would be helpful. Reading the proposed rule, it is unclear which proposed regulations apply strictly to OEMs and which also apply to small volume alternative fuel engine converters. For instance, will small volume alternative fuel engine converters be required to submit fuel economy data when submitting engine certification packages? Will small volume alternative fuel engine converters need to use the GEM software? [EPA-HQ-OAR-2014-0827-1276-A1 p.3]

**Organization:** NGVAmerica

NGVAmerica agrees with the [Preamble] statement and supports the agencies' decision. The one area of potential clarification would be for aftermarket conversion systems (not new engines or vehicles) where the practice has been to retain the original classification of the vehicle/engine undergoing conversion. This would mean that an in-use medium duty diesel engine converted so that it retains the diesel cycle,

would continue to be classified as a diesel engine. The conversion manufacturer would then have to certify or demonstrate compliance with the standards originally applied to the vehicle/engine undergoing conversion. Similarly, if a heavy-duty gasoline engine used in a vehicle rated at 19,500 lbs. GVWR or higher were converted to operate on natural gas, and the engine continued to be an Otto-Cycle engine, the conversion systems would be subject to the Otto-cycle standards, not the compression-ignition standards. Clarifying the treatment of aftermarket conversion would help avoid any possible confusion concerning this issue. [EPA-HQ-OAR-2014-0827-1270-A1 p.3]

**Response:**

It is apparent from the comments that we need to provide an overview of EPA's policy regarding aftermarket fuel conversions as that relates to the prohibitions in the Clean Air Act. As a starting point, EPA requires that manufacturers of new engines and new vehicles obtain certification to allow them to sell their engines and vehicles in the United States. If manufacturers sell new engines or new vehicles without certifying, they would be in violation of CAA section 203(a)(1).

Companies that modify a certified engine or a certified vehicle are subject to the tampering prohibition in CAA section 203(b)(1). The statute broadly prohibits removing or rendering inoperative emission controls. This applies in a straightforward way for modifications such as removing aftertreatment devices or reprogramming an engine's ECU for high-performance applications. This is not straightforward for fuel conversions. EPA has therefore adopted regulations at 40 CFR part 85, subpart F, to provide a path for companies performing aftermarket fuel conversions to demonstrate that their conversions do not remove or render inoperative emission controls. If a company performing conversions meets all the specified requirements, their conversions are exempt from the tampering prohibition. A company performing aftermarket fuel conversions without certifying under 40 CFR part 85, subpart F, is not in violation of the introduction-into-commerce violation of CAA section 203(a)(1).

The one-year delay in emission standards applies for manufacturers of new engines or vehicles certifying to standards under 40 CFR part 86, 1036, or 1037. This means that those manufacturers are exempt from the introduction-into-commerce prohibition under CAA section 203(a)(1) during that time, which means that they do not need to certify their engines or vehicles to the GHG standards that would otherwise apply for that year.

Companies performing aftermarket fuel conversions are subject to the tampering prohibition in CAA section 203(b)(1), with no one-year delay. The whole premise of the conversion provisions in 40 CFR part 85, subpart F, is that the tampering exemption applies where the company is able to make a demonstration that the modified engines and vehicles continue to operate at a level of emission control that is consistent with the original certified configuration. The expectation is that conversions are preserving the level of performance also for GHG emissions as established for the certified configuration when operating on the alternative fuel. This same approach applies for both Phase 1 and Phase 2 GHG standards. We would have no basis under the statute to allow conversions that increase emission levels above those of the original certified configuration.

If companies performing aftermarket fuel conversions would choose to act as a manufacturer and certify the engines or vehicles to the criteria emission standards that apply under 40 CFR part 86, subpart A or S, respectively, they would then qualify for the one-year delay in complying with GHG standards.

We agree with NGV America that the 2019 date is incorrect. We have revised that to state that small manufacturers are exempt from GHG standards until January 1, 2022. The one-year delay for



conversions is not in addition to the one-year delay for other small manufacturers; rather, the one-year delay for alternative-fuel engines applies for each new standard as it applies to new model years.

If any engines or vehicles are not yet certified to GHG standards (from small or non-small manufacturers), the GHG requirements do not apply for conversions of those engines or vehicles. Similarly, if any engines or vehicles are certified to Phase 1 GHG standards, the Phase 2 GHG requirements do not apply for conversions of those engines or vehicles. Standards for conversions never exceed the stringency of standards corresponding to the certified configuration.

Companies performing aftermarket fuel conversions must test engines or vehicles and submit information as specified in 40 CFR part 85, subpart F. This generally involves emission measurements to show that modified engines or vehicles continue to meet applicable emission standards. This would never involve using GEM.

Aftermarket fuel conversions involving a change from, for example, compression-ignition to spark-ignition engine technology continues to be subject to the same standards. Since the aftermarket requirements relate to the statutory tampering prohibition, the modified engines or vehicles are judged relative to the original certified configuration, regardless of the operating characteristics of the modified engines or vehicles.

## 13 Amendments to Phase 1 Standards

### 13.1 General Comments

**Organization:** Daimler Trucks North America LLC

**Changes to Phase 1:** There should be no changes to Phase 1. 80 FR 40519. It is too late for us to revise aero numbers or our delegated assembly procedures, given the agencies' lead time requirements, which require four years' lead time for NHTSA and require a joint program for the EPA (see Massachusetts v. EPA 549 U.S. 497, 532, 2007, where the Supreme Court stated that "there is no reason to think the two agencies [EPA and NHTSA] cannot both administer their obligations and yet avoid inconsistency"). We are busy working on Phase 2, to go back and adjust computer systems or delegated assembly at this point in time is too much for our limited groups. [EPA-HQ-OAR-2014-0827-1164-A1 p.111]  
[Comment is also in 1.4.4 for delegated assembly.]

**Response:**

The final rule mostly includes only a variety of minor changes to the Phase 1 program. In most of these cases, we add options and flexibility, either to reduce burden or to align with the Phase 2 program. There are also several technical amendments where we make corrections or adjustments to testing or compliance procedures for more effective implementation. We are specifically not making changes to the Phase 1 emission standards, GEM simulations, aerodynamic bins, or other aspects of the regulation that define stringency. We have also taken steps to ensure that the Phase 1 amendments do not substantially alter data collection and submission requirements. The rest of this Section 13 describes the specific amendments to the Phase 1 program in greater detail. Section 1.4.4 describes our approach to delegated assembly.

### 13.2 EPA Amendments

#### 13.2.1 Pickups and Vans

**Organization:** California Air Resources Board (CARB)

The CARB staff supports the language added to 40 CFR 86.1819-14 clarifying that the CO2 standards must be met over the full useful life. CARB staff supports the addition of language setting broad applicability and pulling out specific further requirements. This approach by U.S. EPA and NHTSA will close potential loopholes for engines/vehicles that are difficult to fit into existing language. [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

For non-medium-duty passenger vehicle heavy-duty vehicles, the emissions standards in 40 CFR 86.1819 apply for the currently defined useful life of 11 years, 120,000 miles through MY 2020, then increase to 150,000 miles/15 years with MY 2021 and beyond. Under 40 CFR 1036.108 (d), a 150,000 mile/15 year useful life over which compliance must continue is also specified (page 40585 of the NPRM). CARB staff supports the increased useful life for vocational class 2b through 5 vehicles from 110,000 miles/10 years to 150,000 miles/15 years as specified in 40 CFR 1037.105 (e)(1). [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

**Organization:** Daimler Trucks North America LLC

**Part 86 Changes** - We agree with all the changes done in Part 86.

**Response:**

We are adopting the provisions as proposed and as supported by the commenters.

**13.2.2 Differentiating Spark-Ignition and Compression-Ignition Engines**

**Organization:** Power Solutions International (PSI)

One area of the proposed rule seems to discriminate against spark-ignition engines while favoring compression ignition engines. We are specifically concerned with the language pertaining to spark-ignition engines that operate on fuels other than gasoline and are “engines that qualify as medium heavy-duty or heavy heavy-duty and do not operate on gasoline.” The proposed rule would require such spark-ignition engines to comply with standards applicable to compression-ignition engines. [EPA-HQ-OAR-2014-0827-1161-A1 p.1]

We feel this language will put some spark-ignition engines at a disadvantage and will potentially “regulate” these engines out of the market. In turn, this language seems to give an advantage to diesel derived spark-ignition alternative fueled engines (all of which are fueled by CNG fuel only) and may “regulate” these engines into the market. The language in the proposed rule appears to be derived from the diesel engine manufacturer sector, specifically from those manufacturers that offer diesel derived spark-ignition engines that operate on CNG fuel. [EPA-HQ-OAR-2014-0827-1161-A1 p.1]

Diesel engine derived spark-ignition engines are converted from compression-ignition engines. In some cases up to 80% of the diesel derivative components are used in converting the spark-ignition engine variant. Cummins Westport advertises the commonality between their NG ISX/ISL/ISB engines and their Cummins diesel derivatives. These diesel derived spark-ignition engines are generally turbo-charged with CAC, have high compression ratio and are specifically targeted for CNG or LNG fuel. These engines are typically not targeted or sold to applications that use LPG, which requires compression ratios similar to what is used for gasoline fuel. These diesel derived spark-ignition engines are design for rebuild and can be sold into Class 8 line haul applications and down into medium heavy-duty vocational markets. [EPA-HQ-OAR-2014-0827-1161-A1 p.2]

Our company supplies spark-ignition engines into the heavy duty on highway vocational vehicle sector. We supply engines into markets classified as light heavy-duty and medium heavy-duty. Our engines are “fuel agnostic” and are capable of being fueled by gasoline, LPG or CNG. Our engine long blocks are similar regardless of fuel type. Our engines are derived from the automotive sector, some of which are supplied by General Motors Powertrain and some are PSI/internally produced engine blocks. All of our on highway heavy duty spark-ignition engine products are derived and carried over from the automotive market. Our engines do not have cylinder liners and are not designed for rebuild. Our on highway heavy duty engines are all designed as spark-ignition and do not have a compression-ignition derivative. Our engines are can be sold to the light heavy duty and up into the medium heavy-duty market. [EPA-HQ-OAR-2014-0827-1161-A1 p.2]

The current proposed rule, as written, will put our spark-ignition engine products at a distinct disadvantage as compared with “diesel derived” spark-ignition alternatively fueled engine products. Diesel derived spark ignition engines are designed for heavy heavy-duty and are sold down to medium heavy-duty. They carry over 80% of the diesel content, are specifically targeted for CNG fuel and are designed for rebuild. These engines are designed to have an identical interface/foot print as the diesel derivative. [EPA-HQ-OAR-2014-0827-1161-A1 p.2]

A better approach to this regulatory language is presented below. Either approach presented would provide a more level playing field for engine manufacturers supplying non-gasoline fueled spark-ignition engines into the heavy duty vocational vehicle market. [EPA-HQ-OAR-2014-0827-1161-A1 p.2]

**Proposal for non-gasoline spark-ignition language:**

**Option 1:**

Unless other specified, spark-ignition engines that qualify as medium heavy-duty or heavy heavy-duty and operate on LPG or CNG must meet all the emission standards and other requirements of this part that apply for compression-ignition engines, if a manufacturer has derived the spark-ignition engine from a similar compression-ignition base engine block. If an engine qualifies as medium heavy-duty or heavy heavy-duty and operates on LPG or CNG and is derived from a similar gasoline fueled spark-ignition engine block, the engine must meet all emission standards and other requirements of this part that apply to spark-ignition engines. [EPA-HQ-OAR-2014-0827-1161-A1 p.2]

**Option 2:**

Alternatively, the language for Phase 2 could be such to keep all spark ignition engines, regardless of fuel type, regulated the same as gasoline (627 g/hp-hr standard). This would eliminate any biasing toward the higher BMEP “diesel derived” spark ignited engines that exists in the Phase 2 NPRM today, and would effectively put all spark ignited engine on equal footing regardless of fuel type and design origin. Diesel derived spark ignited CNG fueled engines could still have the option to comply with the compression ignition standard, should they choose (as they do today in Phase 1). [EPA-HQ-OAR-2014-0827-1161-A1 p.3]

We feel that the language we are proposing in Option 1 will sufficiently distinguish between dedicated spark-ignition engines and diesel derived spark-ignition engines and will not discriminate either. We feel it would also be acceptable to regulate all spark ignited engines to the 627 g/hp-hr standard, regardless of gasoline or alternative fuel. We are hopeful that the significant nature of this issue is taken into consideration so the final rule can specify requirements that are fair and appropriate for all manufacturers. [EPA-HQ-OAR-2014-0827-1161-A1 p.3]

**Organization:** ROUSCH CleanTech

We are concerned about the proposed changes to the standards applying to spark-ignited engines using clean alternative fuels for MHD/HHD. Two specific paragraphs are included here for reference (emphasis added): [EPA-HQ-OAR-2014-0827-1007-A1 p.2]

*o “We are also proposing that these provisions would apply equally to engines fueled by any fuel other than gasoline or ethanol, should such engines be produced in the future. Given the current and historic market for vehicles above 19,500 lbs GVWR, EPA believes any alternative fueled vehicles in this weight range would be competing primarily with diesel vehicles and should be subject to the same requirements as them. We request comment on all aspects of classifying natural-gas and other engines for purposes of applying emission standards. See Sections XI and XII for additional discussion of natural gas fueled engines.” [EPA-HQ-OAR-2014-0827-1007-A1 p.2]*

o We believe that this discussion is problematic on several levels: [EPA-HQ-OAR-2014-0827-1007-A1 p.2]

o The “current and historic market for vehicles above 19,500 GVWR” includes a wide variety of non-diesel engines. Gasoline engines are offered in commercial stripped chassis and RV chassis up to 26,000# GVWR, and chassis-cab chassis up to 33,000# GVWR. Propane autogas engines are currently offered in all Type C school bus chassis, accounting for approximately 10% of the market, and both CNG and gasoline options have recently been announced for introduction in the next year. [EPA-HQ-OAR-2014-0827-1007-A1 p.2]

o The treatment of “alternative fuels” here is unique to any other context we are aware of. In all other regulatory framework, and in all practical market consideration, natural gas, ethanol, and propane are all considered clean alternative fuels to gasoline. The sole exception to this is the traditional exception that EPA has given diesel engine manufacturers who converted their engines to spark ignition natural gas—those manufacturers were allowed to certify under the compression ignition standards if it was to their benefit. We find it hard to imagine any context in which EPA would encourage the use of gasoline as a substitute for diesel, but discourage those same engines operating on natural gas or propane—but this is exactly what the regulation proposes. Propane is simply not a diesel replacement fuel in any relevant context—its octane and burn characteristics do not allow it to be easily used on a CI-based engine, and there are no current propane engines that are based on CI designs. Natural gas has several historic advantages here—very high knock resistance, and the exclusion of methane from historic pollutant standards—that has allowed its use on CI-based engines, but there is very little penetration of these engines below 33,000#. [EPA-HQ-OAR-2014-0827-1007-A1 p.2-3]

*o “We are not aware of any currently certified engines that would change from compression-ignition to spark-ignition under the proposed clarified approach. Nonetheless, because these proposed standards implicate rules for criteria pollutants (as well as GHGs), the provisions of CAA section 202 (a)(3) (C) apply (for the criteria pollutants), notably the requirement of four years lead time. We are therefore proposing to continue to apply the existing interim provision through model year 2020.110 Starting in model year 2021, all the provisions would apply as described above. Manufacturers would not be permitted to certify any engine families using carryover emission data if a particular engine model switched from compression-ignition to spark-ignition, or vice versa. However, as noted above, in practice these vehicles are already being certified as CI engines, so we view these changes as clarifications ratifying the current status quo.” [EPA-HQ-OAR-2014-0827-1007-A1 p.3]*

o The paragraph above is technically correct, in that it should only apply to engines that are currently certified as compression-ignition. However, the proposed regulatory change doesn’t only apply to those engines—it applies to all SI engines “other than gasoline or ethanol.” Therefore, the logic presented is simply wrong. Using the last complete HD certification data available on the EPA website (2014<sup>1</sup>), it shows spark-ignited engines, certified to SI standards, from BAF, Bi-Phase Technologies, Clean Fuel USA, Greenkraft, ICOM, Landi Renzo, NGV Motori, Roush, Westport, and IMPCO; these engines are all offered in vehicles above 19,500# GVWR (school bus, straight truck, stripped chassis). The only SI engines listed as certified to CI standards are those from Cummins; to the best of our knowledge these engines have little or no market acceptance below 33,000# GVWR. This change would have significant impact to the market below 33,000#. [EPA-HQ-OAR-2014-0827-1007-A1 p.3]

We also believe that the proposed change would cause an unintended distortion of the Class 6/7 market. As proposed, an engine manufacturer which supplies propane or CNG engines, based on conventional SI engine technology, to chassis OEM’s (including at least ROUSH CleanTech and PSI/PTI currently)

would be required to meet the compression ignition standards. These same engines, if certified as conversions, would only be required to meet the spark ignition (gasoline) standards. This makes no sense—it is the same engine, used by the same customer in the same way. Encouraging these engines (which the customer always intends to use on the clean alternative fuel) to circumvent the full OEM certification procedure and move into the conversion standards is a clear market distortion, and will likely reduce the environmental benefits that would be accomplished from a complete OEM certification. Requiring the conversion manufacturers to certify under the CI standard would be even worse; the changes to useful life alone would be prohibitively expensive for a conversion manufacturer. Therefore, we think that this is another strong justification for keeping the certification standards the same for gasoline and clean alternative fuels used on gasoline-based engine technologies (whether they were conversions or not). [EPA-HQ-OAR-2014-0827-1007-A1 p.3]

In general, we believe that the proposal appears to have been developed primarily focused on the Class 8 (over 33,000#) GVWR market, and because of this, that the only alternative fuel that was studied in any detail was natural gas. We believe that the proposed changes below 33,000# would harm consumer choice; are not supported in the text; and are not consistent with actual market conditions. However, we understand the agencies' concern about the potential "loophole" in Class 8 applications which could result in CI manufacturers achieving a competitive advantage through use of the SI standard for natural gas engines which are otherwise fully capable of meeting the CI standard. Therefore, we propose the following revisions: [EPA-HQ-OAR-2014-0827-1007-A1 p.3-4]

- Keep the Phase 1 GHG compliance logic in place for all engines certified for use in vehicles up to 33,000# GVWR (LHD/MHD). Spark-ignited engines certify to the proposed SI standards, regardless of fuel type, and vehicles using these engines will certify to the proposed SI vehicle standards. CI engine manufacturers may choose to certify their SI engines under the CI standards; engines certified in this manner will be considered CI for the purposes of averaging, banking, and trading. [EPA-HQ-OAR-2014-0827-1007-A1 p.4]
- Engines fueled partially or wholly by natural gas, used in vehicles above 33,000# GVWR, must certify to the CI standards, regardless of ignition type. Spark-ignited engines using gasoline must be certified to the SI standards; SI engines using clean alternative fuels other than natural gas may be certified as SI engines or CI engines at the choice of the manufacturer. [EPA-HQ-OAR-2014-0827-1007-A1 p.4]

We believe that this approach protects the consumer choice in the existing Class 6/7 market; eliminates a potential incentive to use gasoline instead of propane/natural gas in these products; and still ensures there is no incentive for Class 8 engine manufacturers to certify as spark-ignited to take advantage of the higher GHG standard. In this way, we think it is fully consistent with the stated intention of Phase 2, and protects all of the proposed environmental benefits better than the original proposal. In the long run, we think that accounting for full life-cycle emissions for all fuels, and ensuring a robust credit trading marketplace between manufacturers, will hopefully eliminate the need for the split SI/CI standards altogether. [EPA-HQ-OAR-2014-0827-1007-A1 p.4]

**Organization:** American Automotive Policy Council

### **Classification of Spark Ignited CNG Engines**

The agencies requested comment (80 Federal Register 40207) on re-classifying natural-gas engines for purposes of emission and GHG regulations. AAPC does not agree with EPA's proposal to reclassify all natural gas and propane fueled vehicles > 19,500 lbs. GVWR from "spark ignition" to "compression ignition" status. While liquid natural gas storage systems and large displacement turbo charged engines

with spark ignition and three way catalysts are an emerging competitor to urea/SCR diesel technology, naturally aspirated spark ignited CNG and propane engines serve entirely different needs and segments much closer to their gasoline powered SI counterparts. [EPA-HQ-OAR-2014-0827-1238-A1 p.30]

AAPC proposes that Phase 2 compressed natural gas / propane emissions classification be subject to the following three criteria: (1) Is the GVWR > 37,000lbs? (2) Is the engine boosted? (3) Is advertised / certified peak torque of the engine > 15 bar BMEP? Only if the answer to any of these questions is “yes” should the engine/vehicle be subjected to the compression ignition standards. [EPA-HQ-OAR-2014-0827-1238-A1 p.30]

**Organization:** California Air Resources Board (CARB)

### **Support Comment**

#### **Comment – Natural gas engines and vehicles certifying according to intended service class**

CARB staff supports the Phase 2 proposal to require any natural gas engine qualifying as a medium heavy-duty (19,500 to 33,000 lbs GVWR) or heavy heavy-duty (over 33,000 lbs GVWR) natural gas engine to be subject to all the emission standards (GHG and criteria pollutant) and other requirements, including the longer useful life and warranty provisions, that apply to compression ignition engines. [EPA-HQ-OAR-2014-0827-1265-A1 p.164-165]

CARB supports the proposal to require medium heavy-duty and heavy heavy-duty engines to meet compression ignition requirements (useful life, warranty, not-to-exceed limits, criteria pollutant standards) because they are more stringent and protective of air quality compared to the comparable spark-ignited requirements. [EPA-HQ-OAR-2014-0827-1265-A1 p.165]

CARB believes there are some 6.8 to 9 liter natural gas engines (produced by BAF, Greenkraft, Impco, Landi Renzo, and Power Solutions) that are currently being certified to the Otto-cycle requirements that may be offered in the future in medium heavy- and even heavy heavy-duty vehicle configurations, and thus could ultimately be impacted by the proposed requirements. Many of these natural gas “converters” offer vehicles primarily in the light heavy-duty classes, and there is some possibility that with the additional requirements they may no longer choose to offer medium heavy-duty and heavy heavy-duty natural gas vehicles. However, this should have minimal market impact as Cummins is already certifying their spark-ignited natural gas engines to the compression ignition requirements. [EPA-HQ-OAR-2014-0827-1265-A1 p.165]

40 CFR1036.150 (e) Alternate phase-in standards (page 40587 of the NPRM) states “[w]here a manufacturer certifies all of its model year 2013 compression-ignition engines within a given primary intended service class to the applicable alternate standards of this paragraph (e), its compression ignition engines within that primary intended service class are subject to the standards of this paragraph (e) for model years 2013 through 2016.” Then follows an untitled table, the last line of which is labeled “Model Years 2016 and later,” and provides standards of 576 g/hp-hr for light heavy-duty and medium heavy-duty engines, and 555 g/hp-hr for heavy-duty diesel engines. CARB staff believes this last line of the table should be labeled “Model Years 2016 through 2020.” The presumably unintended implication in this table as written is that if a manufacturer follows this alternate phase-in schedule, the manufacturer may continue to certify engines to the same standard after 2016 and throughout Phase 2. [EPA-HQ-OAR-2014-0827-1265-A1 p.190]

**Organization:** NGVAmerica

**C. Classification of NG Engines. The notice indicates that the agencies plan to continue the practice of regulating most heavy duty natural gas engines as compression ignition engines.**

NGVAmerica supports the decision to retain the current regulatory framework used to classify natural gas engines. We are not aware of any manufacturers who have requested a change in classification. [EPA-HQ-OAR-2014-0827-1270-A1 p.2-3]

**Organization:** American Power Group Inc. (APG)

C. With regard to Chuck Moulis note 6 August 2015 stating the following: [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

For non-new vehicles (whether inside or outside of the useful life), we proposed: [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

· No delay in the applicable standards under §85.525. [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

· That small converters showing compliance with the applicable part 1036 engine standards under §85.525 would not be required to separately show compliance with the part 1037 vehicle standards as long as the pre-conversion vehicle was certified to the part 1037 standards and the converter does not modify certified vehicle components such as tires, axles, and transmissions. [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

Trying to understand the implications of the above statements to a non-new fully OEM certified HHDD engine (before conversion) and how it would relate to a HHDD (>26K #'s) mixed-fuel converted engine. [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

- GHG standards would apply to mixed-fuel engine emissions under 85.525 and 1036.108 [EPA-HQ-OAR-2014-0827-1197-A1 p.3]

[Table from NPRM under 1036.108 greenhouse gas emissions standards can be found on p.3-4 of docket number EPA-HQ-OAR-2014-0827-1197-A1]

It would appear the CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O standards for HHDD engine Mixed-Fuel conversion in a tractor for a SVM starting in Jan 2023 would be CO<sub>2</sub>.

**Organization:** California Air Resources Board (CARB)

**Oppose/Requested Change Comment**

**Comment – Definitions**

The definition of compression ignition in 40 CFR1036.801 has been expanded to include gas turbines and 'certain' spark-ignited engines. CARB staff believes it would be appropriate to either state here which spark-ignited engines are to be treated like compression ignition and subject to the requirements of compression ignition or to provide a reference to the appropriate section so describing, which would appear to be 40 CFR1036.140. 40 CFR 1036.140 (a) states that medium heavy-duty and heavy heavy-duty engines that do not run on gasoline must meet compression ignition standards, even if they are



spark-ignited engines. Gasoline-fueled (including dual fuel) medium heavy-duty and heavy heavy-duty meet spark-ignited standards. Light heavy-duty spark-ignited engines meet spark-ignited requirements regardless of fuel. Thus, CARB staff suggests the following modification to the definition of compression ignition in 40 CFR 1036.801: [EPA-HQ-OAR-2014-0827-1265-A1 p.188]

Compression ignition means relating to a type of reciprocating, internal-combustion engine that is not a spark-ignited engine. Note that 40 CFR 1036.1 also deems gas turbine engines and other engines to be compression-ignition engines. Note also that certain spark-ignited engines are subject to the requirements for compression-ignition engines, specifically, per 40 CFR 1036.140(a), medium heavy-duty and heavy heavy-duty engines that do not operate on gasoline, even if they are spark-ignited engines. [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

The CARB staff supports the lengthening of the useful lives of class 2b through 8 engines and vehicles to more properly reflect their actual use. [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

**Response:**

As noted in the proposed rule, EPA's objective in setting standards for alternative-fuel engines is to adopt requirements that create a level playing field for competitive products. For Class 5 and smaller vehicles for example (light heavy-duty), it is clear that there is a substantial market position for gasoline-fueled engine. On that basis, we proposed an approach that would allow alternative-fueled spark-ignition engines to meet the same standards that apply for other spark-ignition engines. For bigger vehicles, it was not so clear that there was enough of a market position for gasoline-fueled or other spark-ignition engines to justify setting less stringent standards for alternative-fueled spark ignition engines. The outcome to avoid is one in which an alternative-fueled engine gains a competitive advantage in a market that is dominated by compression-ignition engines, which are subject to more stringent CO<sub>2</sub> standards.

We have concluded that Class 8 vehicles (heavy heavy-duty) are clearly dominated by compression-ignition engines. As such, alternative-fueled engines, whether they are derived from gasoline or diesel engines or created as a new engine design, should be subject to the same emission standards as all the other engines competing in that market.

The situation for engines used in Class 6 and Class 7 vehicles (medium heavy-duty) is less clear-cut. Most of these vehicles use compression-ignition engines, but there is a viable market niche for gasoline-fueled engines. For the final rule, we are opting not to adopt the proposed approach. We are instead setting the standards for medium heavy-duty engines to correspond to the actual engine type, with all spark-ignition engines subject to the same standards that apply for gasoline-fueled engines. Given that some of these engines are already certified to standards for compression-ignition engines, we are also adopting a provision allowing manufacturers to opt into the more stringent compression-ignition standards.

In order to balance our concerns about alternative-fueled engines certifying as spark-ignition, but competing with compression-ignition engines, we are finalizing a restriction against medium heavy-duty alternative-fueled engines generating emission credits relative to the spark-ignition standards. Manufacturers of such engines may generate emission credits only if they choose to certify the engines to the compression-ignition Aftermarketstandards. Aftermarket fuel conversions are certified to meet the specified standards to gain an exemption from the tampering prohibition. As such, converted engines are generally required to meet the same standards that applied to the engine when it was new. The final rule includes a one-year delay for small businesses with respect to meeting new emission standards adopted in this rule.

We revised the final rule to no longer state that spark-ignition engines are subject to the standards that apply for compression-ignition engines. We instead have made the emission standards for heavy heavy-duty engines to be universal, applying equally to both spark-ignition and compression-ignition engines. This approach prevents the confusion addressed by the comment from California ARB.

We have revised the applicability dates for the phase-in standards in §1036.150 as suggested by California ARB.

We are adopting the useful-life provisions for engines as proposed and supported by California ARB.

### **13.2.3 Evaporative Emission Testing for LNG Vehicles**

**Organization:** American Gas Association (AGA) et al.

#### **Industry is Better Situated to Determine LNG Tank Hold-Times**

EPA has proposed adopting industry standard SAE J2343 which requires a 5-day hold-time for natural gas tank boil-off on vehicles powered by LNG. ATA supports the decision of EPA to defer to, and reference, industry standards relating to hold-times for LNG tanks. The current standards address concerns related to emissions from natural gas vehicles that could be parked for long periods of time without use. Concerns related to vehicles that are parked and unused for longer periods of time can, and should be addressed by operational practices such as starting up the vehicle for a short period of time to relieve pressure, or scheduling to ensure that vehicles do not remain parked for long periods of time. Compliance demonstrations of the 5-day hold-times should be the responsibility of tank manufacturers or fuel system packagers. [EPA-HQ-OAR-2014-0827-1243-A1 p.23]

#### **We Support the Proposed Requirement for Industry to Adhere to the Recommended Practices as Defined in SAE J2343 for Evaporative Emissions from LNG Vehicle Fuel Systems**

We support the proposed inclusion of the requirement to adhere to SAE J2343 as a means of demonstrating compliance with the five-day hold time requirement.<sup>18</sup> [EPA-HQ-OAR-2014-0827-1223-A1 p.4]

However, in the final rule, we strongly recommend that the agencies clarify that SAE J2343 applies to a vehicle's fuel system, rather than the engine or vehicle itself. This is an important distinction and one that is not clearly made in the Proposal. Engines and vehicles, as required under the Phase 1 Rule and the Phase 2 Proposal, demonstrate compliance through engine bench or chassis dynamometer tests, as well as simulation in the Greenhouse Gas Emissions Model (GEM).<sup>19</sup> However, demonstrating compliance with SAE J2343 cannot be performed using any of those tests or simulations. Thus, we are providing recommend language below, which will help the agencies better reflect the difference applications of SAE J2343 and the Phase 2 Proposal. [EPA-HQ-OAR-2014-0827-1223-A1 p.4]

The SAE J2343 standard specifies a minimum five-day hold time. However, as the agencies noted, the standard provides little description regarding the procedure for determining the amount of time between a refueling event and initial venting.<sup>20</sup> We provide the following three recommendations to help the agencies clarify the application of SAE J2343: [EPA-HQ-OAR-2014-0827-1223-A1 p.4]

- We recommend that the agencies revise the existing language that “the vehicle must remain parked...”<sup>21</sup> to state clearly that “the tank must remain immobile...” This reflects a more accurate

description of SAE J2343's application to the vehicle's fuel system, rather than the engine or vehicle. [EPA-HQ-OAR-2014-0827-1223-A1 p.4]

- We recommend that the agencies either expand the proposed ambient temperature range of 20-30°C to 10-30°C, or include a temperature correction factor. This revision would provide OEMs and integrators located in northern U.S. states and Canada a more equitable opportunity to conduct fuel systems compliance tests. Further, we note that this broader temperature range of 10-30°C will have minimal impacts as the inner tank temperature is roughly -140°C. [EPA-HQ-OAR-2014-0827-1223-A1 p.4]
- We recommend that the agencies revise the existing language that “This standard and procedure are consistent with Section 9.3.5 of NFPA 52, except that NFPA specifies a three-day hold time”<sup>22</sup> to become “This standard and procedure are consistent with Section 9.3.5 of NFPA 52, except that NFPA specifies a three-day hold time and requires a stabilization period not otherwise required in SAE J2343.” [EPA-HQ-OAR-2014-0827-1223-A1 p.5]

**Organization:** Daimler Trucks North America LLC

**Request for Comment on Extending the 5 Day Hold Time for LNG Vehicles** - [redacted] [EPA-HQ-OAR-2014-0827-1164-A1 p.110]

**LNG venting test:** The agencies discuss an LNG venting test but fail to clarify: is the test at any temperature between 20 and 30°C that the EPA chooses on an audit? In other words, if the system is designed, tested, and demonstrated to pass on a series of 5 days with ambient temperatures varying naturally between 20 and 30°C but the EPA audits by taking the vehicle to a controlled-temperature shed and testing at exactly 30°C for five straight days, under which test the system fails, is that a failed audit? [Redacted], we think that the proposed change to the test procedures is acceptable. [EPA-HQ-OAR-2014-0827-1164-A1 p.110]

**L. 5 Day Hold Time for LNG Vehicles. EPA has proposed adopting industry standards per SAE J2343 that address natural gas boil off on vehicles powered by LNG. This standard requires a 5-day hold time but EPA has requested comments on extending this to 10-days. EPA has requested comment on who should be responsible for certifying compliance with these requirements and how this responsibility could be delegated.** [EPA-HQ-OAR-2014-0827-1270-A1 p.9]

NGVAmerica supports the decision of EPA to defer to, and reference, industry standards relating to hold times for LNG tanks. At this time, we are unable to support modifying requirements for natural gas tanks to extend hold times beyond what is currently recognized by natural gas safety standards. We appreciate EPA's concerns relating to hold times and its interest in understanding whether additional hold times are feasible or necessary. The current hold times are based on a 4-day weekend that includes allowance for holidays. We believe that the current standards address concerns related to emissions from NGVs that could be parked for long periods without use. Any additional concerns related to vehicles that are parked and unused for longer periods of time can and should be addressed by operational practices such as starting up the vehicle for a short period of time to relieve pressure, or scheduling to ensure that vehicles do not remain parked for long periods of time. [EPA-HQ-OAR-2014-0827-1270-A1 p.9]

In terms of responsibility for demonstrating compliance with these standards, it is likely that only tank manufacturers or fuel system packagers would be able to demonstrate this compliance. The existing vehicle regulations, such as chassis testing and engine dynamometer testing, would not be sufficient to demonstrate compliance. [EPA-HQ-OAR-2014-0827-1270-A1 p.10]

NGVAmerica welcomes additional discussion of this issue with EPA and affected industry. [EPA-HQ-OAR-2014-0827-1270-A1 p.10]

**M. Other Issues Related to LNG Vehicles: LNG Boil-Off Warning Systems; Capturing and/or Converting Methane Refueling or Boil-Off Emissions; On-Board Monitoring Requirements for Boil-Off Events and Venting at Refueling.** [EPA-HQ-OAR-2014-0827-1270-A1 p.10]

EPA discusses a host of other issues relating to LNG vehicles and possible emissions. With respect to these issues, we reiterate our support for EPA's decision to rely on existing industry standards for LNG vehicles. We are unable to endorse new requirements or additional regulations when it is not clear what technologies exist to address these issues or how they would impact the safety of operating natural gas vehicles. We welcome additional discussion with EPA on how these standards can be revised or expanded to address issues of concern. [EPA-HQ-OAR-2014-0827-1270-A1 p.10]

**Organization:** Truck & Engine Manufacturers Association (EMA)

In addition, the proposed evaporative emission requirements for LNG vehicles need to be modified to be more consistent with the longstanding and accepted industry guidelines that are incorporated by reference into the proposed regulatory requirements. Proposed section 1037.103(e) incorporates SAE Recommended Practice J2343 and NFPA 52 into the mandated LNG vehicle leak requirements. However, SAE J2343 and NFPA 52 each specify LNG tank requirements, while the agencies' proposed requirements would apply to a vehicle that is built with an LNG tank. For the reasons stated above, and to be consistent with SAE J2343 and NFPA 52, the evaporative emission standard should apply to the tank itself, not the vehicle, regardless of whether it is installed by the vehicle manufacturer or some subsequent manufacturer.<sup>2</sup> [EPA-HQ-OAR-2014-0827-1269-A1 p.44-45]

[T]he proposed changes to the Phase 1 requirements for LNG venting should not be finalized, as those changes also would amount to retroactive amendments to the overall stringency and cost of the Phase 1 program in violation of administrative due process and the CAA's leadtime and stability provisions. Moreover, the proposed LNG venting process is ill-defined, lacks a sufficiently definite test temperature and pressure, and fails to include the necessary audit parameters and procedures. In sum, there is no reason to pull those proposed provisions forward, especially when to do so would disrupt the implementation and feasibility of Phase 1. [EPA-HQ-OAR-2014-0827-1269-A1 p.22]

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<sup>2</sup> If vehicle manufacturers are to be made responsible for testing LNG tanks, better clarity will be required with respect to the starting conditions for such testing, including with respect to LNG tank temperature and pressure.

**Organization:** Union of Concerned Scientists (UCS)

We strongly support the agencies inclusion of controls for LNG tank hold times. [EPA-HQ-OAR-2014-0827-1329-A2 p.26]

**Organization:** Volvo Group

LNG Tank Venting

Volvo Group supports the agencies' efforts to establish hold time requirements for Liquid Natural Gas (LNG) tanks. These are vital since venting is the largest source of evaporative emissions on LNG vehicles, and controlling emissions from tank venting was not addressed in the Tier 3 rulemaking of April 28, 2014. Since the 100 year Global Warming Potential (GWP) of CH<sub>4</sub> is 28-36 times greater than CO<sub>2</sub>, it is appropriate that precautions are taken to limit tank venting and its greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1290-A1 p.46]

The requirements proposed in 1037.103(e) (Evaporative and refueling emission standards) are vague and ambiguous. They make indirect reference to two industry recommended practices without specifying how these conflicting recommended practices should be specifically applied. The Agency stipulates a *vehicle* test to demonstrate LNG tank hold times, whereas SAE J2343 and NFPA 52 specify "tank only" hold time requirements. Demonstration tests performed by tank manufacturers today according to these recommended practices are "tank-only" tests conducted in controlled environments. Volvo Group believes that since LNG tank hold time is dependent on tank design, and has little or no dependence on vehicle installation conditions, fulfillment of any hold time requirements should be met with tank-only demonstrations. Demonstration tests conducted on the tank itself, complete with associated valves, vents and other plumbing, can be conducted in a more controlled environment than is possible after the tanks are installed on the vehicle. This also avoids multiple tests of the same tank design by various vehicle manufacturers, which would unnecessarily add cost, especially given that LNG is today a low volume segment of the vehicle market. [EPA-HQ-OAR-2014-0827-1290-A1 p.46-47]

Section 1037.103(e) specifies the hold time measurement is to start after a "conventional refueling event" without a clear definition of the event itself, or what is meant by a "conventional" event. SAE J2343 (section 4.2) and NFPA 52 (section 9.3.5) each specify unique yet incomplete procedures for the filling/refueling event. A robust test should specify the starting temperature and/or pressure, and quantity of LNG already in the tank, as well as the amount of fuel to be added or tank fill level, and the temperature and/or pressure of the LNG added during the refueling event. Without this specificity concerning starting conditions, the requirements are an incomplete assessment of tank performance, and leave far too much to the discretion of the manufacturer. The Agency also specifies the hold time to start "without a stabilization event" (section 1037.103(e)) which also needs to be defined, as it is not mentioned in SAE J2343. On the other hand, NFPA 52 requires that the LNG be stabilized at the start of the hold time test, which contradicts the agencies' proposed requirements. EPA should clarify their expectations with respect to these conflicting requirements. In addition section 1037.103(e), SAE J2343, and NFPA 52 all specify different ambient temperature requirements for the duration of the hold time test; EPA should specify a single allowable ambient temperature range. [EPA-HQ-OAR-2014-0827-1290-A1 p.47]

Volvo Group supports the EMA comments that propose that the tank manufacturer certify the tank hold time performance with the agencies. This is necessary when considering the fact that LNG tanks are frequently installed by secondary manufacturers and the aforementioned inefficiency in requiring each vehicle manufacturer to repeat the testing. [EPA-HQ-OAR-2014-0827-1290-A1 p.47]

The Agency requested comments as to whether they should increase the LNG tank hold time requirement beyond the current SAE J2343 hold time of 5 days. Volvo Group supports the interest to prolong tank hold times, but only cautions that the agencies consider the technical feasibility of a longer hold time requirement, especially recognizing that the requirement must be fulfilled for the useful life of the vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.47]

Again, the Volvo Group supports the agencies actions to promulgate improved procedures to limit the venting of high global warming potential (GWP) methane into the atmosphere. The proposal can be improved by clarifying, beyond the details in the industry recommended practices today, the refueling procedures and starting conditions for the refueling event. EPA should also consider additional requirements for fueling station equipment and refueling practices. [EPA-HQ-OAR-2014-0827-1290-A1 p.48]

**Organization:** PACCAR, Inc.

PACCAR should not be further burdened with the responsibility for determining leakage [from LNG vehicles]. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Organization:** California Air Resources Board (CARB)

### **Oppose/Requested Change Comment**

#### **Comment – Proposed evaporative emissions testing provisions for LNG vehicles**

The NPRM requests comment on all aspects of the proposed provisions for LNG vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.120]

CARB staff supports regulatory action encouraging long hold times before boil off emissions are emitted, but suggests clarifying the requirements. The draft Phase 2 regulatory language states, “Liquefied natural gas vehicles must meet the requirements in Section 4.2 of SAE J2343 (incorporated by reference in § 1037.810), which specifies that vehicles meet a five-day hold time after a refueling event before the fuel reaches the point of venting to relieve pressure.” [EPA-HQ-OAR-2014-0827-1265-A1 p.120]

SAE Standard J2343 states the following regarding LNG venting and tank design: “Vehicle LNG Tanks shall have a design hold time (build pressure without relieving) of 5 days after being filled net full and at the highest point in the design filling temperature/pressure range.” (Section 4.2 of SAE Standard J2343) [EPA-HQ-OAR-2014-0827-1265-A1 p.120-121]

The SAE Standard J2343 covers the test initial conditions adequately: 1) fill level and 2) thermal energy in the tank as expressed in either temperature or pressure of the fuel, and the draft Phase 2 regulatory language specifies that the vehicle must remain parked away from direct sun with ambient temperatures between (20 and 30) degree Celsius throughout the measurement procedure. [EPA-HQ-OAR-2014-0827-1265-A1 p.121]

However, the SAE Standard J2343 does not give detail about how fill level, thermal energy in tank, or venting would be measured. For example, the fuel flow rate threshold or minimum fuel mass emission that defines a venting event needs to be specified. [EPA-HQ-OAR-2014-0827-1265-A1 p.121]

CARB staff recommends specifying the required measurement techniques for determining hold time. [EPA-HQ-OAR-2014-0827-1265-A1 p.121]

There is also need for durability requirements for LNG tanks. At present the NPRM proposal is for 5 days for new vehicles only with no restriction on subsequent degradation of vacuum insulated tanks. A minimum durability of the insulation is imperative to controlling boil off emissions over the life of the vehicle. CARB staff recommends the following language be added: “vehicle mounted LNG tank

insulation shall continue to meet SAE Standard J2343 hold time standards through the emissions warranty period of the vehicle.” [EPA-HQ-OAR-2014-0827-1265-A1 p.121]

### **Support Comment**

#### **Comment – Proposal to require 5-day hold time for LNG vehicles**

CARB supports the Phase 2 proposal to require a 5-day hold time for LNG vehicles, to reduce the potential for an LNG boil-off event. Manufacturers would have to follow current industry recommended practice, SAE Standard J2343 for 5-day hold time to limit boil-off emissions from LNG vehicles. Boil-off events occur when a LNG truck is parked or driven very little, the fuel vaporizes, and the pressure inside the tank increases to a maximum of 230 pounds per square inch (psi) and a safety release valve releases the methane gas to vent excess pressure. CARB staff concurs that the venting characteristics inherent in LNG vehicles are an emissions concern, and recommends adoption of this requirement. CARB staff believes this is a good step towards limiting the release of methane from natural gas fueled vehicles, and that this will better standardize the requirements. CARB may consider similar requirements in the future. [EPA-HQ-OAR-2014-0827-1265-A1 p.166]

**Organization:** NGV America, et al

### **Additional Comments**

EPA had additional communications with industry representatives to further work out the test procedures associated with LNG venting. Most of these additional comments were related to EPA’s suggested secondary in-use test based on vehicle testing to establish an allowable pressure rise corresponding to the five-day hold time requirement. Manufacturers suggested a standard of 25 kPa per hour instead of EPA’s specified 9 kPa per hour. This greater allowance was largely intended to account for a high degree of variability from operators and other third parties performing tests with a wide range of experiences for refueling, parking, and reading pressure gauges. The accuracy and readability of the pressure gauges themselves were a substantial consideration. Manufacturers also suggested revising the in-use procedure to (1) more closely mimic the refueling event used for tank testing, (2) include a short drive after refueling to help stabilize fuel temperature and pressure inside the tank, and (3) define a window of tank pressures (345 – 900 kPa) to establish a proper starting condition for testing.

**Organization:** Enovation Controls (ENC)

3.3 Fuel Tank Safety - Safety references are made on page 779 with respect to Natural Gas vehicles. Fuel systems for natural gas vehicles are thoroughly vetted in the Heavy Duty market and are subject to extensive, thoughtfully-considered federal regulations, ISO standards and ANSI guidelines. Applicable U.S. Federal Motor Vehicle Safety Standards include: 49 CFR 571.303 Fuel System Integrity of Compressed Natural Gas Vehicles, ISO 15500-9:2012; 49 CFR 571.304 Compressed Natural Gas Fuel Container Integrity; and 49 CFR 393.68 Compressed Natural Gas Fuel Containers. Additional guidelines include: National Fire Protection Association (NFPA) 52 Vehicular Gaseous Fuel Systems Code, 2013; ANSI/IAS NGV 2 Standard for Compressed Natural Gas Fuel Containers; and ANSI/AGA NGV3.1/CGA 12.3 Fuel System Components for Natural Gas Powered Vehicles. We submit that no change is required to existing regulations, and that any future modification to fuel tank regulation should be contained within existing regulatory framework. The section in question in the Phase 2 proposal regarding fuel tank safety is not value-added and should be removed from the Phase II proposal. [EPA-HQ-OAR-2014-0827-1203-A1 p.3]

**Organization:** Quantum Technologies

### XIII. Amendments to Phase 1 Standards

(3) EVAPORATIVE EMISSION TESTING FOR LNG VEHICLES [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

Heavy-duty vehicles fueled by natural gas have for many years been subject to evaporative emission standards and test procedures. While fuel systems containing gasoline require extensive design features to handle vented fuel, fuel systems containing natural gas generally prevent evaporative losses by remaining sealed. In the case of compressed natural gas, there is a voluntary consensus standard, ANSI NGV1-2006, that is designed to ensure that there are no leaks or losses during a refueling event. Since compressed natural gas systems remain sealed indefinitely once the refueling event is complete, we understand that complying with the ANSI refueling standard is sufficient to demonstrate that the vehicle also complies with all applicable evaporative emission standards. The Light-Duty Tier 3 final rule included provisions to clarify that compressed natural gas systems meeting the applicable ANSI standard are deemed to comply with EPA's evaporative emission standards. [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

Quantum proposes the following alternative to the XIII. Amendments to Phase 1 Standards [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

(3) EVAPORATIVE EMISSION TESTING FOR LNG VEHICLES [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

Although the ANSI NGV1-2006 specified CNG refueling device is the correct choice for light duty applications, Quantum believes that specifying only ANSI NGV1-2006 limits better options for refueling heavy duty CNG trucks. The ANSI NGV1-2006 CNG refueling device is very low in flow capability for a heavy duty application. It is common for heavy duty applications to have CNG fuel capacities between 40 to 280 diesel gallon equivalent (DGE). This heavy duty CNG tank capacity is far greater than the typical light duty CNG tank capacity (less than 20 DGE). The small ANSI NGV1-2006 CNG refueling device would cause excessive fill times on heavy duty applications with no benefit to evaporative refueling emissions. Commonly used higher flow CNG refueling devices for heavy duty vehicles meet the requirements of ECE R110 Annex 4F 4.2, and have greater than twice the cross sectional flow area of an ANSI NGV1-2006 device. ECE R110 Annex 4F is comparable to ANSI NGV1-2006 from an evaporative and refueling emissions performance requirement. Like ANSI NGV1-2006, ECE R110 Annex 4F is also designed to ensure that there are no leaks or losses during a refueling event. [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

By allowing the alternative ECE R110 Annex 4F 4.2 in addition to ANSI NGV1-2006 specified CNG refueling devices, the intent of meeting all applicable evaporative emissions is still maintained, and faster filling rates needed for larger heavy duty CNG tank capacities is allowed. [EPA-HQ-OAR-2014-0827-1154-A1 p.2]

#### **Response:**

We are retaining the five-day hold time described in SAE J2343 for the final rule, as supported by most commenters. We agree to some extent with commenters expressing a concern that technological feasibility has not been established for achieving hold times longer than five days throughout a vehicle's useful life.

Before describing detailed responses to the comments, it is important to clarify the context of the proposed hold-time requirement. EPA's evaporative emission standards for heavy-duty vehicles apply



equally to gasoline-fueled and gaseous-fueled vehicles. As such, LNG vehicles are today subject to the current evaporative emission standards and test requirements, even though those standards and test procedures were designed around the technologies associated with gasoline-fueled vehicles. The hold-time requirement is intended to create a parallel compliance demonstration that applies in lieu of the conventional evaporative emission standards. The objective of pursuing a hold-time standard is to capture the current best practices for manufacturers of LNG fuel systems to ensure that vehicles and their fuel tanks are properly designed and manufactured to contain fuel during normal operation (and non-operation) to the greatest degree that can be achieved with available technology.

Because the hold-time standard is an alternative means of demonstrating compliance with an existing standard, the minimum lead-time requirement does not apply. In fact, while we specify a start date of January 1, 2020, we are specifically creating an allowance for manufacturers to certify based on the SAE J2343 protocol directly upon completion of the final rule. It is also the case that the existing framework of requirements that apply under voluntary consensus standards adopted by industry and other associations does not address the concerns associated with EPA's evaporative emission standards, which requires that we adopt provisions to allow for certifying LNG vehicles.

We have revised the measurement procedure for the hold-time test to be focused on the vehicle's fuel tank as the test article. We have similarly revised the certification protocol to allow either vehicle manufacturers or tank manufacturers (or assemblers) to certify with respect to the hold-time standard for evaporative emissions, even if a different company certifies the vehicle with respect to exhaust emissions. We agree with AGA that operational practices play an important role in managing LNG boil-off; however, we understand those practices to be supplemental to adopting a performance standard in line with current industry practice to establish a certain level of performance for LNG systems. This is especially true given that the reference to SAE J2343 allows us to rely on that industry standard for hold-time performance as a means of demonstrating compliance with existing evaporative emission standards.

We have revised the test procedure to address the concerns raised by AGA: (1) We specify that the fuel tank must be at rest, rather than requiring that the vehicle be parked. (2) We allow for ambient temperatures down to 10° C to allow for more flexibility to account for varying temperature control over the 120 hours it takes to complete the test. We would not expect such testing to often go below 20° C, but agree with the comment this has a minor effect on cryogenic behavior. It is also the case that the vehicles remain subject to the hold-time standard at the high end of the temperature range. (3) We have removed the reference to the analogous hold-time protocol adopted by the National Fire Protection Association to avoid confusion.

The proposed approach to allow for valid tests at ambient temperatures ranging from 20 to 30° C is identical to what has applied for almost all engine and vehicle testing for the last 40 years. It means that a test is valid if temperatures remain within the specified window. This means that a test is valid if ambient temperatures stay at 30° C throughout the measurement procedure. We emphasize this by specifying the temperature range as being between (20 and 30)° C rather than  $25\pm 5$ ° C, which means that there is no expectation that testing involves a targeted setpoint at any specific temperature within the specified range. As noted in the previous paragraph, we are expanding the specified temperature range, largely based on the reasoning that this still allows for testing at 30° C and therefore does not compromise the stringency of the standard.

We agree with Volvo that LNG refueling station operators and upstream suppliers should properly manage LNG delivery and storage to allow for consistent refueling at proper temperatures and pressures. Many stations are able to receive fuel vented from vehicle tanks, which is a good and effective way to avoid venting to the atmosphere. We do not have the authority to require such systems, or to require certain financial arrangements for the exchange of vented fuel. We believe market forces are adequate to address the concern.

We have revised the measurement procedures to address the concerns expressed by California ARB and Volvo. We specify a refueling event to automatic shutoff, which adequately addresses the tank fill level and quantity of dispensed fuel. We address the starting point for the hold-time measurement based on the tanks stabilized pressure after refueling to address thermal energy level and the temperature and fill level of the tank before refueling. The time to pressure relief is as simple as operating a clock or stopwatch. We specify the start time based on tank pressure, and we identify pressure venting as the event that defines the end of the test. We allow manufacturers to devise their own method to establish the time at which pressure venting occurs, consistent with good engineering judgment.

We agree with California ARB's concerns about system durability and the proposal, in fact, described the hold-time standards as being subject to warranty and useful life requirements. We have revised the final rule to state directly that the warranty and useful-life provisions apply for the LNG venting standards.

Regarding the in-use test, we have revised the specified procedure to incorporate all the items identified by the industry group. However, we continue to believe that 9 kPa per hour is the appropriate standard to allow for in-tank pressure increases corresponding to the five-day hold time. This allows for a 20 percent margin beyond the 7.5 kPa per hour that correlates directly with a five-day hold time. The 20 percent margin accounts for the possibility of nonlinear pressure increases over time, variability from different starting conditions and ambient temperatures, and the accuracy of measurement equipment. The pressure reading for comparing to the standard is a difference between two measurements, which greatly reduces concerns about accuracy and readability. Any inaccuracy or imprecision in one measurement would generally be canceled out in the second measurement. Manufacturers can also take steps to improve the precision and readability of installed pressure gauges. A digital readout, for example, would eliminate variability associated with reading pressure values from an analog gauge. Manufacturers can also take steps to provide clear instructions on proper preconditioning and measurement procedures. Finally, if there is a dispute regarding proper measurements, manufacturers can arrange for further testing with more carefully controlled conditions and practices to ensure that the test results are reliable.

We recognize the concern described by Optimus for heavy-duty refueling rates. However, we learned that the recommended European protocol is based on systems up to 3000 psi and is therefore not valid for most heavy-duty CNG vehicles in the United States. Representatives of the natural gas industry responded to the comment suggesting the European protocol by recommending that we instead reference a recently published supplement to ANSI NGV1, which accommodates the higher flow rates corresponding to heavy-duty vehicles and current refueling technology. We are accordingly revising the regulation to reference this additional ANSI document, which is known as CSA IR-1-15, "Compressed Natural Gas Vehicle (NGV) High Flow Fueling Connection Devices."

#### **13.2.4 Additional LNG Technology Considerations**

**Organization:** American Gas Association (AGA) et al.

#### **We Recommend that the Agencies Conduct Additional Research on Boil-Off and Refueling Emissions**

We commend the agencies on their efforts to collect information on monitoring and warning systems.<sup>45</sup> However, we caution that such technologies are not well known or researched today. We also note that the boil-off emissions themselves are the result of a critical safety feature used to avoid catastrophic failure of the LNG tanks in the case of over-pressurization. We thus recommend that any efforts to incorporate boil-off monitoring or warning systems into the onboard diagnostics should not

interfere with the critical boil-off release system, especially in emergency cases such as collisions. [EPA-HQ-OAR-2014-0827-1223-A1 p.11-12]

Due to the lack of currently available solutions and the concern that any proposed solution may impinge on the key safety components of the boil-off system, we recommend that the agencies conduct additional technical research on this issue. We would welcome the opportunity to work with the agencies to research, evaluate, and demonstrate the appropriate methods to monitor, quantify, and prevent boil-off releases. [EPA-HQ-OAR-2014-0827-1223-A1 p.12]

In response to the agencies request for additional information, we are also providing the following data on the quantification of vapor released during boil-off events. The Phase 2 Proposal states that each event has the potential of releasing 5,300 – 15,800 grams of methane, which translates to 132,000 – 400,000 grams CO<sub>2</sub>e.<sup>46</sup> However, from a GHG perspective, the amount of vapor released in one event is much less important than the amount of vapor released over a given period – such as the day after the hold time has been exceeded, for example. The amount of vapor is highly dependent on the dynamics of the pressure release valve (PRV) – some PRVs release relatively larger quantities at less frequent intervals while other PRVs release smaller quantities at more frequent intervals. For reference, we consider that, when a natural gas tank has reached its maximum pressure set point, it will boil off between 2 – 3% of its maximum content per day. As an example, a 150 gallon LNG tank contains 240,000 grams of LNG that may boil off 5,000 grams of methane during the course of a whole day. We would be pleased to discuss with the agencies any further data needs to better quantify boil off emissions. [EPA-HQ-OAR-2014-0827-1223-A1 p.12]

We also caution the agencies that the market for certain emissions capture technologies, such as methane canisters, combustion, or conversion via a catalyst,<sup>47</sup> is still very early in its development and many of these technologies are still demonstrating proof-of-concept. Westport has studied experimentally the concept of returning methane vapor to the engine intake, and has identified a number of challenges and opportunities in doing so. We are currently reviewing the specific technologies and strategies identified in the Proposal (methane canisters, combustion, or conversion via a catalyst), and would welcome the opportunity to work with the agencies on further research. [EPA-HQ-OAR-2014-0827-1223-A1 p.12]

It is worth noting that we do see potential value in developing a standardized method to return natural gas tank vapors to the station, perhaps through the integration of technology installed on vehicles' natural gas tanks and natural gas refueling stations. We recommend that the agencies continue to maintain an open dialogue with industry representatives on this issue. [EPA-HQ-OAR-2014-0827-1223-A1 p.12]

Further, we provide the following recommendations regarding how the agencies can improve the explanation of the LNG fuel system, including guidance on the terms “supercooled” and “vacuum.”<sup>48</sup> “Supercooled” refers to the process of lowering the temperature of a liquid or gas below its freezing point without it changing phases (i.e., without the liquid or gas becoming solid).<sup>49</sup> Additionally, we have never found a vacuum condition in an LNG tank, because the LNG fuel system always operates above atmospheric pressure – a condition rendering the creation of a vacuum inside the LNG tank impossible. [EPA-HQ-OAR-2014-0827-1223-A1 p.12-13]

We also find that the agencies' language “that the pressure of the LNG is well below the pressure at which the natural gas vent valve would relieve the LNG pressure” does not correctly explain the physics of the system.<sup>50</sup> We provide the following language as a suggestion to guide the agencies and request

that the agencies follow up directly for any further information: [EPA-HQ-OAR-2014-0827-1223-A1 p.13]

*LNG must be kept below -161°C to stay in its liquid state.<sup>51</sup> Even if an LNG tank is well insulated, a small amount of heat from the atmosphere will still be able to transfer from the exterior tank to the LNG fuel inside the tank. As the temperature of LNG in the tank increases, the density decreases and the pressure increases. When the vehicle is in operation, liquid or vapor is withdrawn from the tank to fuel the engine, which helps maintain the pressure within the operating range of the tank. When the tank is refueled, the introduction of new LNG fuel from the station also decreases the temperature and pressure to the desired level. Thus, under normal operation of an LNG truck, the pressure is maintained within the design operating range and there is no release to the environment. However, if a vehicle is left unused for several days, the pressure inside the tank will eventually increase above the design operating range and some vapor will be released from the tank to prevent over-pressurization of the tank. This vapor is referred to as boil-off.* [EPA-HQ-OAR-2014-0827-1223-A1 p.13]

Finally, we object to the statement that “an LNG truck is inherently high emitting since if the truck were to be parked long enough its entire contents would be emitted to the environment.”<sup>52</sup> We note that, while it is true that a truck parked for a long time will vent, LNG truck owners are incentivized by the low cost of LNG as a fuel to use these vehicles at high utilization rates – in other words, they are unlikely to sit more than 5 days unused in normal operation. [EPA-HQ-OAR-2014-0827-1223-A1 p.13]

### **We Recommend that the Agencies Conduct Additional Research on Extended Hold Time Length for LNG Vehicle Fuel Tanks**

On the issue of hold times, the agencies noted that SAE J2343’s five-day hold time will only apply to new LNG vehicles.<sup>53</sup> This understandably causes the agencies concern over the treatment of aging vehicles, which may have diminished insulating properties that could result in shorter hold times. Though we are unable to submit data at this time, we support the agencies’ efforts to research the availability and feasibility of tank technologies that would enable a 10-day hold time and recommend that the agencies continue to maintain an open dialogue with industry representatives. [EPA-HQ-OAR-2014-0827-1223-A1 p.13]

We would also like to draw the agencies’ attention to the potential for extending hold time and limiting boil-off through the use of LNG fuel temperature management along the distribution chain, at the LNG station, and on the vehicles. When LNG is produced, the fuel temperature is -280°F and stored at near atmospheric pressures (~15 psi). During transportation to the fueling station and storage in the station typically, the fuel temperature rises marginally to around -260°F and the corresponding pressure (referred to as saturation pressure) of the LNG rises to ~30 psi. [EPA-HQ-OAR-2014-0827-1223-A1 p.14]

LNG, if introduced to the LNG vehicle tank at this temperature and saturation pressure, could enable 10-day hold times. However, LNG stations customarily add heat energy to the fuel. Typically, this results in the LNG fuel temperature rising to -220°F at 120 psi. The additional pressure is required by many vehicle fuel systems to move the fuel out of the fuel tank, through the vaporizer, and into the engine’s injectors. This “warm” fuel serves as the basis for the 5-day hold time under SAE J2343. [EPA-HQ-OAR-2014-0827-1223-A1 p.14]

We are aware of LNG storage systems currently available on the market from multiple manufacturers that can receive “cold” fuel (-260°F at ~30 psi) instead, thereby enabling extended hold times. We would therefore welcome a dialogue with the agencies on further research into truck and station systems

and processes that could make further use of “cold” LNG fuel to increase hold times and reduce the risk of boil-off emissions occurring. [EPA-HQ-OAR-2014-0827-1223-A1 p.14]

**Organization:** Volvo Group

The Agency also requested comment on a proposed LNG vehicle boil-off warning system. The cost and complexity of a system needs to be weighed against its benefit. Most venting events occur when a vehicle is not used for an extended period of time, particularly for engine systems that can pull vapor from the LNG tank (typical for SI engines) to lower the pressure via evaporative cooling. During such down time when the vehicle is not in use, a message/warning cannot be observed by the operator to take the appropriate action. A warning system would be more useful if it provided an estimated time to a venting event (assuming vehicle is parked) and also a warning if the LNG tank needs maintenance by detecting deterioration of insulating properties. This could be done by evaluating LNG warming (or pressure increase) rate in relation to fill level and ambient conditions. [EPA-HQ-OAR-2014-0827-1290-A1 p.47]

A final area the Agency should address is the high variability of LNG temperature and pressure at retail fuel delivery stations. This variability can be caused by the temperature and pressure of the LNG as delivered to the refueling station, throughput of LNG in the dispensing equipment, design of the station’s tanks and dispensing equipment, use of systems to maintain LNG temperature and pressure, and other factors. This variability can force vehicle operators to vent the vehicle’s tank(s) to the atmosphere to reduce tank pressure to enable refueling. The agencies should require that refueling stations be equipped with recovery systems that allow operators to vent the vehicle’s tank(s) back into the station’s fuel supply. In addition, the stations should be required to credit the operator for the quantity of fuel returned to the station, so as to incentivize this action on the part of the operator. This would allow for more complete tank filling, potentially improved vehicle hold times, and reduced venting to the atmosphere. [EPA-HQ-OAR-2014-0827-1290-A1 p.47-48]

**Organization:** California Air Resources Board (CARB)

The NPRM also requests comments on other potential requirements to control LNG boil-off emissions. These include control technologies like methane canisters, a methane burner, a catalyst to convert the methane to CO<sub>2</sub>, an on-board monitoring requirements to track boil-off events, and other ways to reduce emissions from LNG refueling. CARB staff has not made final determinations on the efficacy of those technologies at this time, but will further investigate their effectiveness. [EPA-HQ-OAR-2014-0827-1265-A1 p.166]

As estimated in U.S. EPA and NHTSA’s lifecycle analysis, each boil-off event has the potential to release from 3 to 9 gallons of LNG for each boil off event, depending on the fill level of the LNG tank. And because methane has a global warming potential that is 25 times higher (assessed over 100 years) than CO<sub>2</sub>, that equates to 132,000 to 140,000 grams of CO<sub>2</sub> equivalent emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.166]

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45 Phase 2 Proposal, page 40511.

46 Phase 2 Proposal, page 40512. This is based on CH<sub>4</sub>’s GWP of 25 on a 100-year timeframe.

47 Phase 2 Proposal, page 40511.

48 Phase 2 Proposal, page 40506.

49 Rathz, T. "Undercooling of a liquid." National Aeronautics and Space Administration, January 2010. <http://science.nasa.gov/ssl/msad/df/under1.htm> / <http://www.webcitation.org/5mjJauR7S>.

50 Phase 2 Proposal, page 40506.

51 "Frequently Asked Questions About LNG." California Energy Commission. <http://www.energy.ca.gov/lng/faq.html>.

52 Phase 2 Proposal, page 40506.

53 Phase 2 Proposal, page 40510.

**Response:**

We recognize that manufacturers and vehicle operators are motivated to prevent both catastrophic and incidental venting of LNG, for safety and economic reasons. We are nevertheless interested in exploring further ideas of diagnostics, monitoring, control, and refueling practices to provide further assurance that the industry will reduce the frequency and severity of venting. The information provided is a good step in that direction.

**13.2.5 Stockpiling Provisions for Heavy-Duty Highway Engines**

**Organization:** Daimler Trucks North America LLC

- **Stockpiling:** The EPA's proposal for years when emission standards change, allowing three months to use of a prior year's engine in the year that the standards change and an additional several engines upon a showing of hardship, is a good proposal as it gives vehicle manufacturers the clarity we need and is realistic in its three month changeover date. What is problematic is the number of engines allowed past the three month date on showing of hardship. In particular, fifty engines is much less than one day's production; if a manufacturer has a hardship, fifty engines will only allow the manufacturer to weather a portion of day. The number should be at least 1,000 engines, which would better help us in the event of unexpected circumstances. [EPA-HQ-OAR-2014-0827-1164-A1 p.120]

- **The EPA proposes redundant yet conflicting changeover and stockpiling rules.** In 1037.601(a)(1) the EPA proposes to prohibit using an engine from a prior year, which means that engines built in December or November are essentially unusable (given our current engine model year changeovers), but the agency modifies that requirement in 1037.601(a)(2). The EPA should eliminate the duplicative and overly constrictive rules in (a)(1), given that in the very next subparagraph (a)(2) the agency erodes the rule. Moreover, in (c), the EPA proposes to apply 1068.101, which invokes 1068.105(a), which has different changeover and stockpiling rules than the EPA concurrently proposes in 1037. The EPA has proposed mutually conflicting rules and needs to be consistent. A better approach would be simply to write that it is a violation of the regulations to sell a tractor or vocational vehicle with an engine from the previous calendar year installed in the vehicle any later than three months into the next year, except 1) in years when there are no changes to the emission regulations in which case the three month limitation does not apply or 2) when the manufacturer successfully petitions the agency for the fifty engine flexibility (which, as we note above, should be several times greater). 1037.601(a)(1) [EPA-HQ-OAR-2014-0827-1164-A1 p.120]

**Organization:** GILLIG LLC

GILLIG requests the agencies review the proposed March 31 end date for installing engines built before the date of any new or changed standard. GILLIG does not build stock transit buses. As previously mentioned, each bus is custom built to unique customer specifications. There is one engine manufacturer in our market segment and the engines are limited to one diesel, one CNG and one diesel/hybrid offering. If the engine manufacturer has an unforeseen delay in certification or production of the new model year engines, and this delay occurs late in the prior model year, as a vehicle manufacturer we cannot order more of last year's engines and have them built and delivered in time, we cannot substitute other like engine models because there are none, and we cannot move up production buses using other certified engines because of other long lead time parts availability. At that point, getting written permission from EPA to use prior year's engines past the March 31 date, as provided for in the rule, provides no remedy. Having no engines with which to build vehicles would bring transit bus production at GILLIG to a standstill, delay delivery of replacement buses to municipalities responsible for sustaining transportation services, impact jobs at those municipalities, inconvenience those who travel and depend on public transportation, and be financially devastating for our business and our employees. GILLIG has long had the production philosophy to build no more than one bus for a customer in any given day. This helps reduce risks from production issues arising from design problems, parts availability, etc. Additionally, transit buses are typically purchased in fleet quantities to maintain commonality for drivers, spare parts and maintenance. Building out a fleet for a customer can require many months of production time. For the above mentioned reasons, GILLIG would request the agencies allow for installing engines built before the date of any new or changed standard through June of the new emissions standard year. [EPA-HQ-OAR-2014-0827-1156-A1 p.5-6]

**Organization:** PACCAR, Inc.

PACCAR supports the proposed 90-day window after the end of the engine Model Year to address the issue of stockpiling. [EPA-HQ-OAR-2014-0827-1204-A1 p.30]

**Organization:** Volvo Group

**Revisions to Stockpiling Provisions**

As a general matter, Volvo Group supports the codification and clarification of existing guidance designed to prevent the unnecessary stockpiling of engines by vehicle and engine manufacturers during years when emissions standards change. Volvo Group further supports EPA's recognition of particular challenges manufacturers may face during years when new emissions standards take effect. While the rule should account for the need by manufacturers for some flexibility in transitioning to new technology, however, it also must provide objective, clear and unambiguous rules for manufacturers to follow. To remain in accord with the spirit and intent of the Clean Air Act, the rule also must create a level playing field (i.e. one that does not effectively punish manufacturers who comply in a timely manner with new EPA standards, while rewarding those who do not), and must ensure that cleaner engines are introduced into the marketplace as quickly as possible, taking into account the need for flexibility in transition to the use of new, often very complex technologies. [EPA-HQ-OAR-2014-0827-1290-A1 p.72]

Volvo Group believes that the intent of both the Clean Air Act and EPA's existing guidance<sup>15</sup> is to ensure there is a level playing field among vehicle and engine manufacturers subject to new emissions standards. Additionally, the Act and the guidance are intended to ensure that the introduction of new

engines into the market is not unnecessarily delayed, while taking into account the need by manufacturers for flexibility in transitioning to often complex new technologies. Volvo Group supports EPA's efforts to bring law and order to manufacturers' product transition schedules when new standards come into effect, as represented in the amendments proposed in the NPRM. In fact, Volvo Group has been a strong proponent for clear rules that prohibit the stockpiling of engines and that ensure timely transition. Volvo Group does have concern, however, that EPA's proposal did not give full consideration to certain business entities that have relatively low volumes, but for whom many orders are by municipalities for a large quantity of vehicles, often delivered at one time, and for which one of the basic requirements is that all vehicles be of identical specification and even of the same model year. [EPA-HQ-OAR-2014-0827-1290-A1 p.73]

EPA's rule must maintain a level playing field during the transition to new emissions standards, and must ensure technology is introduced into the marketplace expeditiously. [EPA-HQ-OAR-2014-0827-1290-A1 p.73]

This principle is in keeping with the spirit and intent of the Clean Air Act, which requires manufacturers who are unable to introduce compliant technologies due to technological challenges to pay nonconformance penalties (NCPs) designed to remove any competitive advantage they might realize by continuing the sale of older engines. The statute requires that EPA establish such NCPs through a rulemaking that ensures the penalties are "increased periodically in order to create incentives for the development of production vehicles or engines which achieve the required degree of emission reduction" and which "remove any competitive disadvantage to manufacturers whose engines or vehicles achieve the required degree of emissions reductions..." CAA § 206(g), 42 U.S.C. § 7525(g). [EPA-HQ-OAR-2014-0827-1290-A1 p.73]

Left unchecked, a manufacturer's stockpiling practices could have precisely the effect Congress intended to avoid. With the increasing stringency of new emissions standards for heavy-duty diesel engines, engine manufacturers are employing more complex, more expensive engine technologies. Due to their increased cost and complexity, engines that comply with the most recent emission limits are generally less desirable to customers than those compliant to the former standard – thus creating an incentive for manufacturers to stockpile older engines, and a disincentive for them to initiate introduction of new ones. Even with the advent of fuel efficiency standards, which on their face might be perceived as driving the introduction of products more desirable to commercial vehicle customers due to an anticipated reduction of fuel consumption costs, purchasers are often skeptical of products that introduce new technologies not formerly known in the marketplace. Vehicle and engine manufacturers that have prepared for timely introduction of new technology, therefore, are placed at a competitive disadvantage to manufacturers that will delay introduction and rely on continued sale of the engines and vehicles compliant to the previous standards for a longer period of time. [EPA-HQ-OAR-2014-0827-1290-A1 p.73]

There is unfortunate historical evidence of these forces at work. During the months following the new 2010 standards, the mere hint of availability of 2009 engines was generating a chill in market demand for 2010 engines, with customers refusing to place orders for the new technology as long as they knew the older technology was still available. As a result, vehicle manufacturers offering 2010 technologies were already finding the need to discount their vehicles significantly to generate interest from customers, if interest could be generated at all. The result of an ineffective anti-stockpiling policy, therefore, is precisely the opposite of what the Clean Air Act envisions – it imposes a penalty on the leader as opposed to the laggard. In addition, although all manufacturers eventually had to transition to 2010 engines at some point – and thus the manufacture of vehicles using 2009 engines was temporary – the operation of these higher emitting engines will continue for many years. As such, excessive



stockpiling, although a temporary practice, can result in considerable additional emissions when total emissions over the lifetime of the engine are considered. [EPA-HQ-OAR-2014-0827-1290-A1 p.73-74]

Volvo Group believes that EPA's intentions to fortify their stockpiling provisions are an important step forward to securing, at times of transition to new engine or vehicle standards, that stockpiling abuses do not occur, and that the playing field is leveled to avoid disadvantaging manufacturers who establish timely product transition schedules. Volvo Group is quite concerned, however, that EPA's proposed language leaves too much room for creative interpretation that gives license to abuses, and will continue to leave manufacturers who seek to work to the spirit and intent of the regulations at the mercy of those willing to push all limits to gain an unfair market advantage. In fact, given the customer desire for lower cost and less complex engines, the marketplace essentially forces each manufacturer to build and utilize older engines to the regulated limits or be boxed out of the market until competitors exhaust their supply. This practice is costly due to high inventory costs and production disruptions that impact manufacturers, suppliers, and employees. Volvo Group recommends that EPA consider more robust bright line provisions that ensure a level playing field and that better account for the business practices of certain low volume manufacturers. [EPA-HQ-OAR-2014-0827-1290-A1 p.74]

While Volvo Group supports the implementation of the current provisions of 40 CFR 1068 as proposed, we believe there is room for improvements that would better protect against unlawful stockpiling while also addressing some of the nuances of the heavy-duty, on-highway sector. To the extent additional amendments to the current provisions require additional rulemaking, Volvo Group supports implementation of the current provisions as an interim measure. They are an improvement to the current prohibitions to stockpiling that currently exist for heavy-duty highway engines. We believe, however, that additional refinements to the current provisions are necessary and urge EPA to consider such improvements either in the current rulemaking process, or in a follow-up process shortly following the adoption of the current provisions. Volvo Group is willing to work with the Agency to that end. [EPA-HQ-OAR-2014-0827-1290-A1 p.74]

EPA's rule must be unambiguous and apply the same objective standards to all manufacturers. [EPA-HQ-OAR-2014-0827-1290-A1 p.74]

Volvo Group supports EPA's adoption of the Part 1068 provisions that designate the "date of manufacture" of an engine as the date the crank is installed in the block. This convention has been used in the industry for many years, and has become a settled process within the manufacturing scheduling and record systems for many manufacturers. [EPA-HQ-OAR-2014-0827-1290-A1 p.74]

The provisions at 40 CFR 1068.103(j) as proposed to now apply to heavy-duty highway engines state: [EPA-HQ-OAR-2014-0827-1290-A1 p.74]

You may not circumvent the provisions of § 1068.101(a)(1) by stockpiling engines with a date of manufacture before new or changed emission standards take effect by deviating from your normal production and inventory practices. [EPA-HQ-OAR- 2014-0827-1290-A1 p.75]

The term "normal production and inventory practices" is vague and needs to be better defined and delineated to provide clear and consistent guidance on acceptable practices. This language appears to focus primarily on the practices of individual manufacturers without setting a clear, industry-wide standard. Moreover, what EPA considers to be "normal inventory" is subject to multiple possible interpretations and variations, depending on the idiosyncrasies of any one company. It is therefore ripe for abuse. EPA must clarify what it intends by this term through the use of objective standards that will apply equally to all manufacturers. The terms, though now appearing in CFR provisions rather than

guidance, still do not provide for the kind of bright line criteria that are necessary to ensure a level playing field. [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

Volvo Group appreciates that EPA has attempted to achieve greater clarity by expanding on the language in Section 1068.103(j), but remains concerned that it is unacceptably vague. The additional language provides: [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

For most engines you should plan to complete the assembly of an engine of a given model year into its certified configuration within the first week after the end of the model year if new emission standards start to apply in that model year. [EPA-HQ- OAR-2014-0827-1290-A1 p.75]

Once more, the term “most” is ambiguous and will lead to inconsistent interpretation. EPA should better define what qualifies as an acceptable number of engines in this regard. EPA also should objectively define what it means to “complete” an engine. The language continues: [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

For special circumstances it may be appropriate for your normal business practice to involve more time. [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

The manufacturing environment, especially in the transition period of a standards change year, is fraught with challenges that might be considered “special circumstances,” but should not justify stockpiling. Volvo Group is concerned that this provision will be abused in attempts to justify the opportunity to push production practices in ways that otherwise would be deemed stockpiling. It appears that 1068.103 leaves this “special circumstances” determination, and the additional freedom that comes with it, up to the manufacturer. Under this condition, the manufacturer is given a deadline to complete the remainder of engines (of displacement less than 2.5 liters per cylinder): [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

For engines with per-cylinder displacement below 2.5 liters, if new emission standards start to apply in a given year, we would consider an engine not to be covered by a certificate of conformity for the preceding model year if the engine is not assembled in a compliant configuration within 30 days after the end of the model year for that engine family. [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

According to this provision, we see that the first bright line requirement is introduced. Unfortunately, the example that follows in the text weakens, or at minimum confuses, the earlier text: [EPA-HQ-OAR-2014-0827-1290-A1 p.75]

For example, in the case where new standards apply in the 2010 model year, and your normal production period is based on the calendar year, you must complete the assembly of all your 2009 model year engines before January 31, 2010, or an earlier date consistent with your normal production and inventory practices. [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

[Note: The 30 day provision seems to be inconsistent with the January 31 deadline posed in the example][EPA-HQ-OAR-2014-0827-1290-A1 p.76]

In the example, there’s no mention of “special circumstances,” and the “or” proposition seems to leave the choice to the manufacturer. [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

Volvo Group is of the opinion that bright line provisions must be the backbone of anti-stockpiling provisions, not simply the backstop. It's on this basic principle that we will base our recommendations [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

The Agency should effectively define what they mean by "most" when defining the required completion date of an engine manufacturer's prior model year engines that are not complete as of December 31. The requirements should be quantified and scheduled in a way that is controllable and auditable. We would propose eliminating the "normal production and inventory practices" criteria, and provide for specific deadlines. An example of such a provision might look like this: [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

Of the engines having a date of manufacture before the first day of a model year in which new standards apply, and that are not completed by the end of the prior model year, 80% of those that are certified to the prior model year's standards must be completed within 7 days of the new model year. The remainder of the prior model year engine builds must be completed by January 31 of the new model year. [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

There is certainly room for discussion in setting the language to determine the most appropriate dates and percentages, but this kind of language accomplishes two things. First, it restrains build practices tightly enough to avoid that a manufacturer generates a high quantity of stockpiled "crank in block" partial engines, because the manufacturer could not "work off" a large inventory in such a limited timeframe. Second, it provides much greater certainty, and hence ensures a level playing field. Even if the Agency settles on parameters which are slightly more "forgiving" than they might prefer, at least they can be confident of the outcome in any given standards change event, and if there is a small degree of "play" in the provision, each manufacturer can use that play according to his needs. This is especially true of the provision to complete the remainder (20%, in the framework proposal above) of engines by January 31, whereby each manufacturer can deal with its own "special circumstances" as needed, but without Agency review and without uncertainty. In fact, there need not be any special circumstances present to complete the builds by January 31, yet every manufacturer would have identical rules to play by, with a reasonably tight control on engine quantities from the prior model year. The outcome will certainly be far better than what has been witnessed during, and long following, past standards changes. [EPA-HQ-OAR-2014-0827-1290-A1 p.76]

The Volvo Group also believes that there need not be, and therefore should not be, any provisions that sets distinct deadlines on the basis of the size of the engine, whether absolute displacement or per-cylinder displacement. The reason the deadline for completion was conditioned to displacement per cylinder in the original Part 1068 language was because the production volumes of such engines, in the non-road sector, for example, were low, and it was deemed appropriate to allow additional time for the completion of such engines. Volvo Group believes that this is not the case for heavy-duty highway engines, and therefore completion dates should not be conditioned to a displacement or displacement per cylinder basis. If, however, the Agency decides to retain this discriminator, it should clarify which deadline applies to engines having a displacement of 2.5 liters per cylinder (the current language addresses only engines greater than or less than 2.5 liters per cylinder). [EPA-HQ-OAR-2014-0827-1290-A1 p.76-77]

Turning to vehicle assembly controls, Volvo Group finds the language of 40 CFR 1068.105 to be similarly flawed. [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

If new engine-based emission standards apply in a given model year, your equipment produced in that calendar year (or later) must have engines that are certified to the new standards, except that you may

continue to use up normal inventories of earlier engines that were built before the date of the new or changed standards. For purposes of this paragraph (a), normal inventory applies for engines you possess and engines from your engine supplier's normal inventory. [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

[Note: At a technical level, the following language would be preferable: "...you may continue to use up normal inventories of engines certified to the prior model year standards." The term "earlier engines" is somewhat vague and undefined, and some engines "built before the date of the new or changed standards" can be installed without restriction if they're certified to the new standards]. [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

Again, terminology like "normal inventories" is vague and ambiguous, and ripe for abuse, though it is correct that EPA makes it clear that this includes engines in the engine manufacturer(s)' inventories as well. It should also include engines "in transit," or better define "possession." [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

The provision of 1068.105 continues: [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

You may not circumvent the provisions of § 1068.101(a)(1) by stockpiling engines that were built before new or changed standards take effect. Similarly, you may not circumvent the provisions of § 1068.101(a)(1) by knowingly installing engines that were stockpiled by engine suppliers in violation of § 1068.103(f). [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

...and is further limited by 40 CFR 1037.601: [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

The provisions of 40 CFR 1068.105(a) apply for vehicle manufacturers installing engines certified under 40 CFR part 1036 as further limited by this paragraph (a)(2). If new engine emission standards apply in a given model year, you may install engines built before the date of the new or changed standards under the provisions of 40 CFR 1068.105(a) through March 31 of that year without our approval; you may not install such engines after March 31 of that year unless we approve it in advance. Installing such engines after March 31 without our prior approval is considered to be prohibited stockpiling of engines. In a written request for our approval, you must describe how your circumstances led you and your engine supplier to have normal inventories of engines that were not used up in the specified time frame. We will approve your request for up to three additional months to install up to 50 engines under this paragraph (a)(2) if we determine that the excess inventory is a result of unforeseeable circumstances and should not be considered circumvention of emission standards. [EPA-HQ-OAR-2014-0827-1290-A1 p.77]

The requirements in this section are in fact, clearer than in the previous sections with respect to installing prior model year engines. While they are noted as further limiting the provisions of 1068.105(a), the provisions in the subject section seem to lose the limitation of "normal inventory," and address directly a hard-stop completion date. Some manufacturers would take this to be the predominant limiting provision, with little regard for normal inventory practices. In the case of the subject language, at least, there is a requirement to lay out the "unforeseeable circumstances" that EPA could consider before granting an approval for "up to three additional months to install up to 50 engines" [EPA-HQ-OAR-2014-0827-1290-A1 p.77-78]

Once again, the Volvo Group finds these provisions to be unacceptably ambiguous; they must be shored up so as to have all manufacturers working to the same clear requirements and limitations. Any manufacturer's actions should be objectively auditable. [EPA-HQ-OAR-2014-0827-1290-A1 p.78]

One of the problems is that “normal inventory” can be variable according to market conditions. What is normally held constant, however, is the number of engines “in float” relative to the rate of vehicle production rate. There is nothing out of the ordinary, for example, about a manufacturer ramping up production of the “pre-buy” engines and vehicles being phased out at the end of the model year. In this case, vehicle production would increase as the end of the year approaches. As long as vehicle production is ramped up at the same rate as engine production so as not to proliferate the inventory of prior model year engines, and the engine production provisions that protect against stockpiling as discussed above are respected, there should be no real cause for concern about stockpiling. It’s for this reason that Volvo Group suggests that the Agency might consider using a calculation of the ratio of the engines in float (total number of complete engines in the possession of the vehicle manufacturer, and in the possession of the engine manufacturer, or in transit to the vehicle manufacturer) to the weekly vehicle build quantity, as a control parameter. This “float ratio” may differ from one manufacturer to the next, but should be relatively constant for any given manufacturer. The control parameter may have to incorporate a “lag function” to accommodate delivery lead times, the lag being duration of each manufacturer’s choosing within a limited range. Manufacturer-specific variations and production issues can be smoothed out by setting the control parameters on a four-week rolling average basis. The process may require some weekly accounting and reporting of engine quantities and build rates, but in the end may be a reliable parameter to monitor, or to request of manufacturers as an audit mechanism. Specific allowable limitations could be placed on the maximum degree of variation of such a control parameter. The period of control could be pre-defined in the regulation, for example, during the 6 months before and 6 months after a standards change. Alternatively, there could be an “observation period” of 6 months prior to the end of the model year, followed by a control period in the new model year. [EPA-HQ-OAR-2014-0827-1290-A1 p.78]

The methodology as outlined is merely an example of what might be several possible objective, controllable and auditable means to ensure that engines are not being stockpiled and that the playing field is leveled. The Volvo Group is willing to explore other bright line options. [EPA-HQ-OAR-2014-0827-1290-A1 p.78]

The last concept that the Volvo Group thinks the Agency must consider is linked to the production practices of low volume vehicle manufacturers. Typically, low volume manufacturers have much more variation in their processes, and take an extended period of time, perhaps as much as a year or more, to complete a customer order from the first vehicle built to the last. This is sometimes the case for low volume manufacturers that sell large orders to municipalities, wherein the contract has a strong demand that all vehicles be built of exactly the same specification. In these cases, there will be a need to continue to install the prior model year engines into vehicles for an extended period of time. Though the time period may be extended, the volume of engines remains low by the nature of the business. Accommodating this need among low volume manufacturers could be managed in different ways. First, the Agency might consider a unique set of requirements for low volume manufacturers. The “float ratio” example is likely not well suited to low volume manufacturers, given the mathematical variability that naturally comes from lower volumes, but also because there’s less of a refined “rhythm” to the assembly process in such production environments. So, the Agency could consider allowing a certain “carry-over” volume, either in the absolute, or as a percentage of annual production volumes. Another possibility is that the set carry-over engine quantity could be applied also to the higher volume highway market, such that that volume is not included in the float ratio calculation. This would serve as another mechanism to provide flexibility necessary for changes to the industrial setup or component supply issues that often arise in a model year changeover or a high demand pre-buy market, while applying flexibility evenly with all manufacturers. [EPA-HQ-OAR-2014-0827-1290-A1 p.78-79]

Volvo Group would be very willing to bring proposals and to take part in any discussions to develop sound, workable concepts that meet industry's needs and ensure the goals of the Agency are met in the transition to a new standard. The key is to set specific bright line requirements that provide certainty, require a minimum of Agency approvals or interventions, and ensure a level playing field. [EPA-HQ-OAR-2014-0827-1290-A1 p.79]

As a final note, the Volvo Group believes stockpiling prohibitions will, as a practical matter, be a matter for necessary controls only with respect to changes to engine standards. Concerning changes to vehicle standards, we don't think there will be issues of concern with respect to stockpiling. This is largely due to the fact that the Phase 2 GHG standards as proposed tie standards changes to the model year of the vehicle. Because manufacturers routinely introduce the new model year vehicles many months before the calendar year of applicability (for example, most manufacturers introduced 2012 model year vehicles in the first quarter of 2011), the vehicles compliant to the new standards are introduced well ahead of the regulated effective date. To the extent that a manufacturer might modify this convention by delaying introduction of the new model year to a date much closer to the "latest January 1" effective date, any actions by the manufacturer to build a large number of the prior model year vehicles before years' end should not be construed as stockpiling, so long as all those vehicles were completed by the end of the year. In such a case, the agencies may have to modify the definition of "date of manufacture" for vehicles, to ensure that it is clear and deterministic, and void of opportunity for gaming. [EPA-HQ-OAR-2014-0827-1290-A1 p.79]

### **Revisions to Stockpiling Provisions**

While not addressed in the NoDA, EPA's NPRM proposed to apply certain non-road prohibitions against stockpiling to highway heavy-duty engines and vehicles when new emissions standards take effect. As a general matter, Volvo Group supports the codification and clarification of existing guidance designed to prevent the unnecessary stockpiling of engines by vehicle and engine manufacturers during years when emissions standards change. Volvo Group further supports EPA's recognition of particular challenges manufacturers may face during years when new emissions standards take effect. While the rule should account for the need by manufacturers for some flexibility in transitioning to new technology, however, it also must provide objective, clear and unambiguous rules for manufacturers to follow. To remain in accord with the spirit and intent of the Clean Air Act, the rule also must create a level playing field (i.e. one that does not effectively punish manufacturers who comply in a timely manner with new EPA standards, while rewarding those who do not), and must ensure that cleaner engines are introduced into the marketplace as quickly as possible, taking into account the need for flexibility in transition to the use of new, often very complex technologies. [EPA-HQ-OAR-2014-0827-1928-A1 p.25-26]

The Volvo Group submitted extensive comments to EPA's proposed changes to heavy-duty highway engine and vehicle stockpiling provisions in the July 13, 2015 NPRM. Our comments were supportive of EPA's intention to clarify acceptable practices with respect to timely completion of engines compliant to prior standards in a standards change year, and timely installation of said engines into vehicles. In fact, Volvo seriously questioned the strength of EPA's reliance on "normal production and inventory practices," and lack of clarity as to what might constitute "special circumstances." We made suggestions as to how the stockpiling prohibitions should be improved to provide bright line, auditable requirements by which all manufacturers could reliably be measured, so as to avoid the abuses that have been witnessed in previous standards change years. The Volvo Group insists that such improvements are necessary to ensure a level playing field. [EPA-HQ-OAR-2014-0827-1928-A1 p.26]

In our NPRM comments, we also expressed concern that EPA's proposal did not give full consideration to certain business entities that have relatively low volumes, but for whom many orders are by municipalities for a large quantity of vehicles, and for which one of the basic requirements is that all vehicles be of identical specification and even of the same model year. [EPA-HQ-OAR-2014-0827-1928-A1 p.26]

Anticipating that EPA will determine that some of the recommendations made by the Volvo Group are too extensive to be completed in this rulemaking, we would like to take this opportunity to reinforce some of our earlier comments to the NPRM. We support the implementation of the provisions of 40 CFR 1068 as proposed, but we believe some changes to the proposal are necessary to ensure successful implementation in the heavy-duty highway sector. [EPA-HQ-OAR-2014-0827-1928-A1 p.26]

Volvo Group supports EPA's adoption of the Part 1068 provisions that designate the "date of manufacture" of an engine as the date the crank is installed in the block. This convention has been used in the industry for many years, and has become a settled process within the manufacturing scheduling and record systems for many manufacturers. [EPA-HQ-OAR-2014-0827-1928-A1 p.26]

In our NPRM comments, we incorrectly cautioned that the example cited in 40 CFR 1068(g) was in contradiction with previous language. We cited the text "...we would consider an engine not to be covered by a certificate of conformity for the preceding model year if the engine is not assembled in a compliant configuration within 30 days after the end of the model year for that engine family" as being contradicted later by "For example, in the case where new standards apply in the 2010 model year, and your normal production period is based on the calendar year, you must complete the assembly of all your 2009 model year engines before January 31, 2010,..." (italics ours, in both cases). Since our comments were submitted, we've determined that there is no contradiction. [EPA-HQ-OAR-2014-0827-1928-A1 p.26-27]

Further to the provisions of Part 1068, the Volvo Group also believes that there need not be, and therefore should not be, any provisions that set unique deadlines on the basis of the size of the engine, whether absolute displacement or per-cylinder displacement. The proposed provisions provide greater flexibility for completing engines having a "per-cylinder displacement at or above 2.5 liters." The reason the deadline for completion was conditioned to displacement per cylinder in the original Part 1068 language was because the production volumes of such engines, in the non-road sector, for example, were low, and it was deemed appropriate to allow additional time for the completion of such engines. Volvo Group believes that this is not the case for heavy-duty highway engines, and therefore completion dates should not be conditioned to a displacement or displacement per cylinder basis. [EPA-HQ-OAR-2014-0827-1928-A1 p.27]

Finally, the Volvo Group thinks the Agency must consider the production practices of low volume vehicle manufacturers. Typically, low volume manufacturers have much more variation in their processes, and take an extended period of time, perhaps as much as a year or more, to complete a customer order from the first vehicle built to the last. This is sometimes the case for low volume manufacturers that sell large orders to municipalities, wherein the contract has an absolute demand that all vehicles be built of exactly the same specification. In these cases, there will be a need to continue to install the prior model year engines into vehicles for an extended period of time. Though the time period may be extended, the volume of engines remains low by the nature of the business. [EPA-HQ-OAR-2014-0827-1928-A1 p.27]

Accommodating this business critical need among low volume manufacturers could be managed in different ways. First, the Agency might consider a unique set of requirements for low volume

manufacturers. For example, the Agency could consider allowing a certain “carry-over” volume, either in the absolute, or as a percentage of annual production volumes for these low volume manufacturers. Another possibility is that an absolute carry-over engine quantity could be applied also to the higher volume highway market, such that that volume is not included within the volume considered according to other prohibition controls the Agency has proposed. This would serve as another mechanism to provide flexibility necessary for changes to the industrial setup or component supply issues that often arise in a model year changeover or a high demand pre-buy market, while applying flexibility evenly with all manufacturers, and accommodating the unique needs of the low volume manufacturers. The Volvo Group would be very willing to work with the Agency to determine appropriate carry-over volume limitations. [EPA-HQ-OAR-2014-0827-1928-A1 p.27]

**Response:**

Volvo’s comments effectively capture the logic, rationale, and objectives underlying the proposed limitations on stockpiling and inventory practices in the transition to new, more stringent emission standards.

Daimler’s concern about engine volumes seems to indicate an expectation that the proposed limits apply for ongoing engine production in the year that new emission standards start to apply. This is not the case. The stockpiling provisions of 40 CFR 1037.601 describe how vehicle manufacturers may continue to install previous-tier engines in the year that new emission standards have already started to apply. Vehicle manufacturers must plan their engine orders to comply with emission standards. For the high-volume production described by Daimler, we would expect manufacturers to order engines on a weekly basis, with engine installations proceeding at the same pace. Such a vehicle manufacturer would not find itself several months after the transition to new emission standards with a need to install thousands of additional previous-tier engines. We believe the proposed provisions properly establish the need to continue with established ordering and build practices, subject to clear deadlines for installing previous-tier engines.

We have revised the language in 40 CFR 1037.601(a)(1) to more broadly establish the principle that heavy-duty vehicles need to have certified engines to avoid violating statutory prohibitions. We have also reduced the risk of noncompliance related to mismatched model years between engines and vehicles by identifying the vehicle’s model year as being dependent on the engine’s model year in Phase 2. Specifically, starting with vehicles built on or after January 1, 2021, the vehicle’s model year is the same as the calendar year corresponding to the vehicle’s build date, though we also allow the vehicle’s model year to be one year previous to match the engine’s model year. The provisions in 40 CFR 1068.105 do not conflict with the proposed provisions in 40 CFR 1037.601; rather, the highway-specific provisions add clarity and further limitations that go beyond what applies under 40 CFR 1068.105.

Gillig describes a production scenario that closely matches the proposed stockpiling provisions of 40 CFR 1037.601. As a low-volume manufacturer, they have a normal practice of managing engine inventories for an extended interval requiring installation of a common engine platform over a several-month production run. This will generally be complete within three months after new emission standards take effect, but EPA approval can accommodate further use of previous-tier engines for three additional months. A further flexibility implied by Gillig’s comments is that we should perhaps allow engine manufacturers to produce new previous-tier engines after the new emission standards already apply. This would introduce a host of problems for EPA oversight, enforceability, level playing field, etc.; we are therefore not pursuing that option. We believe the provisions as proposed adequately address the concerns of low-volume vehicle manufacturers as expressed by Gillig.

Volvo’s comments address inventory and stockpiling practices for both vehicle manufacturers (40 CFR 1037.601 and 1068.105) and engine manufacturers (40 CFR 1037.103). We first address comments related to inventory and stockpiling practices for vehicle manufacturers.



The final rule at 40 CFR 1037.601 restates the provision from 40 CFR 1068.105 describing as a starting point that we disallow departing from normal inventory practices, even if that does not cross the “bright-line” dates in the regulation. We believe the combined approach of accommodating normal inventory practices, subject to a firm deadline, appropriately balances the need for a clear, objective, and enforceable requirement with the variety of industry build practices and the unpredictability of building vehicles for an uncertain market.

We agree that the term “earlier engines” in 40 CFR 1068.105(a) is not helpful. Since the rest of that sentence already describes those engines as being built before the date of new or revised emission standards, we believe it is best to simply delete the word “earlier.”

We believe that the regulation allowing for “inventory” to include engines both at the equipment manufacturer and “from the engine supplier’s normal inventory” clearly also allows for engines in transit.

Volvo’s suggested approach would add a significant complexity to tighten up inventory practices in the three-month transition period specified in the regulation. We believe the proposed provisions, as modified for the final rule, establish clear deadlines with a reasonable accommodation for varied production volumes and market uncertainty. We will monitor manufacturers’ behavior in the coming transition to new emission standards, and will consider further refining the inventory and stockpiling provisions based on that experience.

Volvo also commented on the stockpiling provisions for engine manufacturers in 40 CFR 1068.103. Volvo objected to referencing “normal production and inventory practices” for engine manufacturers. As with the vehicle-manufacturer provisions described above, we believe it is necessary to combine a flexible approach with a bright-line date to accommodate varied production volumes and market uncertainty. This is profoundly applicable for the provisions in 40 CFR part 1068, which apply to sectors ranging from lawnmowers and snowmobiles to locomotives and ocean-going vessels. We adopted more specific requirements for heavy-duty vehicle manufacturers, and can consider more specific requirements for heavy-duty highway engine manufacturers in the future; however, in the current rule, we believe the general approach that already applies under 40 CFR 1068.103 appropriately addresses the issue for heavy-duty highway engines. In particular, the one-month backstop specification applies as an objective standard for all sizes and power ratings of heavy-duty highway engines, since they all have per-cylinder displacement well below 2.5 liters. Applying the more subjective “normal inventory” standard for most engines and applying the objective one-month deadline for all engines properly balances the need to accommodate varied production volumes and market uncertainty.

We believe Volvo’s suggested approach of requiring 80 percent of engines completed after effective date of new standards is arbitrary, unnecessary, and contrary to our expectation that there will be numerous circumstances where such an objective criterion would inappropriately limit a manufacturer’s ability to manage their transition to the new standards.

We believe the example cited for compliance with 2010 standards properly describes the balance between the subjective and objective compliance criteria. We also believe “completing engine assembly” has a plain meaning. Ready to ship. It is not clear why Volvo wants us to revise the regulation to address engines with per-cylinder displacement of exactly 2.5 liters, since the existing CFR text already references engines “at or above 2.5 liters.”

### **13.2.6 Compliance and Other General Provisions**

**Organization:** American Trucking Associations (ATA)

**Clean Air Act Section 203 Tampering Provisions will Cause Hesitation for Fleets**

Fuel-efficient, add-on equipment on a tractor or trailer is now considered to be emission control devices subject to the provisions under Clean Air Act Section 203. In the past it was abundantly clear that modifications made to an EPA-certified “engine” that increased emission levels was considered tampering and subject to an enforcement action. It would be a stretch to envision that Congress’ original intent was to characterize mismatched tires with different levels of rolling resistance, pieces of plastic, or non-functioning tire inflation systems as being subject to enforcement actions under Section 203’s tampering provisions. [EPA-HQ-OAR-2014-0827-1243-A1 p.13-14]

Fleets continue to express concerns over the potential for future enforcement actions involving such mundane matters by either the agencies or states. If such actions do indeed occur, fleets will seriously decide whether to specify fuel-efficient equipment when they place their orders with OEMs. In the alternative, fleets will invest in fuel-efficient equipment in the aftermarket which will not benefit OEMs in meeting their targets or the agencies’ objectives. [EPA-HQ-OAR-2014-0827-1243-A1 p.14]

Section 207 of the Clean Air Act states that compliance by vehicles and engines “in use” is done through manufacturer warranties that are provided to purchasers. Several of the equipment maintenance concerns under Phase 2 will therefore be addressed under appropriate warranty claims. Once such warranties expire, it follows that enforcement burdens will likely shift onto fleets. An overriding presumption must be recognized that fleets purchasing expensive, fuel-efficient technologies have both the interest and intent to use and maintain such equipment. To do otherwise would be economically counter-productive and ill-conceived. Therefore, ATA strongly recommends that any enforcement actions that may be directed at fleets (beyond engine alterations) be addressed with “fix-it” tickets versus financial penalties. [EPA-HQ-OAR-2014-0827-1243-A1 p.14]

**Organization:** National Automobile Dealers Association (NADA)

The final Phase 2 rule should not impose downstream “tampering” liabilities related to fuel economy and GHGs. While Section 203(a)(3)(A) of the Clean Air Act makes it unlawful for “any person to render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser,” that provision makes no sense in the context of fuel use and GHG reduction controls (42 USC 7522). If anything, commercial vehicle customers are economically incentivized to maintain and operate their vehicles with the goal of maximizing, not reducing fuel efficiency (and thus GHG emissions performance). Since similar incentives have not historically existed with respect to criteria emissions, EPA’s tampering policies have made sense when applied to components related to such emissions. Notably, changes to aerodynamics or tires, for example, are expected in the normal course of truck or tractor operations, and in some cases, may be done for safety reasons (winter tires, skirt and fairing modifications, etc.). [EPA-HQ-OAR-2014-0827-1309-A1 p.11]

**Organization:** Daimler Trucks North America LLC

**Rewording in 1037.241(was b, now a):** the EPA changes the regulations to say that a vehicle is noncompliant if its GEM score is above the applicable standard, but the EPA needs to add in something like 'unless the vehicle's exceedance is covered by credits accumulated from some other vehicle.' 1037.241 [EPA-HQ-OAR-2014-0827-1164-A1 p.131]

**Organization:** California Air Resources Board (CARB)

**Support Comment**

The definition of basic vehicle frontal area in 40 CFR 1037.801 (page 40661 of the NPRM) would be enhanced by an illustration. The language states that “basic vehicle frontal area means the area enclosed by the geometric projection of the basic vehicle along the longitudinal axis onto a plane perpendicular to the longitudinal axis of the vehicle, including tires but excluding mirrors and air reflectors.” [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

### **Neutral/Provide Additional Info Comment**

#### **Comment - Manufacturer data submittal**

The NPRM discusses ways to streamline the submittal of manufacturer data, avoid unnecessary duplication, and allow timely access to the data by both U.S. EPA and NHTSA, for example by allowing manufacturers to submit compliance data to U.S. EPA's VERIFY database system for use by both U.S. EPA and NHTSA. When CARB staff proposes its California's Phase 2 regulations, we will seek ways to similarly allow CARB staff timely access to Phase 2 compliance data, potentially by requiring all manufacturers who wish to certify in California to submit data to CARB simultaneous with submittal to U.S. EPA and NHTSA. CARB staff looks forward to finding the most efficient way to allow this access. [EPA-HQ-OAR-2014-0827-1265-A1 p.191]

**Organization:** Chemours Company FC, LLC

Chemours recommends that imported Medium- and Heavy-Duty vehicles should also comply with this new standard. [EPA-HQ-OAR-2014-0827-1231-A1 p.1]

**Organization:** PACCAR, Inc.

#### **Wording Change to 1036.130(b)(5)**

The words “steady-state” should be deleted. In this subsection of 1036, EPA states, “*Describe how your certification is limited for any type of application. For example, if you certify heavy heavy-duty engines to the CO2 standards using only steady-state transient FTP testing, you must make clear that the engine may not be installed only in tractors.*” The section is referring to the FTP transient test but calls out “. . .steady-state transient FTP testing,” which are opposite conditions. [EPA-HQ-OAR-2014-0827-1204-A1 p.31]

#### **Response:**

With respect to tampering and certified configurations, we note that the CAA prohibits—

“for any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser, or for any person knowingly to remove or render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser.”

Because this is a statutory requirement, NADA's position that it “makes no sense in the context of fuel use and GHG reduction controls” is not relevant to this rulemaking. The plain meaning of this provision leads us to conclude that we have no alternative other than to apply the tampering prohibition to the range of parts and specifications that vehicle manufacturers rely on to establish their certified configuration. This is not so different from applying this same principle to fuel injectors or catalytic converters. The emission standards are premised on manufacturers producing their vehicles in a certified

configuration, and specifying maintenance that allows for a reasonable expectation that in-use vehicles will continue to operate consistent with that original certified configuration. See Section 1.4 of this RTC for additional discussion of permissible modifications.

We disagree with ATA that “Section 207 of the Clean Air Act states that compliance by vehicles and engines “in use” is done through manufacturer warranties that are provided to purchasers.” The Act includes many provisions directly addressing, including the prohibition against tampering. In fact, section 207(c)(3)(A) specifies how the manufacturers must inform operators of proper maintenance. A vehicle manufacturer’s certification includes a review of those maintenance instructions, which is intended to address the manufacturers’ burden to demonstrate that the specified maintenance will occur with in-use vehicles. While we may pursue a case against fleet operators or other vehicle owners that violate the tampering prohibition by installing tires or other replacement components that do not conform to the manufacturer’s original certified configuration, consistent with the statute, we could also focus on the manufacturer’s role to ensure that in-use vehicles are getting anticipated maintenance as described in the application for certification. Thus, actions against the manufacturer would not excuse an operator from a tampering violation under the Act. ATA “recommends that any enforcement actions that may be directed at fleets (beyond engine alterations) be addressed with “fix-it” tickets versus financial penalties” but provides no legal basis for EPA to do so.

We address Daimler’s concern about demonstrating compliance in the context of an averaging program in two ways. The proposed rule already described that an individual vehicle or family is compliant or noncompliant based on its performance relative to the “applicable standard,” which we note as being the Family Emission Limit in cases involving generation or use of emission credits. For the final rule, we are expanding this discussion to provide more clarity. In addition, the regulations at 40 CFR 1037.750 describe the manufacturer’s obligation to determine at the end of each model year whether there is a deficit credit balance for the year, and to describe plans for resolving any existing credit deficit.

“Basic vehicle frontal area” has been part of the EPA regulation for several decades. We may pursue an illustration that clarifies the meaning of the term, but believe this is not needed in the regulation.

We expect to work with California ARB as part of the effort to coordinate data management as part of our respective compliance programs.

The new standards apply to all new engines and vehicles, with specific standards applying based on the applicable model year, consistent with the Clean Air Act. This applies to both domestically produced and imported products.

We have corrected the typographical error of including “steady-state” in 40 CFR 1036.130(b)(5).

### **13.2.7 Compliance Provisions for Tires**

**Organization:** Truck Trailer Manufacturers Association (TTMA)

#### **Requirements of Tire & Component Manufacturers:**

On page 40278 and in footnote 246, the rule mentions that EPA is considering adopting regulatory text addressing obligations for tire manufacturers. Specifically, the EPA asks that, in the event they discover tires on certified trailers that do not conform to the regulations, that they require the tire manufacturer to recall and replace the nonconforming tires. TTMA supports this concept and suggests that when and if regulatory authority is granted, if possible, it be extended in two specific ways. First, that the recall and replace provisions not be limited to tire manufacturers, but to all suppliers of regulated trailer components including Automatic Tire Inflation Systems and Aerodynamic Components. As EPA alludes to in footnote 246, the industry would be uniquely challenged by recall and replace provisions if

a tire manufacturer is found to be out of compliance, but the same situation would apply if an aerodynamic skirt were also found to be out of compliance. Second, if the agency insists on collecting data for every trailer made, that the agency tracks the relevant performance figures from component manufacturers (CRR for tires, Delta CDA for aero-devices) and allows the manufacturers to select the actual component they fitted when filing with the Agency so that it will auto populate with the correct figure. This would have two major advantages. [EPA-HQ-OAR-2014-0827-1172-A1 p.16]

First it would prevent transcription errors as manufacturers filed with the agency. Second, it would provide the Agency with a database of trailers that may have been fitted with a given tire or aero-device in the event that they determine that a recall is required. Provision would still be needed for trailer manufacturers to enter their own data in the event they are using components of their own manufacture or their own testing of particular device combinations as the Agency is encouraging. [EPA-HQ-OAR-2014-0827-1172-A1 p.17]

**Organization:** Rubber Manufacturers Association (RMA)

### **EPA Should Not Add Regulatory Text Giving the Agency Authority to Recall Trailer Tires**

In the Preamble, EPA requested comment on whether it should add regulatory text that would essentially give the agency authority to recall trailer tires that do not conform to the regulations. As support for this idea, EPA points to section 207(c)(1) of the Clean Air Act, the Act's recall provision. Section 207(c)(1) notes that: [EPA-HQ-OAR-2014-0827-1304-A1 p.21-22]

If the Administrator determines that a substantial number of any class or category of vehicles or engines, although properly maintained and used, do not conform to the regulations ... of this title, when in actual use throughout their useful life ... [the Administrator] shall require the manufacturer to submit a plan for remedying the nonconformity of the vehicles or engines...[EPA-HQ-OAR-2014-0827-1304-A1 p.22]

Section 216 of the Clean Air Act defines manufacturer as "any person engaged in the manufacturing or assembling of new motor vehicles ... or [any person] who acts for and is under control of any such person." The plain language of these provisions seems to provide EPA with recall authority over manufacturers of vehicles and engines only, not over other part manufacturers. [EPA-HQ-OAR-2014-0827-1304-A1 p.22]

The legislative history provides additional evidence that Congress did not intend to give EPA recall authority over other part manufacturers. The portions of the U.S. House Committee Report and the Conference Report that covered section 207 only mention vehicles and engines as the products that could be recalled under that section of the Clean Air Act.<sup>21</sup> The House Committee also envisioned testing of vehicles and engines to be quick, easy, and uniform, which seems incongruous to the testing process for tires.<sup>22</sup> [EPA-HQ-OAR-2014-0827-1304-A1 p.22]

Additionally, tires are a consumable item, not a durable component of the trailer and EPA has historically focused on durable components of vehicles for recall purposes. In addition, unlike many other emissions-related vehicle components, a tire's efficiency improves (tire rolling resistance decreases) as a tire wears, thus improving the tire's contribution to fuel economy. In the most recent and publicly available guidance document on recalls, EPA tracked vehicle and engine recalls by problem category and none of the categories seem comparable to tires. For example, EPA recalls have primarily been related to the catalytic system, the fuel delivery system, or the computer system based on their

direct impact on emissions. A tire's impact on emissions is more attenuated. [EPA-HQ-OAR-2014-0827-1304-A1 p.22-23]

If EPA's recall regulations were applied to tires, it is unclear how they would be enforced. The agency has acknowledged that insignificant defects do not warrant recalls. In the proposal, EPA does not discuss tolerances or other policies to account for manufacturing or testing variability. Similar issues have been addressed in Europe, where regulations setting rolling resistance performance thresholds set a regulatory allowance of 0.3 kg/T to accommodate sources of variability.<sup>25</sup> [EPA-HQ-OAR-2014-0827-1304-A1 p.23]

Other global regions that have adopted the allowance of +0.3 kg/t allowance for conformity of production testing include: [EPA-HQ-OAR-2014-0827-1304-A1 p.23]

The Brazilian Regulation # R544 "Conformity Assessment Requirements For New Tires" [EPA-HQ-OAR-2014-0827-1304-A1 p.23] South Korea "Regulations for Measurement of Energy Efficiency of Tires for Motor Vehicles, and Its Rating and Identification" [EPA-HQ-OAR-2014-0827-1304-A1 p.23] Without an alignment procedure that addresses sources of testing variability (machine alignment, machine drift, production variation, etc.), demonstrating non-compliance would be very difficult. [EPA-HQ-OAR-2014-0827-1304-A1 p.23]

**EPA Should not Expand Authority to Include Tire Recalls.** In part because there is no reference laboratory, and to be consistent with the Clean Air Act, its legislative history, and EPA's past practice, EPA should not add regulatory text giving the agency authority to recall trailer tires. [EPA-HQ-OAR-2014-0827-1304-A1 p.2]

**Rolling Resistance Machine Alignment.** RMA renews its call for the agencies to establish a reference laboratory for use in correlating rolling resistance data generated in support of this rule and to provide a clear and unambiguous guide to the compliance tests that the agencies may conduct to enforce this regulation. [EPA-HQ-OAR-2014-0827-1304-A1 p.2]

**Tire Rolling Resistance Testing.** The agencies Should Specify a Procedure for a Tire Rolling Resistance Reference Machine, Consistent with ISO 28580

**i. A reference machine is necessary to limit the effects of machine-to-machine variation.**

In the NPRM, the agencies have proposed to continue to allow use of either STL or Smithers in testing based on their conclusion that lab-to-lab variability is very small and would not significantly affect RRc values. Consistent with its comments during Phase I of this regulation, RMA advocates that EPA/NHTSA establish a reference machine, pursuant to the requirements of ISO 28580. Establishing a reference machine in this regulation would be consistent with NHTSA's approach in the consumer tire information rulemaking. In its final rule on its Tire Fuel Efficiency Consumer Information Program, NHTSA states, "NHTSA must specify [a reference laboratory] for the purposes of implementing this rule so that tire manufacturers know the identity of the machine against which they may correlate their test results." [EPA-HQ-OAR-2014-0827-1304-A1 p.5]

In the final rule for Phase I of this regulation, the agencies recognized the value of machine alignment in measuring rolling resistance consistently across multiple machines in multiple locations. However, the agencies stated that "Because the test procedure has not been finalized and heavy-duty LATs [Laboratory Alignment Tires] are not currently defined, the agencies are postponing the use of these elements of ISO 28580 to a future rulemaking." International Standard ISO 28580:2009,<sup>7</sup> together with

its accompanying TR 16377:2012<sup>8</sup> specifies an alignment method using a set of two predetermined tires measured by both the candidate and reference machines (Clause 3.10 of ISO28580:2009). The standard provides criteria for any user of the standard, such as a government agency or its designated alignment lab to select alignment tires for alignment purposes. In particular, alignment tires must meet the criteria of clause 10.4, which provides specifications for (a) the minimum range of tire rolling resistance values between the alignment tires, (b) alignment tire section width, (c) alignment tire outer diameter, (d) load index values and (e) the number of alignment tires (two). [EPA-HQ-OAR-2014-0827-1304-A1 p.5-6]

The fact that the ISO 28580 standard does not list specific alignment tires should not be viewed as a barrier to establishing a reference machine for purposes of this rule. In the case of Passenger Car Tires, ISO identified alignment tires in a letter submitted to the NHTSA docket (NHTSA-2010-0036-0016).<sup>9</sup> No manufacturer or lab has volunteered to provide specific alignment tires for Truck Bus tires. However, the operator of a selected reference machine could simply select regular production tires that meet the specifications for alignment tires in the ISO standard and sell them to candidate laboratories as part of a RR alignment service. [EPA-HQ-OAR-2014-0827-1304-A1 p.6]

**ii. RMA challenges the Agencies' assertion that the machine variability is very small and does not vary over time.**

In the NPRM, the agencies conclude that lab-to-lab variability is very small and would not have a significant impact on RRc values. RMA member company experts continuously study rolling resistance measurements, relative machine performance and machine-to-machine correlations. Two RMA members have provided correlation studies for inclusion in these comments. [EPA-HQ-OAR-2014-0827-1304-A1 p.6]

The first RMA member company ("Company A") provided data showing rolling resistance measurements from 19 tires, three replicates each, with tires tested at both Smithers and STL. A summary of that data is included in Figure 1. These data show that while the measurements taken at both labs are similar, they are not identical, and highlight the need for a reference machine. Company A also shows in Figure 2 that the laboratories can be correlated, with an R<sup>2</sup> value of 0.9029. [EPA-HQ-OAR-2014-0827-1304-A1 p.6-7]

[Figure 1, 'Company A RRc Data for Truck/Bus Tires, Measured at STL and Smithers (kg/T)', and Figure 2, 'Company A Rolling Resistance Correlation data between STL and Smithers (kg/T)', can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

The second RMA member company ("Company B") has studied the correlation between Smithers and STL over time. Included is an illustration from that work. Figure 3 contains comparisons among several tires tested at both STL and Smithers in 2011 and 2014. Company B also correlated its own machine to both Smithers and STL. [EPA-HQ-OAR-2014-0827-1304-A1 p.8]

These data show several important reasons why machine alignment is critical. First, while Smithers and STL are well correlated, they do not produce the same results. It is important to understand that differences in measured rolling resistance coefficient (RRc), even small percentage differences, can be very meaningful to a tire company, particularly in business and auditing or compliance contexts. Second, this analysis shows that the percent difference in tested values at the two labs is not the same for all tires tested. In fact, some tires perform better at one lab, while others perform better at the other. The example comparison at the bottom of Figure 3 shows this phenomenon. Third, the values at each lab drift over time. In Figure 3, tires 1A, 3C and 4B were tested in 2011 and 2014. The values for each

of these tires changed from 2011 to 2014. Further, the values correlated between the two labs but did not remain constant across the two testing periods. [EPA-HQ-OAR-2014-0827-1304-A1 p.8]

### **iii. A reference machine is necessary to limit the effects of measurement drift over time.**

Establishing a reference machine is important to limit the effects of machine-to-machine variation and manage machine drift over time. Even accepting the view the agencies state in the NPRM that “agencies believe the lab-to-lab variation for the STL and Smithers laboratories would have very small effect on measured rolling resistance values,” this analysis only addresses one aspect of the alignment – machine-to-machine variation. 80 Fed. Reg. at 40283. The other aspect, management of machine drift over time, should also be addressed in the regulation. The effect of drift and how to manage it can be evaluated by comparing rolling resistance measurements from a tire company’s machine to results for the same tires using the machines at STL and Smithers. To illustrate this point, Company B has conducted such an evaluation and presents measurements of the tires it compared in Figure 4. [EPA-HQ-OAR-2014-0827-1304-A1 p.8]

[Figure 3, 'Company B Correlations Between STL and Smithers for ISO 28580 Truck/Bus Tires', can be found on p.9 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

[Figure 4, 'Company B Correlation Data Among Company B, STL and Smithers', can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

Company B also provided Figure 5 and Figure 6, below, which illustrate the correlation among Smithers, STL and Company B in 2011 and 2014. These two figures show that while Company B’s machine was well-correlated with both Smithers’ and STL’s machines in 2011, the correlation equations are different for each machine. The same phenomenon was observed in 2014. In addition, the correlations shifted from 2011 to 2014, which indicate measurement drift. Measurement drift can be managed by periodic re-correlation. While this illustration shows management of drift for certification and compliance measurement purposes, the agencies should also address drift from the perspective of rolling resistance target-setting or compliance auditing. [EPA-HQ-OAR-2014-0827-1304-A1 p.10]

[Figure 5 and 6, 'Company B Truck/Bus RR Correlation of Smithers and STL' in Oct 2011 and March 2014, can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1304-A1]

Two AIAG manuals speak to the management of drift, specifically for automotive parts, which evolve with measurement. Measurement Systems Analysis (MSA)<sup>10</sup> and Statistical Process Control (SPC)<sup>11</sup> are both good manuals for guidance on how to apply statistics in real applications. In the MSA manual see Chapter IV, Sections A and C, particularly V7 and V8. In the SPC manual, Chapter III on Regression Charts and Residual Charts are helpful. Generally, the recommendation is that the next rolling resistance value should be predicted based on the known evolution and the statistical analysis should be conducted based on the error to the predicted value. These manuals can be ordered from [www.aiag.org](http://www.aiag.org). [EPA-HQ-OAR-2014-0827-1304-A1 p.12]

The agencies also have invited comment on whether “tire testing facilities are interested in and willing to commit to developing a reference machine.”<sup>12</sup> Of course, in considering whether to establish a reference machine, it is critical that a testing firm agree to serve to develop and maintain that machine. In order to gauge interest among those in the tire testing community, RMA recommends that the agencies create a request for proposal (RFP) and post it to [www.FedBusOpps.gov](http://www.FedBusOpps.gov), as NHTSA did when it established its National Alignment Lab for passenger car tire rolling resistance testing. Using this process would be the one true mechanism to gauge interest among testing firms. It is unlikely that a



testing firm would telegraph its business plans in the context of a rulemaking. [EPA-HQ-OAR-2014-0827-1304-A1 p.12]

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7 ISO 28580:2009 Passenger car, truck and bus tires -- Methods of measuring rolling resistance -- Single point test and correlation of measurement results.

8 ISO/TR 16377:2012 Further clarification of ISO 28580.

9 <http://www.regulations.gov/#!documentDetail;D=NHTSA-2010-0036-0016>.

10 DaimlerChrysler Corporation (Auburn Hills, Mich.). (2010). Measurement Systems Analysis: Reference manual; [MSA]. Southfield, Mich.: Automotive Industry Action Group.

11 Automotive Industry Action Group., Chrysler Corporation., Ford Motor Company., & General Motors Corporation. (2005). Statistical process control (SPC): Reference manual. Southfield, MI: Automotive Industry Action Group.

12 Id.

**Response:**

As discussed in Section I.C(1)(f) of the FRM preamble, CAA section 207(c)(1) requires “the manufacturer” to remedy certain in-use problems. The remedy process is to recall the nonconforming vehicles and bring them into conformity with the standards and the certificate. The regulations for this process are in 40 CFR part 1068, subpart F. EPA is also adopting regulatory text addressing recall obligations for component manufacturers and other non-certifying manufacturers. Under EPA regulations, we can require any person meeting the definition of manufacturer for a nonconforming vehicle to participate in a recall. However, we would normally presume the certificate holder to have the primary responsibility.

We agree with that the Rubber Manufacturers Association that CAA section 207(c)(1) effectively assigns recall liability to manufacturers of motor vehicles and motor vehicle engines. However, EPA remains of the view that in the event that vehicles (e.g. trailers) do not conform to the standards in-use due to nonconforming tires, tire manufacturers would have a role to play in remedying the problem. In this (hypothetical) situation, a tire manufacturer would not only have produced the part in question, but in the case of a trailer manufacturer or other small vehicle manufacturer, would have significantly more resources and knowledge regarding how to address (and redress) the problem. Accordingly, EPA would likely require that a component manufacturer responsible for the nonconformity assist in the recall to an extent and in a manner consistent with the provisions of CAA 208 (a). This section specifies that component and part manufacturers “shall establish and maintain records, perform tests where such testing is not otherwise reasonably available under this part and part C of this subchapter (including fees for testing), make reports and provide information the Administrator may reasonably require to determine whether the manufacturer or other person has acted or is acting in compliance with this part and part C of this subchapter and regulations thereunder, or to otherwise carry out the provision of this part and part C of this subchapter...”. Any such action would be considered on a case-by-case basis, adapted to the particular circumstances at the time.

We also encourage manufacturers of tractors, trailers, and vocational vehicles to pursue their own business arrangement with their suppliers to address the in-use performance of products from those suppliers. This applies equally to tires, tire-pressure systems, aerodynamic devices, and any other components needed for demonstrating compliance with emission standards. This is also no different than arrangements that are presumably already in place for a wide range of engine and vehicle components, especially aftertreatment devices, where the component supplier bears a disproportionate responsibility for the overall compliance of the engine or vehicle relative to applicable emission standards.

Moreover, in the case of tires meeting a certain performance level as part of GEM simulation, vehicle manufacturers can declare their FELs so that measured rolling resistance slightly above the Tire Rolling Resistance Level (TRRL) used for certification would not alone cause the vehicle to exceed the emission standard (and thereby fail to conform to the regulation). On the other hand, where we specify TRRL levels as design standards (such as for non-box trailers, and non-aero box vans), a tire that is shown to exceed the specified TRRL would be a direct finding of not conforming to the regulation. In such a case, we would expect to work with all affected trailer manufacturers to arrange for a remedy to address the problem in a way that involves the tire manufacturer, in line with statutory limitations. For example, the regulation identifies the tire manufacturer's statement reporting TRRL values to vehicle manufacturers as a submission to EPA, which means that we have a role in determining the truthfulness of that information if subsequent test results show that production and in-use tires do not meet reported TRRL values.

There is a potential for future enhancements to our certification program to allow for real-time information management and auto-populating data fields. This is currently more than we are able to do.

We intend to determine whether tires comply with emission standards the same way we have always handled compliance with exhaust emission standards. We establish standards based on specified measurement procedures. In the case of tires, we reference ISO 28580 and identify several clarifying provisions in 40 CFR 1037.520. As a general matter, any testing meeting the published specifications is considered a valid test for verifying TRRL values, either in the context of GEM inputs, or for demonstrating compliance with design standards. Manufacturers are expected to account for this variability when selecting TRRL values for compliance purposes. In fact, the (proposed and final) regulation specifies that tire manufacturers may select TRRL values that are identical to measured rolling resistance, or any higher value. This option to select a higher TRRL value is intended, among other things to account for measurement variability when performing tests according to the procedure specified in the regulation. In addition, the feasibility assessment for the Phase 2 standards is effectively an extension of what was already established under the Phase 1 program, with manufacturers continuing to incorporate compliance margins needed to meet standards.

We did not identify a reference laboratory for measuring tire rolling resistance by regulation. Individual manufacturers may ask us to identify a laboratory to correlate their results to. EPA invites manufacturers to do any amount of in-house or round-robin testing to better understand measurement variability, whether that is from variability to account for the various tolerances within the specified procedure, or lab-to-lab variability, variability from aging equipment, or variability from any other source.

### **13.3 Other Compliance Provisions for NHTSA**

#### **13.3.1 Standards and Credit Alignment**

**Organization:** Daimler Trucks North America LLC

**Standards and Credit Alignment** - The agencies request comment on whether optional compliance should be allowed. We agree with the addition of significant digits to align the credit calculations. 80 FR 40521. [EPA-HQ-OAR-2014-0827-1164-A1 p.118]

**Response:**

The final rule includes the provisions as proposed and as supported by the commenters.

## 14 Other Regulatory Provisions

### 14.1 General Comments 1822

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

The Alliance and Global Automakers (referred to jointly as “Automakers” in these comments) appreciate the opportunity to provide comments on the light-duty (LD) vehicle issues contained within the Phase 2 heavy duty (HD) greenhouse gas (GHG) and fuel efficiency proposed rule (the “HD NPRM”). We would like to also thank the agencies for supplying the redline-strikeout version of all the regulatory changes. This saves both agencies and automotive manufacturers review time and focuses limited resources to important changes, thereby allowing a more extensive review. [EPA-HQ-OAR-2014-0827-1271-A1 p.3]

This HD NPRM, in addition to containing new HD requirements, unexpectedly also contains several proposals and requests for comments on significant regulatory changes specific to LD. Also, neither the Preamble nor the Regulatory Impact Analysis (RIA) contained discussions of the rationale or background underlying many of these changes. While the Automakers agree that some of these changes are minor in nature and do not need significant evaluation, some of the proposals are substantive. In particular, the emission defect reporting and related provisions, and proposals to change the global warming potential values for certain compounds are of significant concern. These proposals would benefit from a fulsome discussion and analysis, and therefore we request that they be removed from this rulemaking and addressed in a separate rulemaking. [EPA-HQ-OAR-2014-0827-1271-A1 p.3]

In addition to comments on the substantive light-duty issues described above, the Automakers also provide comment on the agencies’ approach to other light-duty issues contained within or related to this rulemaking. [EPA-HQ-OAR-2014-0827-1271-A1 p.3]

**Organization:** Truck & Engine Manufacturers Association (EMA)

Proposed Technical Amendments

EPA is proposing numerous technical amendments as part of the NPRM process. EMA is in agreement with most of the proposed amendments, and, in general, is not providing comments on those changes. There are, however, certain proposed changes where EMA feels it is important to offer comments, and those comments are set forth in detail below. [EPA-HQ-OAR-2014-0827-1269-A1 p.73]

**Response:**

We note and agree that there are several noteworthy and substantive amendments in addition to the wide range of minor amendments. We address those amendments receiving specific comment in Section 13 and the rest of this Section 14.

## 14.2 Amendments Affecting Gliders and Glider Kits

**Organization:** American Council for an Energy-Efficient Economy (ACEEE)

### Glider Kits

ACEEE fully supports EPA's proposal to establish GHG and criteria emissions standards for engines in glider kits and NHTSA's proposal to include glider kits under its Phase 2 standards. The Phase 2 proposal will allow only engines that have been certified to meet current standards to be installed in new glider vehicles (p.40174). The agencies have observed sharp increase in glider kit production (p.40529) recently, which suggests that gliders are being used more and more as a loophole to avoid purchasing engines that meet 2010 EPA emission standards, and potentially to avoid NHTSA safety regulations<sup>26</sup>. These vehicles, unless regulated, will emit significantly higher NOx and PM emissions than from equivalent vehicles being produced with new engines. [EPA-HQ-OAR-2014-0827-1280-A1 p.29]

*Recommendation: Glider Kits* [EPA-HQ-OAR-2014-0827-1280-A1 p.30]

- Adopt standards for Glider vehicles in order to prevent them from using older engines with high criteria emissions. [EPA-HQ-OAR-2014-0827-1280-A1 p.30]

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<sup>26</sup> <http://www3.epa.gov/otaq/climate/documents/420f15904.pdf>

**Organization:** American Lung Association

The American Lung Association offers the following recommendations to strengthen the stringency and timing of the proposal and address several key elements of California's commitment to protecting public health and air quality. [NHTSA-2014-0132-0087-A1 p.2]

**The American Lung Association urges that the glider kit loophole be closed.** Glider kits sales have grown significantly. Many of the engines have substantially greater emissions of NOx and particulate matter than current emissions standards allow. Glider kit manufacturers must no longer be able to exploit this loophole leading to more health-threatening pollution. We urge you to finalize the provisions that would close the glider kit loophole. [NHTSA-2014-0132-0087-A1 p.3]

**Organization:** California Air Resources Board (CARB)

### Comment on Topic Where NPRM Requests Comment

#### **Comment – Gliders: Proposed amendment to U.S. EPA and NHTSA vehicle and engine standards**

CARB staff supports U.S. EPA's proposal to end Phase 1 provisions in 40 CFR part 1037 that: a) allow used, remanufactured or rebuilt engines certified to pre-Phase 1 emission standards to be installed in glider kits; and b) exempt glider kits and glider vehicles<sup>46</sup> produced by small businesses from the requirement to obtain a *vehicle certificate*<sup>47</sup> for GHG emissions compliance. Since the adoption of the federal 2007/2010 emission standards for PM and NOx, glider sales have significantly increased, and

the Phase 1 provisions affecting glider kit and glider vehicle production did not inhibit the accelerated growth in the glider market. [EPA-HQ-OAR-2014-0827-1265-A1 p.133]

U.S. EPA believes, and CARB staff concurs, that the proposed changes in the Phase 2 rulemaking are necessary to curb the nearly 10-fold increase<sup>48</sup> in the sale of glider vehicles with older engines (used, remanufactured, or rebuilt), and the associated increase in emissions that has occurred since the implementation of the 2007/2010 NO<sub>x</sub> and PM standards. While criteria pollutant increases due to the sale of glider vehicles with older engines is somewhat constrained in California as a result of CARB's Truck and Bus Regulation, which required the installation of DPFs on heavier trucks (GVWR over 26,000 lbs) starting in 2012, and engine upgrades to at least 2010 NO<sub>x</sub> and PM emission levels starting in 2015 for lighter trucks (with GVWR under 26,000 lbs), CARB staff supports U.S. EPA's proposal to limit the production and sale of glider vehicles with older, higher-emitting engines for the nationwide protection of human health and the environment and to close potential enforcement loopholes. [EPA-HQ-OAR-2014-0827-1265-A1 p.133-134]

Glider kits and glider vehicles are currently exempt from NHTSA's Phase 1 fuel consumption standards. Unlike U.S. EPA, NHTSA defines glider kits as motor vehicle equipment, not as motor vehicles, and therefore is only considering the inclusion of completed glider vehicles in its proposed Phase 2 requirements which will be similar in effect to U.S. EPA's proposal, including special provisions for small business manufacturers. NHTSA is seeking comments from the glider industry regarding its intent to include glider vehicles in its Phase 2 requirements. CARB staff supports NHTSA's intent to apply Phase 2 requirements to completed glider vehicles and strongly encourages it to develop provisions that align, to the extent possible, with U.S. EPA's proposed requirements. [EPA-HQ-OAR-2014-0827-1265-A1 p.134]

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<sup>46</sup> "Glider kit" typically refers to a chassis and cab assembly produced by a manufacturer without a new engine, transmission, or rear axle. "Glider vehicle" or "glider" typically refers to the completed assembly of the glider kit with a used, remanufactured, or rebuilt engine, a transmission, and/or rear axle. U.S. EPA considers "glider kits" to be incomplete motor vehicles, and, under the Clean Air Act, has the authority to regulate incomplete motor vehicles, including un-motorized chassis.

<sup>47</sup> Under Phase 1, U.S. EPA requires glider kits and gliders to obtain a *vehicle* certificate, except those produced by small businesses. The engine installed in the glider kit is not required to certify to the Phase 1 engine standards. Thus, depending on the size of the business producing the glider kit or glider vehicle, some are exempt from the requirement to obtain a Phase 1 vehicle certificate prior to introduction into commerce as a new vehicle.

<sup>48</sup> (U.S. EPA, 2015) "Frequently Asked Questions about Heavy-Duty Glider Vehicles and Glider Kits."

**Organization:** Capacity Trucks, Inc.

A terminal truck is a purpose-built truck: its only purpose is to move trailers in-yard more efficiently and effectively than can be done with a traditional heavy-duty over-the-road truck. Seventy percent of terminal trucks are built for off-road use only, operating only in yards. The terminal tractor industry is very small with only 4,000-6,000 terminal trucks built per year, and is primarily comprised of small businesses. Fifty percent of our competitors are small businesses and will be exempt from the proposed Phase 2 regulations governing glider kits and glider vehicles because of their size. This will likely cause a shift in the market and negatively impact our business.[EPA-HQ-OAR-2014-0827-1303-A1 p.1]

EPA should exempt engines that are still within their useful life—as measured by miles only, not years—from the proposed regulations governing glider kits and glider vehicles. Terminal trucks take a beating on the outside, while the powertrains remain intact. Capacity chassis are typically rebuilt or refurbished due to severe duty and use, with terminal trucks operating two and three shifts per day at an average speed of 20 mph. At the time of rebuilding/refurbishment, these trucks may be 5 years old or 25 years old, depending on the customer's use of the vehicle, but typically have limited miles on them. Terminal trucks are rebuilt and refurbished due to their operating environment: a small confined area, numerous impacts to trailers and docks or other obstructions, and corrosion from weather exposure. When a truck couples to a trailer parked against a dock door, as much as 7-8 gs of force is transmitted through the chassis. [EPA-HQ-OAR-2014-0827-1303-A1 p.1-2]

Vehicles with powertrains that are still within their mile and/or hour useful life should be exempted from the rule. EPA should not use the years component of the useful life definition because customers frequently bring in terminal trucks that are greater than ten years old but have very limited miles. Reusing these powertrains with rebuilt/refurbished or new chassis and vehicle components has no effect on overall emissions or negative environmental impacts, but results in important cost savings to our customers, many of whom are small businesses. [EPA-HQ-OAR-2014-0827-1303-A1 p.2]

**Organization:** Clarke Power Services

## I. Amendments Affecting Gliders

### A. Glider Definition Proposed Rules and Past Practices

1. *Glidert and Glider Kits:* The EPA has defined a Glider as a Motor Vehicle in the proposed rules and as a Motor Vehicle, Gliders would be subject to the Model Year (MY) Phase 2 GHG requirements. Reviewing past practices, the trucking industry over the last decade has worked under the NHTSA guidance that a glider is a repair part not dissimilar to any rebuilt part that is used in the repair and maintenance of heavy duty trucks and not a Motor Vehicle. The rebuilt engine in the Glider, as a repair part, complies to the criteria pollutant rules for the MY of the engine that is rebuilt. As a repair part, Gliders have been used by fleets to refresh or refurbish an “older” heavy duty truck that is beyond its useful life (defined as a greater than 435,000 miles). Trucks beyond useful life often have rebuilt engines, transmissions, and rear axle differentials installed to lengthen the miles and years a chassis can be utilized to haul freight. Fleets move the rebuilt engine, transmission, and/or the rear axle differentials from the “older” truck to the Glider after which the remainder of the “old” truck is salvaged removing it from service. Trucking fleets that have made this truck repair process using a Glider repair part an ongoing method for maintaining their fleet have dramatically changed the safety profile of their fleet. Glider repaired trucks now have “new” cab, electronics, controls, brakes, and air conditioning along with rebuilt engines, transmissions, and/or rear axle differentials. The engine, transmission and axles are supplied from the “older” truck, often called a “donor” truck in the industry, and are usually rebuilt. For a fleet that does not have adequate capital (usually smaller fleets with less than 1000 heavy duty trucks in service) to purchase new equipment utilizing a Glider as a replacement part gives a freshly refurbished truck that has the following positive impacts: [EPA-HQ-OAR-2014-0827-1005-A1 p.1-2]

- a) Improved operating costs with less down time for maintenance which improves utilization and reduces the number of trucks required to haul the same tonnage of freight.
- b) Improved safety with the same braking, lane drift devices, dynamic cruise control, and blind spot detection devices found on current MY heavy duty trucks.

- c) The new cab and controls improve driver skill level and safety.
- d) Improved particulate, NOx, and GHG emissions of a newly rebuilt engine compared to worn oil burning engine which is beyond its useful life. The engine is returned to the MY standard of the “donor” truck.
- e) New air-conditioning components reducing GHG emission compared to hydrofluorocarbon leakage from the old components. Also the latest standard for refrigerant can be used on Glider equipment with new air-conditioning components part of the kit.

This commenter recommends that used engines be eliminated as an option when assembling gliders. A rebuilt engine that has been brought back to the original MY EPA emission standard is always a cleaner option than a used engine installed in a Glider chassis. [EPA-HQ-OAR-2014-0827-1005-A1 p.2]

2. *Phase-out and Exemptions for Small Trucking Fleets:* It is the opinion of this commenter that the intentions of trucking fleets using gliders as described in this paragraph are not motivated by circumventing the EPA policies, but are most interested in being more efficient by removing old equipment from service and introducing a significantly improved heavy duty truck in its place. This being said, the agencies proposing the rule change should carefully assess the impact on small trucking companies. A delay of the rules with an “appropriate” phase-out of the oldest engines to ease the burden on the small trucking fleets is needed. Also as part of the phase-out and to encourage the oldest engines to continue to be retired, a hard look at and consideration of the 2010 engine specification for the small fleet use in Glider equipment is also merited. A recommended schedule for Phase-out of older engines in Gliders follows: [EPA-HQ-OAR-2014-0827-1005-A1 p.2]

| <u>MY EPA Standard</u> | <u>Phase out in Gliders by</u> |
|------------------------|--------------------------------|
| 1998 – 2003            | 2021                           |
| 2004 – 2007            | 2023                           |
| 2008 – 2009            | 2025                           |
| 2010                   | 2027                           |

Further, with the potential impact being severe on small trucking companies that have adopted the Glider repair part business model, exempting small trucking companies that have a history of assembling gliders for their own use should be considered. The agencies should use similar logic on exempting small fleets as other users of Gliders (Vocational Fleets) to limit the total number of Gliders. For example each small trucking company’s exemption could be the lesser of the average number of Gliders built annually over the past 3 years or 150 units/year. This would limit the impact on GHG emissions because of small numbers of Gliders and aid small fleets in remaining competitive providing trucking capacity and driver jobs as transition is made. [EPA-HQ-OAR-2014-0827-1005-A1 p.3]

3. *Assemblers/Manufacturers of Gliders:* There are two type of Glider Assemblers that have been defined as Manufacturers by the agency’s proposed new rules:[EPA-HQ-OAR-2014-0827-1005-A1 p.3]

- a) Type 1 is an assembler/manufacture that builds Gliders to sell directly to the industry either as a retail or wholesale completed truck [EPA-HQ-OAR-2014-0827-1005-A1 p.3]



b) Type 2 is an assembler/manufacture that is contracted as a third party to assemble a complete truck. This type of assembler never owns the glider and is not building to resell the final product to an end user. [EPA-HQ-OAR-2014-0827-1005-A1 p.3]

As defined above, Type 2 assemblers/manufacturers are often hired by small trucking company customers to assemble the parts, components, and glider repair part into a completed truck. This type of assembler also has several small businesses that are dependent upon it for a small quantity of Glider assemblies each year. Further exemption should be evaluated for manufacturers dedicated to assembly only with no intent or history of retail or wholesale selling of the completed truck. The logic is that exempt Gliders for small businesses, vocational truck fleets, and off-highway and oil field operators can all benefit from the synergies of a quality manufacturer that is hired to complete the exempt Glider. The main qualification for this exemption would be that the Glider is never owned by the assembler/manufacture and is not intended for retail sale or wholesale to the end user of the truck. The end user in this case owns the Glider and donor components throughout the assembly process. [EPA-HQ-OAR-2014-0827-1005-A1 p.3]

4. *Impact of Section XIV.B:* The proposing agencies need to assess carefully the impact of the proposed rules in light of past practice and the impact on small trucking companies and the assemblers that support them. There were four impacted groups identified by the agencies; Trailer Manufacturers, Alternative Fuel Converter, Vocational Chassis Manufacturer, and Glider Vehicle Assemblers. However, one of the most impacted groups was not identified by the agencies, small trucking companies. This commenter strongly recommends more diligent review of the impact on small trucking companies as part of the small business initial impact study as required by the SBREFA. [EPA-HQ-OAR-2014-0827-1005-A1 p.3]

5. *Cap of Glider Assemblies:* This commenter believes that the trucking company's decision to utilize Gliders will rationalize itself based on economic factors. As newer MY engines have become more fuel efficient, the demand for Gliders with cleaner engines will become the choice. Additionally, there is growing shortages of older engines, since diesel engine blocks have limited life and can only be rebuilt 3 times. This industry is currently considering MY 2010 engines as the choice for Gliders moving forward. So as the trucking industry transitions, this commenter recommends caps on non-exempt Gliders based on three years of production as recommended by the Panel Report, c, subsection xi, page 40545; however, instead of using production years 2010-2012 to establish peak levels use production years 2015-2016. [EPA-HQ-OAR-2014-0827-1005-A1 p.4]

## B. Gliders for Special Purpose Vocational Trucks Proposed Rules

1. *Vocational Trucks related to Gliders:* Throughout the proposed rules beginning with the Executive Summary at Section D.(2) page 40142, the agencies discuss vocational trucks and define them as "a wide variety of truck and bus types (e.g. delivery, refuse, utility, dump, cement, transit bus, shuttle bus, school bus, emergency vehicles, and recreational vehicles." Clarity from the agencies in relating vocational trucks to Gliders would be helpful. [EPA-HQ-OAR-2014-0827-1005-A1 p.4]

a) 1037.630 Special Purpose Tractors states: "Vocational tractors are treated as vocational vehicles and are exempt from the standards of § 1037.106....This allowance is intended only for vehicles that do not typically operate at highway speeds, or would otherwise not benefit from efficiency improvements designed for line-haul tractors. This allowance is limited to the following vehicle and application types: [EPA-HQ-OAR-2014-0827-1005-A1 p.4]

1. Low-roof tractors intended for intra-city pickup and delivery, such as those that deliver bottled beverages to retail stores.
2. Tractors intended for off-road operation (including mixed service operation), such as those with reinforced frames and increased ground clearance.
3. Model year 2020 and earlier tractors with a gross combination weight rating (GCWR) over 120,000 pounds....”

b) This commenter recommends the agencies provide clarity which is specificity related to Gliders in the case of Special Purpose Tractors or Vocational Trucks. While exemptions from Phase 2 have been suggested in the proposed rules the definition of Vocational Trucks should clearly include trucks that are heavily modified for a vocational application. While heavy duty chassis, limited speeds when on-highway, and predominately off-highway application were called out by the agencies there are several vocational applications that the agencies intend to include in the proposed exclusions that are not clear. For example many utility, dump, and concrete applications are supported by Vocational Gliders that have mixed pattern of use i.e. stop and go city driving, urban highway driving, and/or rural highway driving where speed may be in excess of 55 MPH but the truck is clearly a special use vocational truck. The speed only test and/or the predominately off road test do not always apply to these types of vocational trucks or the Gliders that support their industries. [EPA-HQ-OAR-2014-0827-1005-A1 p.4-5]

2. *Special Use Trucks*: Other special use trucks for which Gliders are used and that need to brought to the attention of the agencies are: [EPA-HQ-OAR-2014-0827-1005-A1 p.5]

a) *Auto Hauling Tractors*: This is a special use tractor that is heavily modified with a substantially lower roof than even a day cab. This low roof requires a modification that is not performed by a major OEM but is contracted to a fabrication/modification “shop” The resulting vehicle is low in height and also to the ground with low ground clearances. This low configuration is necessary to haul the number of automobiles on a single load required to be cost, fuel consumption and therefore emissions per delivered car effective. The auto hauling tractor has limited suppliers in the market place. Modified Gliders assembled for this purpose is one of only two acceptable suppliers today. This commenter recommends including auto hauling Gliders in the exemption rules being proposed for vocational equipment. [EPA-HQ-OAR-2014-0827-1005-A1 p.5]

b) *Safety Issues with Auto Hauling Tractors*: Trucks conforming to MY 2014 emission requirements have proven to be not-fit-for the purpose of auto hauling. There have been reported cases in the auto hauling industry of fires that result from the regeneration cycle of MY 2014 and newer equipment that have been modified to haul automobiles. Because of the low ground clearances of the auto hauler the heat that is produced during the regen cycle has caught dry combustible material (grass and leaves) that may be under the truck when it is parked. This has damaged equipment and the automobiles that were being hauled. Using a Gilder with pre MY 2014 rebuilt engine solves this problem and is further evidence that Auto hauling Gliders need be included as a vocational truck in the proposed rules. [EPA-HQ-OAR-2014-0827-1005-A1 p.5]

c) *Ultra-Light Weight Gliders*: This is a Special Use Glider Truck that has been heavily modified to lower the overall weight of the Truck by 1,500 lbs. These modifications allow certain products to be transported more efficiently by loading more product into the trailer while conforming to the total vehicle weight limit required by the DOT. A lighter truck means more freight per load, therefore less loads are required to haul the same tonnage of product. A Glider can be produced that is the lightest heavy duty truck on the road today and is well received by carriers hauling products like beverages;

bulk powdered or liquid starches, syrups, and other bulk food grade products; and dry bulk and liquid chemicals. [EPA-HQ-OAR-2014-0827-1005-A1 p.5]

3. *1031.631 Exemption of vocational vehicles intended for off-road use:* The chassis of vehicles in the vocational industries in general and the off-road vehicles take a tremendous amount of load and torque (twisting). This kind of use guarantees that the chassis will be worn out prior to the modifications that were used to prepare the vehicle to be a vocational truck. The work box, crane, hydraulic lifts, etc. that are required in the vocational application are expensive and are transferred to the next chassis. When the replacement chassis is a Glider, then this commenter believes that the flexibility should be granted with regard to the engine choice. This commenter recommends that one sentence should be struck from 1031.631; that sentence being “This section does not exempt engines used in vehicles from the standards of 40 CFR part 86 or part 1036” atop of page 40655 . Striking this sentence will give maximum flexibility once the agencies realize the vocational equipment being described may be older than MY 2014. [EPA-HQ-OAR-2014-0827-1005-A1 p.5-6]

C. *Exemption Caps for vocational:* [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

1. *Impact Study of number of Gliders:* The agencies proposing the Phase 2 GHG gas rules have not adequately defined the impact of the current number of Gliders which are assembled each year (XIV,B,3, page 40528), since no production numbers are reported to the EPA. Since the total is unknown, the impact on pollutants is also unknown; therefore additional studies need to be made to adequately define the “right” number of Gliders allowed. [EPA-HQ-OAR-2014-0827-1005-A1 p.6]
2. *Vocational Caps:* It is clear that the agencies propose to exempt vocational gliders, however, a cap is also being considered in the rules; proposed as not more than 21,000 in any three year period. This 7,000 average per year can be limiting to certain major U.S. industries and does not allow for growth and replacement for all transportation segments. This commenter recommends with regard to vocational trucks that no cap be mandated: [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

a) The in-service life of a vocational truck exceeds 10 years and the equipment on the truck can be moved from one chassis to the next. So capping the number of gliders will adversely impact the moving of the very equipment needed to make the replacement Glider able to do the vocational work. The investment to modify a Glider chassis for vocational applications is large and every time vocational equipment can be moved to a new chassis it will be done. Caps become overly complicated when replacement and growth Gliders are considered. [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

b) As the agencies have noted in their vocational definitions several different transportation segments and major industries are using vocational equipment. Limiting or capping vocational trucks can have the unintended effect of giving one transportation segment or industry access to Glider equipment over another. This can drive cost up as availability is limited and offer a favored advantages to a selected few U.S. industries that can pay. [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

c) As the agencies commented the over-all volume of vocational is relatively low so the need to cap vocational is also low. So allowing each industry to rationalize the number of vocational vehicles necessary each year is more prudent that trying to regulate an artificial cap. [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

II. Small Business Proposed Rules related to Gliders [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

A. EPA Status Quo and Proposed Cap of Glider Builds [EPA-HQ-OAR-2014-0827-1005-A1 p.6]

1. *EPA Regulatory Status Quo Proposed Rules*: Section XIV.B.(3) page 40529 This commenter is also concerned about the economic impacts on small businesses that assemble gliders and build glider kits. The agencies are correct in assuming that the activities of these small manufacturers are for non-circumvention purposes. The proposed rules that maintains the regulatory status quo for existing small businesses is supported. The additional point this commenter would make is to expand the small businesses impacted to include small trucking companies that have a history of assembling gliders in lieu of operating used equipment. Regulatory relief for this group would also be appropriate with reasonable caps. [EPA-HQ-OAR-2014-0827-1005-A1 p.7]
2. *Cap of Gliders Allowed*: The agencies ask for comment with regard to the methodology and total number of Gliders allowed to be assembled by small businesses. It is the opinion of this commenter that the number of small businesses engaged in Glider assembly is likely to decrease with the rule changes being proposed. If this is accurate then using the history of total production as the basis for establishing the limit on total production may disallow an otherwise efficient small business from acquiring additional customers as other assemblers cease business. A more equitable method would be to allow any small business assembler that has built a minimum of 100 gliders within the last three years be granted an exemption for gliders being built in any given year up to a cap of 300 gliders/year. This allows for competition and for high quality small business assemblers to secure business from lesser assemblers. Additionally, the vocational exemptions the agencies are proposing should also be made available to small business assemblers and it is recommended that this cap would also be 300 vocational units based on the definition of the final rules. The maximum cap with Gliders and Vocational Gliders would be 600/year. [EPA-HQ-OAR-2014-0827-1005-A1 p.7]
3. *Timing*: The EPA has solicited comment with regard to the timing of implementation of the proposed rules. The proposed date of January 1, 2018 is tight to transition all of the stake holders in the Glider industry. It is the opinion of this commenter that Phase 2 should be postponed until January 1, 2020 assuming there has been adequate assessment of the impact on the impacted groups including small trucking companies. [EPA-HQ-OAR-2014-0827-1005-A1 p.7]

**Organization:** Cummins, Inc.

*Cummins supports limitations on the use of glider kits* [EPA-HQ-OAR-2014-0827-1298-A1 p.41]

Glider kits are a necessary option for replacing damaged vehicles that still have usable powertrain components. However, glider kits should not be used to circumvent the purchase of a currently certified engine and aftertreatment system. Cummins urges the agencies to work with the industry to develop a workable solution for glider kits. [EPA-HQ-OAR-2014-0827-1298-A1 p.41]

**Organization:** Daimler Trucks North America and Detroit Diesel Company

• Memorandum discussing legal issues related to glider vehicles and glider kits (EPA-HQ-OAR-2014-0827-1627, NHTSA-2014-0132-0189):

We submitted separately to the docket a letter going into detail on the EPA's memorandum. [This letter can be found in docket number EPA-HQ-OAR-2014-0827-1926-A1][EPA-HQ-OAR-2014-0827-1918-A2 p.9]

**Organization:** Daimler Trucks North America LLC

## **I. Legal Issues with Glider Provisions**

As DTNA expressed in its comments to the Phase 2 Proposed Rule, DTNA has concerns with EPA's proposed regulation of 'glider kits' and 'glider vehicles,' including EPA's legal authority for regulating them. EPA's Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act ('CAA'), which does not provide EPA authority to regulate the sale of motor vehicle components. The CAA only provides EPA with authority to regulate 'new motor vehicles' and their engines, defined as 'self-propelled' vehicles 'the equitable or legal title to which has never been transferred to the ultimate purchaser'—not non-motorized frames, cabs, and axles. 42 U.S.C. §§ 7522(a), 7550(3). In turn, any regulation of glider kits is beyond the agency's authority. Further, glider vehicles when constructed retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not 'new' under the CAA. Thus, EPA lacks authority to regulate glider vehicles. And even if the EPA had authority to regulate, the CAA requires 4-years' lead-time for new or revised NOx and PM requirements and for regulations governing engine rebuilding practices, which has not been met under the proposed regulations. [EPA-HQ-OAR-2014-0827-1926-A1 p.2] [[This comment can also be found in section 1.3.1 of the Comment Summary.]]

### **A. Distinction Between 'Glider Kit' and 'Glider Vehicle'**

As DTNA explained in its comments to the Phase 2 Proposed Rule, EPA has proposed two overlapping and potentially confusing definitions: 'Glider kit means any of the following: (1) A new vehicle that is incomplete because it lacks an engine, transmission, or axle; (2) A new vehicle produced with a used engine (including a rebuilt or remanufactured engine); (3) Any other new equipment that is intended to become a motor vehicle with a previously used engine (including a rebuilt or remanufactured engine)'; and 'Glider vehicle means a new vehicle produced with a used engine.' As EPA has proposed these definitions, 'glider vehicle' is a subset of 'glider kit,' whereas under industry usage and understanding, the two are separate, and should remain so under the regulations. A 'glider kit' should instead be defined as 'an assemblage of new vehicle components, including at a minimum the chassis, cab and front axle, but lacking a new engine, transmission, and rear axle.' Once the glider kit is used to rebuild a truck, EPA would consider it a 'glider vehicle.' [EPA-HQ-OAR-2014-0827-1926-A1 p.2]

EPA should clarify when a glider vehicle becomes a 'new motor vehicle' subject to regulation, as NHTSA has done, by adopting a provision similar to 49 C.F.R. § 571.7(e). Under its regulations, NHTSA considers a truck to be 'newly manufactured' and subject to Federal Motor Vehicle Safety Standards when a new cab is used in its assembly, 'unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle.' 49 C.F.R. § 571.7(e) (emphasis added). In other words, as long as the engine, transmission, and drive axle(s) are remanufactured and not new, and at least two of these components were taken from the same vehicle, the resulting glider vehicle would not be a new motor vehicle subject to regulation, and the glider kit used to build the glider vehicle could contain the third component (remanufactured engine, remanufactured transmission, or remanufactured drive axle(s)). This harmonization would be consistent with the agencies' commitment to establish a national GHG program. [EPA-HQ-OAR-2014-0827-1926-A1 p.2]

### **B. EPA Lacks Authority to Regulate 'Glider Kits' and 'Glider Vehicles'**

The distinction between 'glider kits' and 'glider vehicles' is important because EPA lacks authority to regulate vehicle parts, including assemblages of parts (without an engine) such as glider kits. EPA's Phase 2 Proposed Rule is being carried out under the authority of the CAA, and the CAA does not provide EPA authority to regulate the sale of motor vehicle components, which is all that glider kits are.

The CAA only authorizes EPA to set emission standards for 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7521(a)(1), and to prohibit the sale of uncertified 'new motor vehicles' and 'new motor vehicle engines,' see 42 U.S.C. § 7522(a)(1). 'New motor vehicles' are defined under the CAA as 'self-propelled' vehicles 'the equitable or legal title to which has never been transferred to an ultimate purchaser'—not non-motorized frames, cabs, and axles. 42 U.S.C. § 7550(2), (3). Because glider kits do not contain engines, transmissions, and drive axles, and have no motive power, the CAA does not authorize EPA to regulate the sale of glider kits. [EPA-HQ-OAR-2014-0827-1926-A1 p.2-3] [[This comment can also be found in section 1.3.1 of the Comment Summary.]]

EPA's examples of CAA provisions that address certain vehicle components are inapplicable. EPA cites to three CAA provisions granting it authority to regulate evaporative emissions, including from certain components, and concludes from those specific provisions that it has authority to regulate all vehicle components, whether or not they produce emissions in any form. Specifically, EPA cites to 'CAA section 202(a)(6) (standards for onboard vapor recovery systems on 'new light-duty vehicles,' and requiring installation of such systems); section 202(a)(5)(A) (standards to control emissions from refueling motor vehicles, and requiring consideration of, and possible design standards for, fueling system components), 202(k) (standards to control evaporative emissions from gasoline-fueled motor vehicles).' EPA Legal Memo, at 3. From these examples, EPA concludes that it has authority to regulate all vehicle components, a conclusion that is not justified under the language, of the Act. First, the fact that the CAA lists specific components that EPA may regulate suggests that EPA lacks authority to regulate other components that are not specifically listed, particularly given the broader dictate that EPA may set emission standards only for 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7521(a)(1), and may prohibit only the sale of uncertified 'new motor vehicles' and 'new motor vehicle engines,' 42 U.S.C. § 7522(a)(1). Second, all of the examples cited by EPA relate to evaporative emissions. Although EPA might be able to argue that it has authority to regulate evaporative emissions from those specific components, and exhaust emissions from 'new motor vehicles' and 'new motor vehicle engines,' it is a stretch to say that EPA has authority to regulate all motor vehicle components. This is particularly true where, as with glider kits, the components do not produce emissions on their own. EPA itself recognizes that it cannot extend its argument to the smallest vehicle component—'This is not to say that the Act authorizes emission standards for any part of a motor vehicle, however small,' EPA Legal Memo, at 3—but nonetheless believes it has the authority to draw the line to include glider kits and trailers. In fact, Congress drew the line in the CAA at 'new motor vehicles' and 'new motor vehicle engines,' and EPA may not extend its authority further than Congress allowed. [EPA-HQ-OAR-2014-0827-1926-A1 p.3] [[This comment can also be found in section 1.3.1 of the Comment Summary.]]

EPA also lacks authority to regulate glider vehicles. When constructed, glider vehicles retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not 'new' under the CAA and not subject to EPA's regulatory authority. EPA's argument that glider assemblers market their finished products as 'new trucks' is unavailing. A company's marketing materials have no bearing on the statutory definition that governs EPA's authority. Although the CAA may not reference Vehicle Identification Numbers as determinative of new motor vehicle status, the Act does contain an express definition of 'new motor vehicles'—'self-propelled' vehicles 'the equitable or legal title to which has never been transferred to an ultimate purchaser,' 42 U.S.C. § 7550(2), (3)—which EPA is not free to disregard. Glider vehicles incorporate not just a used engine, as EPA suggests, but the engine, transmission, and rear axle—the entire powertrain that comprises a significant portion of a vehicle's cost and identity—from a previously owned vehicle. The glider kit, which may be considered to be 'new' vehicle parts, is not self-propelled. The glider becomes self-propelled only when the powertrain components are added, but cannot be a 'new motor vehicle' because the equitable or legal title of those powertrain components has previously been transferred to an ultimate purchaser. [EPA-

HQ-OAR-2014-0827-1926-A1 p.3-4] [[This comment can also be found in section 1.3.1 of the Comment Summary.]]

### **C. Regulation of 'Glider Vehicles' Targets NOx/PM Emissions and Must Meet Statutory Lead-Time Requirement**

In addition, the proposed regulation of 'glider vehicles' actually targets NOx/PM emissions rather than GHG emissions, as EPA concedes, and is therefore inappropriate for inclusion in a GHG rule. Glider sales actually create the potential to reduce GHG emissions by incorporating used and rebuilt engines in newer, more aerodynamic vehicles. Rebuilt engines used in glider vehicles emit fewer GHGs, and new cabs and low rolling resistance tires are more efficient than what they replace. Because regulation of glider vehicles targets NOx/PM emissions, it should be done only in a separate rulemaking, if at all. [EPA-HQ-OAR-2014-0827-1926-A1 p.4]

In addition, this separate rulemaking should be carefully drafted to meet statutory lead-time requirements for NO and PM regulations as required by statute. NO and PM emissions standards are subject to an express CAA lead-time requirement under which new or revised NOx and PM requirements cannot take effect sooner than the model year commencing 4 years after a new or revised standard is promulgated. 42 U.S.C. § 7521(a)(3)(C). As currently proposed, with an effective date of January 1, 2018, the proposed glider regulations violate the 4-year lead-time requirement under the CAA. Assuming the Phase 2 rule is finalized in early 2016, the earliest that the regulations governing glider vehicles could take effect would be 2020, in compliance with the CAA lead-time requirement. [EPA-HQ-OAR-2014-0827-1926-A1 p.4]

For its proposed glider provisions, EPA purports to rely on its authority to regulate the 'practice of rebuilding heavy-duty engines.' 42 U.S.C. § 7521(a)(3)(D). However, EPA is not regulating engine rebuilding practices, as evidenced by the lack of relevant proposed amendments to its engine rebuilding regulations (40 C.F.R. §§ 86.004-40, 1068.120). Instead, EPA is attempting to regulate vehicle rebuilding, which it clearly does not have the authority to do under the CAA. Congress granted EPA authority to regulate 'new motor vehicles' and 'new motor vehicle engines' only, and while Congress granted EPA authority to regulate engine rebuilding, it did not grant EPA similar authority to regulate vehicle rebuilding. EPA's reliance on (3)(D) is misplaced with respect to its proposed regulation of glider vehicles. Even if EPA were properly regulating heavy-duty engine rebuilding practices with its proposed glider provisions, it would be subject to the same four-year statutory lead-time requirement. [EPA-HQ-OAR-2014-0827-1926-A1 p.4]

As currently proposed, EPA is attempting to regulate NO and PM in the GHG rule in a way it could not undertake in a proper NOx and PM rulemaking. Under the CAA, EPA must allow four years of lead time, at a minimum, before its proposed glider provisions would take effect. [EPA-HQ-OAR-2014-0827-1926-A1 p.4]

## **II. Alternative Provisions Proposed by EPA**

In its draft legal memorandum, EPA proposes several alternative provisions for comment. These include alternative provisions governing glider kit manufacturers, engine remanufacturers, and glider vehicles using newer engines. [EPA-HQ-OAR-2014-0827-1926-A1 p.5]

### **A. Alternative Provisions for Glider Kit Manufacturers as Manufacturers of Motor Vehicle Parts**

EPA proposes alternative provisions governing glider kit manufacturers that would apply in the event that its primary implementation provisions are held inapplicable. EPA asserts that a glider kit sold in a configuration that would not meet the tractor emission standard when the specified engine, transmission, and axle are installed would 'cause' a violation of that standard in violation of 42 U.S.C. § 7522(a)(1), or could be considered a prohibited defeat device under 42 U.S.C. § 7522(a)(3)(B). Under 42 U.S.C. § 7522(a)(1), a manufacturer is prohibited from distributing in commerce, selling or offering for sale, or introducing or delivering for introduction into commerce, a 'new motor vehicle' or 'new motor vehicle engine' that is not covered by a certificate of conformity. As explained above, neither a glider kit nor a glider vehicle meet the definition of 'new motor vehicle.' As a result, EPA's assertion that the sale of a glider kit could 'cause' a violation of an emission standard applicable to a new motor vehicle fails for the same reason that EPA does not have authority to regulate glider kits and glider vehicles—they are not 'new motor vehicles.' [EPA-HQ-OAR-2014-0827-1926-A1 p.5]

With respect to 'defeat devices,' the CAA prohibits 'any person' from manufacturing or selling or offering to sell or installing 'any part or component intended for use with, or as part of, any motor vehicle or motor vehicle engine, where a principal effect of the part or component is to bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this subchapter, and where the person knows or should know that such part or component is being offered for sale or installed for such use or put to such use.' 42 U.S.C. § 7522(a)(3)(B). It is difficult to see how a 'principal effect' of a glider kit is to 'bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine.' Because the engines installed in glider vehicles are typically older model year engines subject to less stringent emission standards, a glider kit generally improves the GHG emissions performance of the engine/vehicle. It is unclear how a glider kit could be said to 'bypass, defeat, or render inoperative any device or element of design installed on or in' these older model year engines, let alone for that to be the glider kit's 'principal effect.' [EPA-HQ-OAR-2014-0827-1926-A1 p.5]

EPA proposes an alternative rule which would require glider kit manufacturers to do one of two things: either a) affix a label on the glider kit stating that the 'glider kit is not to be used in combination with tractors certified to the applicable phase 2 GHG standard,' or b) 'conduct testing (including aerodynamic and tire testing) to show that the glider kit is consistent with the glider vehicle's final certified condition.' EPA Legal Memo, at 8. Both of these alternatives still assume that EPA has authority under the CAA to regulate glider kits as 'new motor vehicles' or as motor vehicle components and to regulate glider vehicles as 'new motor vehicles,' which as explained above, EPA does not. [EPA-HQ-OAR-2014-0827-1926-A1 p.5]

If EPA moves forward with regulating gliders, it should pursue a variation on the proposed cap rather than these alternative rules. As DTNA explained in its comments to the Phase 2 Proposed Rule, a cap of 300 vehicles is too low given the abrupt change this regulation brings to the 50-year-old glider industry and the disproportionate impact it will have on small businesses. A more reasonable approach would be to begin with a higher initial cap and gradually reduce it over time to allow large and small businesses in the glider industry to adapt to EPA's new requirements. Specifically, if EPA decides to implement a certification requirement for glider vehicles, the small business exemption should start with a cap of 1,500 vehicles in 2020 (complying with the statutory lead-time requirement) and then reduce the cap by 250 each year for the next 3 years to 1,250 in 2021, to 1,000 in 2022, and finally to 750 vehicles in 2023. Such a phase-down would allow these small manufacturers to transition to other lines of business and to move their employees to other types of work without extensive layoffs. Many small manufacturers will already be limited by their highest annual sales volume and will not be affected by the cap, while for those that are, the initial 1,500 vehicle cap and subsequent phase-down represents a substantial reduction. [EPA-HQ-OAR-2014-0827-1926-A1 p.5-6]



Further, EPA should clarify that the proposed glider provisions apply only to the final assembler of the glider vehicle, as that is the only entity that knows what the final vehicle configuration will be. There is no need for a glider kit manufacturer to label the assemblage of parts that it sells in accordance with the delegated assembly provisions. It is obvious that the glider kit requires further assembly as it lacks an engine, transmission, and/or rear axle. The regulations should require that only the glider vehicle, once assembled and ready to drive, be labeled by the assembler. [EPA-HQ-OAR-2014-0827-1926-A1 p.6]

### **B. Alternative Provisions for Engine Remanufacturers**

EPA is also considering alternative provisions for engine remanufacturers if the primary implementing provisions are held to apply only to the glider vehicle assembler. Relying on its section 202(a)(3)(D) authority, EPA would require any rebuilt/remanufactured motor vehicle engines to meet current model year engine standards if they are intended to be installed in new motor vehicle chassis. [EPA-HQ-OAR-2014-0827-1926-A1 p.6]

If EPA proposes to amend its heavy-duty engine rebuilding provisions (40 C.F.R. §§ 86.004-40, 1068.120), it must do so in a separate rulemaking subject to public notice and comment, rather than making such a proposal in a draft legal memorandum entered into the Phase 2 Proposed Rule docket and not proposed or explained in the Federal Register. Further, if EPA intends to rely on its authority to regulate the 'practice of rebuilding heavy-duty engines' under 42 U.S.C. § 7521(a)(3)(D) to amend the heavy-duty engine rebuilding regulations, such amendment would be subject to the four-year statutory lead-time requirement. The four-year lead-time and three-year stability requirements of 42 U.S.C. § 7521(a)(3)(C) are applicable to all of paragraph 3, which includes the engine rebuilding provision contained in (3)(D). It is not enough for EPA to opine that the January 1, 2018 implementation date for the glider provisions allows 'sufficient time to permit the development and application of the requisite control measures' under 42 U.S.C. § 7521(a)(3)(D). The four-year lead-time and three-year stability requirements of (3)(C) provide an absolute minimum, even for engine rebuilding regulations, and then EPA must determine whether additional time is required above and beyond that based on its determination under the standard contained in (3)(D). [EPA-HQ-OAR-2014-0827-1926-A1 p.6]

### **C. Glider Vehicles Using Newer Engines**

Assuming EPA moves forward with its proposal to regulate glider kits and glider vehicles, EPA solicits comment on certain potential flexibilities for glider vehicles using newer engines: (1) raising or eliminating the cap on sales for engines that were certified to meet the 2010 NO<sub>x</sub> and PM standards, as opposed to pre-2010 engines; (2) for vehicles using engines meeting the 2010 NO<sub>x</sub> and PM standards, raising or eliminating the cap on sales for glider vehicles using engines still within their regulatory useful life; and (3) for Class 8 vehicles, treating engines with high years/low mileage or low years/high mileage (e.g., engines that are more than 10 years old but have fewer than 100,000 miles or that are less than 3 years old regardless of mileage) as still within their useful life. EPA Legal Memo, at 9-10. DTNA would support all of these potential flexibilities. [EPA-HQ-OAR-2014-0827-1926-A1 p.6-7]

EPA should eliminate the cap on sales for engines that were certified to meet the 2010 NO<sub>x</sub> and PM standards. As EPA recognizes, the potential for adverse environmental effects from these engines is significantly reduced when compared to pre-2010 engines that have higher criteria pollutant emissions. This alternative would cover all 2010 and later engines without regard to their useful life and would provide manufacturers with necessary flexibility going forward. [EPA-HQ-OAR-2014-0827-1926-A1 p.7]

EPA should also eliminate the cap on sales for glider vehicles using engines that are still within their regulatory useful life, including treating Class 8 engines with high years/low mileage or low years/high mileage as being within their useful life. For Class 8 engines to be within their useful life under current regulations, they must be both less than 10 years old and have fewer than 435,000 miles of use. As EPA recognizes, some vehicles in very low use applications may have less than 100,000 miles after 10 years, while other vehicles may reach 435,000 miles within a few years. EPA should treat these engines as being within their useful life and eliminate the cap on sales for glider vehicles using these engines. [EPA-HQ-OAR-2014-0827-1926-A1 p.7]

### **III. NHTSA Exemption**

As DTNA expressed in its comments to the Phase 2 Proposed Rule, DTNA supports NHTSA's current proposal to maintain its existing regulations with respect to glider kits and glider vehicles, under which NHTSA does not consider glider kits to be motor vehicles, and not to include gliders under its Phase 2 program. Since at least 1975, NHTSA has recognized that 'use of a new 'glider kit' ['typically a cab, frame rails, and front suspension'] in combination with the valuable components from an existing vehicle' is 'common practice' in the industry. 40 Fed. Reg. 19,485 (proposed May 5, 1975). In response to this common industry practice, NHTSA finalized a regulatory provision clarifying what it does and does not consider to be a 'new vehicle,' striking an appropriate balance between common-sense, cost-effective reuse of vehicle components and the need for adequate safety regulation of new vehicles. 40 Fed. Reg. 49,340 (Oct. 22, 1975). Under its regulations, NHTSA considers a truck to be 'newly manufactured' and subject to Federal Motor Vehicle Safety Standards when a new cab is used in its assembly, 'unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle.' 49 C.F.R. § 571.7(e) (emphasis added). DTNA supports the continuation of this long-standing regulatory provision. To the extent that NHTSA has concerns about compliance, it should issue guidance and engage in outreach to glider assemblers rather than revising its regulations. Further, NHTSA should not pursue inclusion of gliders under its Phase 2 program. [EPA-HQ-OAR-2014-0827-1926-A1 p.7]

#### 8. Gliders

· **Legal Issues with Glider Provisions** - DTNA has concerns with EPA's proposed regulation of "glider kits" and "glider vehicles," including EPA's legal authority for regulating them. EPA's Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act ("CAA"), which does not provide EPA authority to regulate the sale of motor vehicle components. Moreover, the CAA only provides authority to regulate "new motor vehicles" and their engines,<sup>2</sup> defined as "self-propelled" vehicles "the equitable or legal title to which has never been transferred to the ultimate purchaser"—not non-motorized frames, cabs, and axles. CAA §§ 203(a), 216(3). In turn, any regulation of glider kits is beyond the agency's authority. Further, glider vehicles, when constructed retain the identity of the donor vehicle, such that the title has already been exchanged, making the vehicles not "new" under the CAA. So the EPA may not regulate them either. And even if the EPA had authority to regulate, the CAA requires 4-years' lead-time for new or revised NOx and PM requirements and for regulations governing engine rebuilding practices, which has not been met under the proposed regulations. [EPA-HQ-OAR-2014-0827-1164-A1 p.121-122]

· **Proposed Definitions of 'Glider Kit' and 'Glider Vehicle'** - EPA has proposed two overlapping and potentially confusing definitions: "Glider kit means any of the following: (1) A new vehicle that is incomplete because it lacks an engine, transmission, or axle; (2) A new vehicle produced with a used engine (including a rebuilt or remanufactured engine); (3) Any other new equipment that is intended to become a motor vehicle with a previously used engine (including a rebuilt or remanufactured engine)";

and “Glider vehicle means a new vehicle produced with a used engine.” As EPA has proposed these definitions, “glider vehicle” is a subset of “glider kit,” whereas under industry usage and understanding, the two are separate, and should remain so under the regulations. A “glider kit” should instead be defined as “an assemblage of new vehicle components, including at a minimum the chassis, cab and front axle, but lacking an engine, transmission, and rear axle.” Once the glider kit is used to rebuild a truck, EPA would consider it a “glider vehicle.” The EPA-proposed definitions are confusing because they conflate the two, which are typically sold by separate businesses. DTNA manufactures and sells glider kits, while most glider assemblers sell glider vehicles but do not manufacture glider kits. The third part of the proposed “glider kit” definition is simply too broad and vague to be workable: “Any other new equipment that is intended to become a motor vehicle with a previously used engine (including a rebuilt or remanufactured engine)” could potentially encompass any number of vehicle parts. Any other assemblages of parts that EPA considers to be “new equipment that is intended to become a motor vehicle” could potentially be regulated as a glider kit, down to the wiring that constitutes a single headlight, or the glass and metal parts that together comprise a side mirror. This part of the proposed definition should be deleted. [EPA-HQ-OAR-2014-0827-1164-A1 p.122]

· **EPA Lacks Authority to Regulate 'Glider Kits'** - The distinction between “glider kits” and “glider vehicles” is important because EPA lacks authority to regulate vehicle parts, including assemblages of parts (without an engine) such as glider kits. EPA’s Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act (“CAA”), and the CAA does not provide EPA authority to regulate the sale of motor vehicle components, which is all that glider kits are. The CAA only authorizes EPA to prohibit the sale of uncertified “new motor vehicles” and “new motor vehicle engines.” See 42 U.S.C. § 7522(a)(1). “New motor vehicles” are defined under the CAA as “self-propelled” vehicles “the equitable or legal title to which has never been transferred to an ultimate purchaser”—not non-motorized frames, cabs, and axles. 42 U.S.C. § 7550(2), (3). Because glider kits do not contain engines, and have no motive power, the CAA does not authorize EPA to regulate the sale of glider kits. [EPA-HQ-OAR-2014-0827-1164-A1 p.122-123] [This comment can also be found in section 1.3.1 of this comment document]

· **Regulation of 'Glider Vehicles' Targets NO<sub>x</sub> / PM Emissions and Must Meet Statutory Lead Time Requirement** - In addition, the proposed regulation of “glider vehicles” actually targets NO<sub>x</sub>/PM emissions rather than GHG emissions, as EPA concedes, and is therefore inappropriate for inclusion in a GHG rule. Glider sales actually create the potential to reduce GHG emissions by incorporating used and rebuilt engines in newer, more aerodynamic vehicles. Rebuilt engines used in glider vehicles emit fewer GHGs, and new cabs and low rolling resistance tires are more efficient than what they replace. Because regulation of glider vehicles targets NO<sub>x</sub>/PM emissions, it should be done only in a separate rulemaking, if at all. [EPA-HQ-OAR-2014-0827-1164-A1 p.123] [This comment can also be found in section 1.3.1 of this comment document]

In addition, this separate rulemaking should be carefully drafted to meet statutory lead-time requirements for NO<sub>x</sub> and PM regulations as required by statute. NO<sub>x</sub> and PM emissions standards are subject to an express CAA lead-time requirement under which new or revised NO<sub>x</sub> and PM requirements cannot take effect sooner than the model year commencing 4 years after new or revised standard is promulgated. 42 U.S.C. § 7521(a)(3)(C). As currently proposed, with an effective date of January 1, 2018, the proposed glider regulations violate the 4- year lead-time requirement under the CAA. Assuming the Phase 2 rule is finalized in early 2016, the earliest that the regulations governing glider vehicles could take effect would be 2020, in compliance with the CAA lead-time requirement. [EPA-HQ-OAR-2014-0827-1164-A1 p.123] [This comment can also be found in section 1.3.1 of this comment document]

For its proposed glider provisions, EPA purports to rely on its authority to regulate the “practice of rebuilding heavy-duty engines.” 42 U.S.C. § 7521(a)(3)(D). However, EPA is not regulating engine rebuilding practices, as evidenced by the lack of relevant proposed amendments to its engine rebuilding regulations (40 C.F.R. §§ 86.004-40, 1068.120). Instead, EPA is attempting to regulate vehicle rebuilding, which it clearly does not have the authority to do under the CAA. Congress granted EPA authority to regulate “new motor vehicles” and “new motor vehicle engines” only, and while Congress granted EPA authority to regulate engine rebuilding, it did not grant EPA similar authority to regulate vehicle rebuilding. EPA’s reliance on (3)(D) is misplaced with respect to its proposed regulation of glider vehicles.[EPA-HQ-OAR-2014-0827-1164-A1 p.123] [This comment can also be found in section 1.3.1 of this comment document]

Even if EPA were properly regulating heavy-duty engine rebuilding practices with its proposed glider provisions, it would be subject to the same four-year statutory lead-time requirement. The four-year lead-time and three-year stability requirements of 42 U.S.C. § 7521(a)(3)(C) are applicable to all of paragraph 3, which includes the engine rebuilding provision contained in (3)(D). It is not enough for EPA to opine that the January 1, 2018 implementation date for the glider provisions allows “sufficient time to ‘permit the development and application of the requisite control measures’” under 42 U.S.C. § 7521(a)(3)(D). The four-year lead-time and three-year stability requirements of (3)(C) provide an absolute minimum, even for engine rebuilding regulations, and then EPA must determine whether additional time is required above and beyond that based on its determination under the standard contained in (3)(D). [EPA- HQ-OAR-2014-0827-1164-A1 p.123] [This comment can also be found in section 1.3.1 of this comment document]

· **Additional Considerations with Glider Provisions** - Although EPA states that it considered impacts on small businesses in drafting the Phase 2 Proposed Rule, the glider provisions particularly impact small businesses and it is not clear that EPA fully considered the consequences the proposed regulations will have or how they could be minimized. As EPA notes, the Small Business Advocacy Review Panel process—which EPA undertook to meet its legal requirements under the Regulatory Flexibility Act and Small Business Regulatory Enforcement Fairness Act—included only one glider assembler. As a result of this oversight, if EPA moves forward with regulation of glider vehicles in its Phase 2 rule, which would not be appropriate under the CAA, there are a number of additional ways that the proposal should be modified to mitigate the impacts of any glider regulation on small businesses, jobs, and the economy in general. [EPA-HQ-OAR-2014-0827-1164-A1 p.124]

· **'Glider Vehicle' Exemption Cap** - EPA has proposed that small manufacturers would be eligible for an exemption from EPA’s proposed glider vehicle certification requirements under 40 C.F.R. § 1037.635 that would allow them to continue selling a limited number of glider vehicles. This cap would be based on the manufacturer’s highest annual sales volume for calendar years 2010 through 2014 up to a maximum of 300 exempt glider vehicles. A cap of 300 vehicles is too low given the abrupt change this regulation brings to the 50-year-old glider industry and the disproportionate impact it will have on small businesses. A more reasonable approach would be to begin with a higher initial cap and gradually reduce it over time to allow large and small businesses in the glider industry to adapt to EPA’s new requirements. Specifically, if EPA decides to implement a certification requirement for glider vehicles, the small business exemption should start with a cap of 1,500 vehicles in 2020 (complying with the statutory lead-time requirement) and then reduce the cap by 250 each year for the next 3 years to 1,250 in 2021, to 1,000 in 2022, and finally to 750 vehicles in 2023. Such a phase-down would allow these small manufacturers to transition to other lines of business and to move their employees to other types of work without extensive layoffs. Many small manufacturers will already be limited by their highest annual sales volume and will not be affected by the cap, while for those that are, the initial 1,500 vehicle cap and subsequent phase-down represents a substantial reduction. The adjustment of the cap

applicable to glider assemblers, coupled with the additional lead-time required under the CAA, is also critical to saving as many as 1,000 jobs at Detroit Reman, where a substantial portion of the business is driven by glider kit sales. [EPA-HQ-OAR-2014-0827-1164-A1 p.124]

**Applicability to Engine Model Years** - As EPA recognizes, “the environmental impacts of gliders using 2010 and later engines would be much smaller,” and as a result, EPA’s proposed regulations should govern glider vehicles using pre-2010 engines only. As stated above, EPA’s glider regulation is intended to address NOx and PM emissions, which are primarily a concern with pre-2010 engines rather than 2010 and later engines. Based on engine core availability, glider vehicles using pre-2010 engines will naturally decrease over time. While 2010 and later engines are not currently being used in glider vehicles in large numbers, their future use would enable many of the benefits to the U.S. economy from glider kit usage to continue, without the potential environmental impacts associated with the use of pre-2010 engines. EPA should incentivize, rather than limit, the rebuilding and reuse of 2010 and later engines in glider vehicles because such use would generate all of the benefits of rebuilding the engines and installing them in newer, more aerodynamic vehicles detailed above, including using 85% less energy than manufacturing the engines new, without the potential drawbacks of higher NOx and PM emissions. In the Phase 2 Proposed Rule, EPA proposes a requirement that glider vehicles incorporate engines certified to meet standards applicable for the engine model year corresponding to the vehicle’s date of assembly but allows that earlier model year engines may be used “if the standards were identical.” 40 C.F.R. § 1037.635. EPA does not offer a definition of “identical standards,” which creates uncertainty. For example, new on-board diagnostics (“OBD”) requirements may be introduced in a model year where otherwise emissions standards remained the same. It is unclear whether, under EPA’s proposed regulations, an earlier model year engine could be used in a glider vehicle assembled in a year when new OBD requirements are in effect. EPA should instead allow the use of any 2010 or later engine in a glider vehicle, or at a minimum, define what it means by “identical standards.” Although EPA recognizes that “salvaging powertrains from vehicles otherwise destroyed in accidents” is a “legitimate” purpose for producing glider vehicles, its requirement that glider vehicles incorporate engines certified to meet standards applicable for the engine model year corresponding to the vehicle’s date of assembly could prevent this “legitimate” purpose from being met. As one example, under EPA’s proposal, a new truck built to meet current emission standards and purchased in December that is then wrecked in February of the next year when new engine standards took effect, would require a brand-new engine due to the new engine standards, even though the salvageable engine was only a few months old. On a larger scale, if a fleet of more than 300 vehicles becomes wrecked—for example, in a flood—but the engines are salvageable, EPA should not prevent a company, no matter its size, from restoring the vehicles to service cost-effectively with glider kits and remanufacturing processes. EPA should provide sufficient exemptions for “legitimate” rebuilds of wrecked vehicles. [EPA-HQ-OAR-2014-0827-1164-A1 p.124-125]

**Eligibility for Small Manufacturer Exemption** - EPA has proposed that only those small businesses that sold glider vehicles in 2014 (under the provisions of 40 C.F.R. § 1037.150(j)) are eligible for the exemption under 40 C.F.R. § 1037.635 that would allow them to continue selling a limited number of glider vehicles. This is too narrow a window for sales and associated exemption eligibility, and ignores business practices common to the industry. While some glider assemblers sell glider vehicles each year, others may not, depending on the extent of their glider assembly operations and their customers’ demands. Some fleets order a few glider vehicles every year while others order every other year or every few years. In addition, due to delays associated with manufacturing and assembly, a customer might order a glider kit and not receive it for 12 months or more, with vehicle assembly taking additional time. As a result, EPA’s current proposal unfairly penalizes those small businesses that did not sell gliders in 2014, but might have sold them in 2013 or 2015. Instead, EPA should allow small businesses that sold any glider vehicles in the calendar year 2010-2014 time period to be eligible for the exemption up to the highest annual sales volume from those years. This

modification would still have the effect of preventing new market entrants (in 2015 and later), thereby limiting future glider vehicle production as EPA intends with its proposal, but not unfairly put a company out of business in year one simply because it did not sell a glider vehicle in 2014. [EPA-HQ-OAR-2014-0827-1164-A1 p.125-126]

**NHTSA Exemption** - DTNA supports NHTSA's current proposal to maintain its existing regulations with respect to glider kits and glider vehicles, under which NHTSA does not consider glider kits to be motor vehicles, and not to include gliders under its Phase 2 program. Since at least 1975, NHTSA has recognized that "use of a new 'glider kit' ["typically a cab, frame rails, and front suspension"] in combination with the valuable components from an existing vehicle" is "common practice" in the industry. 40 Fed. Reg. 19,485 (proposed May 5, 1975). In response to this common industry practice, NHTSA finalized a regulatory provision clarifying what it does and does not consider to be a "new vehicle," striking an appropriate balance between common-sense, cost-effective reuse of vehicle components and the need for adequate safety regulation of new vehicles. 40 Fed. Reg. 49,340 (Oct. 22, 1975). Under its regulations, NHTSA considers a truck to be "newly manufactured" and subject to Federal Motor Vehicle Safety Standards when a new cab is used in its assembly, "unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle." 49 C.F.R. § 571.7(e) (emphasis added). DTNA supports the continuation of this long-standing regulatory provision. To the extent that NHTSA has concerns about compliance, it should issue guidance and engage in outreach to glider assemblers rather than revising its regulations. Further, NHTSA should not pursue inclusion of gliders under its Phase 2 program. [EPA-HQ-OAR-2014-0827-1164-A1 p.125]

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2 The CAA does authorize the EPA to regulate engine rebuilding practices, so in that limited respect the agency can regulate non-new products. But engine rebuilding is not at issue here. Moreover, given that Congress authorized regulation of engine rebuilding and could have similarly authorized vehicle rebuilding but did not, Congress made clear its intent not to authorize regulation of vehicle rebuilding.

**Organization:** Diesel 2 Gas, Inc.

Proposed EPA Glider Rule Detrimental To Lowering Heavy Duty Trucks Emissions [EPA-HQ-OAR-2014-0827-1198 p.1]

Glider Kit Trucks are the only means by which hundreds of thousands of Class 8 Trucks can have access to natural gas as an engine fuel. Several EPA approved dual fuel conversion systems are currently being applied to heavy duty engines 2009 and older allowing trucks to operate with up to 60% natural gas. [EPA-HQ-OAR-2014-0827-1198 p.1]

Modern 2010 and newer Class 8 Truck engines cannot be converted efficiently to dual fuel mode with any known technology. The electronics associated with these modern engines makes adaptation of dual fuel conversions not achievable in the foreseeable future. [EPA-HQ-OAR-2014-0827-1198 p.1]

Dedicated gas fired engines fail to meet the operating requirements of U.S. Class 8 Truck fleets in many operating applications. The lower horsepower and torque, lower efficiency and range limitations of dedicated gas engines prohibit many fleets from using them in their operating applications. Trucks carrying heavy loads and trucks operating in mountainous terrains cannot use the gas fired engines. [EPA-HQ-OAR-2014-0827-1198 p.1]

Without the availability of dual fuel conversion systems, these trucking applications cannot use natural gas as an engine fuel and will continue to be limited to diesel as a fuel. Operators of these trucks rebuild old engines of their old trucks that are less energy efficient than that of new Glider models. The effects of this rule change will stop the progress of natural gas use in these trucking applications. [EPA-HQ-OAR-2014-0827-1198 p.2]

The effect of this rule change will have a detrimental effect on the development of dual fuel technologies for Class 8 Trucks. Dual Fuel technologies have not been embraced by heavy duty engine OEMs. Therefore the current EPA approved dual fuel technologies have been developed by small and midsized and mostly U.S. companies. Owners of older trucks find it difficult to justify the expense of converting their depreciated older trucks to dual fuel. Gliders have provided the best platform to deploy these dual fuel systems allowing U.S. dual fuel manufactures to lead the world in heavy duty dual fuel technologies. 'Dual Fuel Gliders' have allowed these U.S. companies to continue prove and improve their technologies in the field. These sales provide resources for these companies to work on finding technology improvements that may lead to the eventual conversion of modern heavy duty engines. Without Gliders many of these technologies will fail to advance into reaching new post 2010 engines. [EPA-HQ-OAR-2014-0827-1198 p.2]

Without Gliders many of the current U.S. manufacturers of dual fuel conversion systems will fail. This will give foreign companies an advantage in deploying their own inferior dual fuel technologies overseas in countries where trucks are not required meet EPA standards. The effect of the proposed rule will have a detrimental effect on U.S. companies leading the world in availing natural gas as a means to lower the emissions of heavy duty engines. This rule will have a chilling effect on lowering U.S. and global emissions from heavy duty truck engines. [EPA-HQ-OAR-2014-0827-1198 p.2]

EPA's own previous rulings in 2011 state the beneficial environmental impact of dual fuel aftermarket conversion systems in many Class 8 Truck applications. The proposed rule is in conflict with EPA's previous ruling. [EPA-HQ-OAR-2014-0827-1198 p.2]

**Organization:** E-ONE

E-ONE would like to take this opportunity to comment on the proposed Phase 2 of the Heavy Duty Greenhouse Gas rule 40 CFR 1037. More specifically E-ONE would like to comment on the proposal that gliders will be required to meet current emission standards for the year in which they are produced. [EPA-HQ-OAR-2014-0827-1185-A1 p.1]

Gliders are an important product in the emergency vehicle industry. An emergency vehicle, while critical to saving lives in the event of an emergency; typically does not drive very many miles over the lifetime of the vehicle. The industry standard of the lifetime of an emergency vehicle is 10 to 20 years in which an emergency vehicle may only have traveled 10-50,000 miles, although it is not uncommon for an emergency vehicle of 30+ years of service to have the same amount of miles. E-ONE has found that the durability of engines in class 8 emergency vehicles far surpass the longevity of the chassis that they power, this can be attributed to the extreme environment that these vehicles have to endure. Having the ability to purchase a glider allows municipalities with limited financial resources capable of maintain a fleet that is required to save lives. [EPA-HQ-OAR-2014-0827-1185-A1 p.1]

E-ONE's stance is that it would be advantageous to allow gliders, given that the donor engine is still within its useful life based on mileage but not based on age. Doing so will allow the EPA to limit the amount of gliders produced enough to make a significant difference in the emissions of heavy duty

vehicles while still creating a standard that requires vehicles over time to continually increase in emission standards. [EPA-HQ-OAR-2014-0827-1185-A1 p.1]

With ever changing technology and the need for increased safety and efficiency of fire protection it can become a challenge for a community to determine when to replace a piece of fire apparatus. There is a large financial burden to a community when a new fire apparatus is purchased. This being said, every option needs to be explored to make the best financial decision for the community. While many large communities have a replacement program in place for their apparatus where the impact of this cost can be spread out, many smaller communities do not. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

In our service shops we offer a glider kit program to extend the life of a fire truck for communities with limited budgets. Fire trucks are historically extremely low mileage with many units as old as 10, 15 and 20 years with 10,000, 25,000 and 50,000 miles. The diesel engines and transmissions used in the fire service are designed to perform for a minimum of 300,000 to 1,000,000 miles. This gives the communities fire departments the ability to reuse these components, extending the life of the apparatus. This thus gives them the ability to increase the safety and efficiency of the apparatus while reducing the financial impact. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

Glider kits provide a new cab and chassis with the option to reuse the engine, transmission, axles, fire pumps and apparatus bodies or any combinations of these components (components that have considerable useful life remaining). This gives the small community department a piece of apparatus that will provide several years of additional service without the cost of a new apparatus. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

If the ability to 'glider' fire apparatus is prohibited it will have a serious impact on many communities and their fire departments across the country. When departments cannot afford to purchase new fire apparatus their only option is to repair or refurbish their existing apparatus. Most fire departments across the country are volunteer with limited budgets and sometimes purchase only one new truck and strive to maintain that unit for as long as possible. We need to give these communities as many options as possible. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

I believe it would be a financial burden for many of these departments. With only one or two trucks and no other options, most would have to disband and close for lack of funds to support new apparatus. This could seriously affect the personal safety of lives in those communities. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

I have attached some letters for existing fire department so you can see firsthand their financial situation. [EPA-HQ-OAR-2014-0827-1253-A1 p.1]

**Organization:** Environmental Defense Fund (EDF)

### **EDF supports closing the loophole for dirty glider kits**

EDF fully supports EPA's proposal to establish GHG and criteria emissions standards for engines in glider kits and NHTSA's proposal to include glider kits under its Phase 2 standards. These provisions are important to close the current loophole for glider kit manufacturers – which currently allows an older dirtier engine to be installed in a new body and certified as a new vehicle. EPA estimates significant growth in glider kit production.<sup>74</sup> And glider vehicles using pre-2007 engines have in-use NOx and PM emissions tenfold the emissions from equivalent vehicles being produced with new



engines. This combination could result in a significant increase in criteria emissions from in-use trucks if the current loophole is not addressed. [EPA-HQ-OAR-2014-0827-1312-A1 p.16]

The proposal does not limit the use of glider kits or rebuilt engines – it simply requires that engines be certified to the same standards (for both GHG and criteria standards) as apply for the calendar year of the glider vehicle assembly. As noted in the Preamble, there has been adequate time for glider manufacturers to transition to a compliance regime. And the agencies have determined that removing the exemption for these glider vehicles will be cost-effective. The agencies should finalize these important provisions to level the playing field and bring glider kits in line with all new truck standards. [EPA-HQ-OAR-2014-0827-1312-A1 p.16]

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74 80 Fed. Reg. (July 13, 2015) Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2: Proposed Rule at 40529. (Hereinafter “Preamble”).

**Organization:** Fitzgerald Truck Sales

*Fitzgerald Truck Sales* appreciates the opportunity to submit its comments on the Phase 2 Proposed Rule. In section I we speak to the underestimated and under investigated economic impact to small businesses and misconceptions about gliders and their part in a “Green” environment. In section II we see some key elements making gliders part of this Phase 2 proposal, in our opinion, lacking a comprehensive investigation and frankly confronting some legal challenges. [EPA-HQ-OAR-2014-0827-1134-A1 p.1]

EPA and NHTSA have specifically requested comment on their proposed regulation of “gliders” as part of the Phase 2 Proposed Rule. As used in the industry, a “glider kit” is a new cab, front axle, and frame rail/chassis that uses existing or rebuilt drivetrain components (engine, transmission, and rear axle) to repair or extend the life of a used truck. Fitzgerald Truck Sales rebuilds tractors using these OE supplied glider kits, and has been building kits since 1989. Rebuilding tractors with glider kits drives a significant volume and business to local economies especially in the smaller communities of Tennessee, like Byrdstown, Crossville and Jamestown. [EPA-HQ-OAR-2014-0827-1134-A1 p.1]

**Glider History and its Economies** - Glider kits have been around for almost 50 years and are used for a number of reasons. Gliders are less expensive than new trucks and offer a more economical option for smaller fleets and owner/operators to maintain the reliability of their commercial trucking operations. The reused drivetrain components constitute approximately 30-50% of the value of a new truck, which generates significant cost savings for small businesses and owner-operators. Rebuilding an engine and transmission uses 85% less energy than manufacturing them new, and results in engines and transmissions that are more reliable and efficient than pre-rebuild. With improved aerodynamics and low rolling resistance tires on trucks assembled from glider kits, these rebuilt vehicles actually have better fuel efficiency than when they were new. The engines most commonly used in gliders actually have better fuel economy and greenhouse gas (“GHG”) emissions than today’s ultra-low NO<sub>x</sub> engines (pre-EGR EPA98 S60s). Wrecked or otherwise damaged trucks can be put back on the road economically by placing the undamaged powertrain components in a new cab/chassis. In addition to the use of glider kits for rebuilds, many CNG fleet operators prefer to buy glider kits and power them themselves, often recycling the fuel system or saving money on CNG system installation. Hundreds of small businesses have come to rely on gliders over the past 50 years as a cost-effective way of doing business. These businesses include glider distributors, glider assemblers, small fleets, owner/operators, and other small businesses in the commercial trucking industry. [EPA-HQ-OAR-2014-0827-1134-A1 p.1-2]

### **Additional Considerations with Glider Provisions**

Although EPA states that it considered impacts on small businesses in drafting the Phase 2 Proposed Rule, the glider provisions particularly impact small businesses and it is not clear that EPA fully considered the consequences the proposed regulations will have or how they could be minimized. As EPA notes, the Small Business Advocacy Review Panel process—which EPA undertook to meet its legal requirements under the Regulatory Flexibility Act and Small Business Regulatory Enforcement Fairness Act—included only one glider assembler. As a result of this oversight, there are a number of additional ways that the proposal should be modified to mitigate the impacts of any glider regulation on small businesses, jobs, and the economy in general. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]

### **Economic Impacts**

- Gliders as a whole represent over 10,000 units annually. While this is insignificant as compared to new trucks sold it does support a very significant number of jobs both locally and nationwide. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- Fitzgerald Employs 285 employees locally, predominately in areas historically economically challenged in recent years. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- Fitzgerald supports 137 vendor/suppliers not including the OEM's and their downstream support. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- The end user of Gliders is the smaller business owner and employer who may not be economically competitive and is definitely at risk if such rulings were to attempt to force them to rely solely on new equipment. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- The independent truckers buying one or a few gliders does not have the purchasing power to buy new trucks at the same acquisition costs as a large fleet placing them at a disadvantage. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- Beyond Fitzgerald, the Supporting OEM's like Daimler (DTNA) and Peterbilt and Kenworth (PACCAR), employ hundreds of men and women in the creation, support and manufacture of the base Glider chassis. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]
- Detroit Diesel, is the largest supplier of rebuilt engines and engine parts in support of gliders and maintains an entire manufacturing facility in Ohio that would be devastated by the current proposal. [EPA-HQ-OAR-2014-0827-1134-A1 p.2]

### **“Glider Vehicle” Exemption Cap**

EPA has proposed that small manufacturers would be eligible for an exemption from EPA's proposed glider vehicle certification requirements under 40 C.F.R. § 1037.635 that would allow them to continue selling a limited number of glider vehicles. This cap would be based on the manufacturer's highest annual sales volume for calendar years 2010 through 2014 up to a maximum of 300 exempt glider vehicles. A cap of 300 vehicles is too low given the abrupt change this regulation brings to the 50-year-old glider industry and the disproportionate impact it will have on small businesses. A more reasonable approach would be to begin with a higher initial cap and gradually reduce it over time to allow large and small businesses in the glider industry to adapt to EPA's new requirements. Specifically, if EPA decides to implement a certification requirement for glider vehicles, the small business exemption should start with a cap equal to the 2015 sales levels of vehicles in 2020 (complying with the statutory lead-time requirement) and then reduce the cap annually in levels that give business time to adjust. Such a phase-down would allow these small manufacturers to transition to other lines of business and to move their employees to other types of work without extensive layoffs. Many small manufacturers will already be limited by their highest annual sales volume and will not be affected by the cap. The adjustment of the cap applicable to glider assemblers, coupled with the additional lead-time required

under the CAA, is also critical to saving literally thousands of jobs. [EPA-HQ-OAR-2014-0827-1134-A1 p.3]

### **Legal Issues with Glider Provisions**

We are not alone in our concerns with EPA's proposed regulation of "glider kits" and "glider vehicles," including EPA's legal authority for regulating "glider kits." EPA's Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act ("CAA"), which does not provide EPA authority to regulate the sale of motor vehicle components. Moreover, the CAA requires 4-years' lead-time for new or revised NO<sub>x</sub> and PM requirements, which has not been met under the proposed regulations. [EPA-HQ-OAR-2014-0827-1134-A1 p.3]

### **Proposed Definitions of "Glider Kit" and "Glider Vehicle"**

EPA has proposed two overlapping and potentially confusing definitions: "*Glider kit* means any of the following: (1) A new vehicle that is incomplete because it lacks an engine, transmission, or axle; (2) A new vehicle produced with a used engine (including a rebuilt or remanufactured engine); (3) Any other new equipment that is intended to become a motor vehicle with a previously used engine (including a rebuilt or remanufactured engine)"; and "*Glider vehicle* means a new vehicle produced with a used engine." As EPA has proposed these definitions, "glider vehicle" is a subset of "glider kit," whereas under industry usage and understanding, the two are separate, and should remain so under the regulations. [EPA-HQ-OAR-2014-0827-1134-A1 p.3]

A "glider kit" should instead be defined as "an assemblage of new vehicle components, including at a minimum the chassis, cab and front axle, but lacking an engine, transmission, and rear axle." Once the glider kit is assembled using existing or rebuilt drivetrain components (engine, transmission, and rear axle), then it becomes a rebuilt truck, which EPA would consider a "glider vehicle." The EPA-proposed definitions are confusing because they conflate the two, which are typically sold by separate businesses. DTNA sells glider kits but not glider vehicles, while most glider assemblers sell glider vehicles but do not manufacture glider kits. The third part of the proposed "glider kit" definition is simply too broad and vague to be workable: "Any other new equipment that is intended to become a motor vehicle with a previously used engine (including a rebuilt or remanufactured engine)" could potentially encompass a single headlight or side mirror as a "glider kit." This part of the proposed definition should be deleted. [EPA-HQ-OAR-2014-0827-1134-A1 p.3-4]

### **Regulation of "Glider Vehicles" Targets NO<sub>x</sub>/PM Emissions and Must Meet Statutory Lead-Time Requirement**

In addition, the proposed regulation of "glider vehicles" actually targets NO<sub>x</sub>/PM emissions rather than GHG emissions, as EPA concedes, and is therefore inappropriate for inclusion in a GHG rule. Glider sales actually create the potential to reduce GHG emissions by incorporating used and rebuilt engines in newer, more aerodynamic vehicles. Rebuilt engines used in glider vehicles emit fewer GHGs, and new cabs and low rolling resistance tires are more efficient than what they replace. Because regulation of glider vehicles targets NO<sub>x</sub>/PM emissions, it should be done only in a separate rulemaking, if at all. In addition, this separate rulemaking should be carefully drafted to meet statutory lead-time requirements for NO<sub>x</sub> and PM regulations as required by statute. NO<sub>x</sub> and PM emissions standards are subject to an express CAA lead-time requirement under which new or revised NO<sub>x</sub> and PM requirements cannot take effect sooner than the model year commencing 4 years after new or revised standard is promulgated. 42 U.S.C. § 7521(3)(C). As currently proposed with an effective date of January 1, 2018, the proposed glider regulations violate the 4-year lead-time requirement under the CAA. Assuming the Phase 2 rule

is finalized in early 2016, the earliest that the regulations governing glider vehicles could take effect would be 2020, in compliance with the CAA lead-time requirement. As currently proposed, EPA is attempting to regulate NO<sub>x</sub> and PM in the GHG rule in a way it could not undertake in a proper NO<sub>x</sub> and PM rulemaking. [EPA-HQ-OAR-2014-0827-1134-A1 p.4]

**Organization:** GATR Truck Center

GATR Truck Center strongly supports the agencies' proposal to impose new requirements on companies assembling and offering for sale vehicles produced by installing used driveline components into new glider kits. EPA and NHTSA should require that manufacturers of these glider-based vehicles comply with all applicable and current greenhouse gas and criteria emissions standards. NHTSA should also enforce the existing regulations that require manufacturers of glider-based vehicles to comply with all applicable safety standards. [EPA-HQ-OAR-2014-0827-1010-A2 p.1]

Dealers such as ours have been subject to a growing unfair competition from this rapidly expanding market of non-compliant vehicles. Over the past few years, an increasing number of our customers have purchased these non-compliant glider vehicles at prices that are 25% less than our comparable new compliant trucks. [EPA-HQ-OAR-2014-0827-1010-A2 p.2]

GATR Truck Center supports the application of glider kits as a means to repair badly damaged vehicles, while taking advantage of the remaining useful life in the damaged vehicle's driveline components. When conducted within the requirements of 49 CFR 571.7(e), which sets forth NHTSA's rules for re-use of driveline components for installation into a glider kit, we have no specific concerns with such legitimate applications of glider kits. It's when these rules are violated, however, in an effort to offer for sale an essentially new vehicle whose production costs and total cost of ownership may be tens of thousands of dollars less than the fully compliant new products sold by our dealership that we strongly object to such an unfair disruption of market competition. Unfortunately, this practice has become widespread without consequence to the glider-based vehicle manufacturers, and it is unfairly and negatively impacting our business. In many cases, the manufacturers of glider-based vehicles are not collecting the 12% federal excise tax ('FET') that normally applies to new vehicle sales, giving customers even further financial incentive to purchase glider vehicles rather than fully compliant new vehicles. This abusive application of glider kits must be stopped; we strongly support the agencies' efforts to do so through appropriate new regulations and enforcement of existing regulations. EPA and NHTSA should seek to remedy this situation as soon as practicable, while protecting for the continued use of glider kits for legitimate purposes as we have described. [EPA-HQ-OAR-2014-0827-1010-A2 p.2]

We refer you to the comments of the Volvo Group North America for a more complete analysis and set of recommendations with respect to the regulation and enforcement of glider-based vehicles. GATR Truck Center supports the comments submitted by Volvo Group North America. [EPA-HQ-OAR-2014-0827-1010-A2 p.2]

The rapidly expanding glider-based vehicle market is seriously undermining the significant gains EPA, NHTSA, and the heavy-duty vehicle industry have made to reduce criteria and greenhouse gas emissions, reduce fuel consumption, and improve roadway safety. The market availability of these non-compliant engines and vehicles poses an unfair competitive disadvantage to manufacturers that have undertaken the enormous effort and investment necessary to comply with all applicable emissions, fuel efficiency, and safety standards, and likewise an unfair competitive advantage to the dealer network representing those OEM's. It is therefore imperative that the agencies follow through by finalizing regulations that prohibit the production of glider-based vehicles for anything other than legitimate

purposes, and that the agencies actively ensure compliance to those requirements. [EPA-HQ-OAR-2014-0827-1010-A2 p.2]

**Organization:** Harrison Truck Centers

EPA and NHTSA have specifically requested comment on their proposed regulation of “gliders” as part of the Phase 2 Proposed Rule. As used in the industry, a “glider kit” is a new cab, front axle, and frame rail/chassis that uses existing or rebuilt drivetrain components (engine, transmission, and rear axle) to repair or extend the life of a used truck. Harrison Truck Centers rebuilds tractors using these glider kits, and has for over fifteen years. Rebuilding tractors with gliders kits drive a significant volume and business to our area. [NHTSA-2014-0132-0059-A1 p.1]

Glider kits have been around for almost 50 years and are used for a number of reasons. Gliders are less expensive than new trucks and offer a more economical option for smaller fleets and owner/operators to maintain the reliability of their commercial trucking operations. The reused drivetrain components constitute approximately 30-50% of the value of a new truck, which generates significant cost savings for small businesses and owner-operators. Remanufacturing an engine and transmission uses 85% less energy than manufacturing them new, and results in engines and transmissions that are more reliable and efficient than pre-rebuild. With improved aerodynamics and low rolling resistance tires on trucks assembled from glider kits, these rebuilt vehicles actually have better fuel efficiency than when they were new. The engines most commonly used in gliders actually have better fuel economy and greenhouse gas (“GHG”) emissions than today’s ultra-low NOX engines (pre-EGR EPA98 S60s). Wrecked or otherwise damaged trucks can be put back on the road economically by placing the undamaged powertrain components in a new cab/chassis. In addition to the use of glider kits for rebuilds, many CNG fleet operators prefer to buy glider kits and power them themselves, often recycling the fuel system or saving money on CNG system installation. Hundreds of small businesses have come to rely on gliders over the past 50 years as a cost-effective way of doing business. These businesses include glider distributors, glider assemblers, small fleets, owner/operators, and other small businesses in the commercial trucking industry. [NHTSA-2014-0132-0059-A1 p.1-2]

Harrison Truck Centers also repeated comments summarized above for Daimler.

**Organization:** International Council on Clean Transportation (ICCT)

### **Potential regulatory loophole**

The ICCT recommends that the agencies ensure there are no regulatory loopholes whereby increasing unforeseen numbers of trucks exploit regulatory exemptions to avoid deploying emission reduction and efficiency technology. The ICCT spends a considerable amount of time investigating gaps between policy objectives and their market outcomes. The U.S. exemption for gliders (i.e., “glider kits,” “gliders,” or “glider vehicles”) in the criteria pollutant heavy-duty vehicle regulations is among the more egregious and high-risk regulatory gaps. The glider kit provision that was previously used to assist in bringing hundreds of repaired vehicles per year is now creating an entirely new market with tens of thousands of sales per year, now with multiple suppliers competing in the space. This glider market is predicated upon reduced costs from vehicles that are not regulated and not certified through the full process that most modern tractors are. This is a clear distortion of the market and the exploitation of a regulatory provision that was not foreseen to be used in such a way. We recommend that the agencies’ include glider kit-manufactured vehicles within the greenhouse gas emission and efficiency regulations, as well as criteria pollutant emission regulations as soon as possible. Exemptions, if granted, would ideally be restricted to a number that is consistent with pre-emission-regulation glider production – on

the order of hundreds of units per year industry wide – and only those with legally or insurance-verified evidence of inoperably damaged tractor frames. [EPA-HQ-OAR-2014-0827-1180-A4 p.16]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **Heavy-Duty Glider Kits and Glider Vehicles**

MECA strongly supports the agency’s proposal to require that the engines installed in glider vehicles meet the same criteria and GHG emission requirements as new engines certified in the same model year. The recent rapid growth in the number of glider vehicles sold since 2007 to over 5,000 vehicles a year shows the large emissions impact that this category of high emitters has on the overall contribution of PM and NOx from heavy-duty engines. As new engines become cleaner in the future the contribution from glider vehicles will continue to grow. Glider vehicles are classified as “new motor vehicles” because they use a new chassis, although they can continue to use engines that are 10-15 years old and emit 20-40 times more pollution than vehicles equipped with a new engine. The existing exemption of glider vehicles from the latest pollution requirements represents a huge loophole in the regulation. Using this “new motor vehicle” designation under the clean air act, glider vehicles could potentially qualify for clean air incentive funding under some state in-use fleet programs while not meeting the intent or emission reduction goals of those programs. Glider vehicles, equipped with old diesel engines, or converted to alternative fuels could potentially compete for funding with newly manufactured trucks, replacement engines or retrofit emission control devices. The proposed glider kit and glider vehicle provision in this proposal takes an important step towards closing this loophole and MECA supports inclusion of this provision in the final regulation and moving the implementation date ahead of the proposed 2018 start date. There should be no “dirty diesel” loophole left in EPA’s regulatory programs. [EPA-HQ-OAR-2014-0827-1210-A3 p.12] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.212.]]

MECA is concerned that the present proposed limited grandfathering of glider vehicle production for existing small businesses would still allow the continued production of up to 300 assembled gliders a year, per company. This exemption poses a significant threat to air quality as 300 trucks could emit the same amount of NOx as 7500 new heavy duty trucks. EPA should include a phase-out of this glider loophole completely that reduces the 300 glider kit limit per small existing business over a course of three years after which full compliance is required. This should provide sufficient time for small businesses to adapt their business models to produce and maintain clean diesels. Retaining a 300 per year limit indefinitely could result in a disproportionate number of dirty vehicles to continue to be produced and remain in the fleet for decades to come. To minimize the opportunity to abuse this exemption, EPA might consider limiting the conditions under which a glider vehicle may be purchased to legitimate situations such as when a vehicle is damaged in an accident and the engine can be salvaged. Requirements should include record keeping guidelines to support legitimate transactions to purchase glider vehicles. [EPA-HQ-OAR-2014-0827-1210-A3 p.12]

**Organization:** Mississippi Furniture Xpress (MFX)

MFX, LLC is one of the companies who would be negatively impacted by passage of this ruling due to our purchasing of glider trucks. This ruling would not only impact our company, but also our 150 employees as well as the numerous connected businesses with whom we contract and provide services throughout the country. [EPA-HQ-OAR-2014-0827-1338-A1 p.1]

In the past EPA regulations have been imposed with no opportunity for discourse and their impact on business and the livelihoods of those affected often not given consideration. This represents one of the

many reasons that the citizens of this country are dissatisfied with government. I have worked in the trucking industry for over 30 years and have seen the advancements related to safety and emissions by the industry as a whole. The changes have been significant and positive; however, our industry faces a constant barrage of costly and restrictive regulations that threaten our operations so greatly, that we as business owners are deeply concerned that tighter regulations will be too costly, time consuming and burdensome to overcome. Pending regulations by FMCSA regarding ELD's is enough to ruin many small companies, much less adding more restrictive and burdensome EPA rules. [EPA-HQ-OAR-2014-0827-1338-A1 p.1]

We purchased used trucks when we began our company and nearly went bankrupt trying to keep them running due to all of the problems caused by EPA regulations on engines after 2007. Those problems continue to be devastating to companies who operate trucks with certain engines; the cost of repairs often exceeds 50% of the cost of the truck itself. Buying glider trucks absolutely saved us from going out of business due to repair costs for the used trucks we had purchased. Further regulations to these trucks feels like overreach and we're unaware of studies which show that the small percentage of glider trucks being sold have any appreciable impact on the environment, whereas they are most certainly having a positive economic effect for the people and businesses that choose to purchase them. [EPA-HQ-OAR-2014-0827-1338-A1 p.2]

Our current understanding is that the EPA does not have legal authority for regulation of glider kits. EPA's Phase 2 Proposed Rule is being carried out under the authority of the Clean Air Act ('CAA'), which does not provide EPA authority to regulate the sale of motor vehicle components. Moreover, the CAA requires 4-years' lead-time for new or revised NO<sub>x</sub> and PM requirements, which has not been met under the proposed regulations. EPA has been aware of the use of glider kits for over 35 years, and has not attempted to regulate them because they are not 'new motor vehicles' or 'new motor vehicle engines' under the CAA. As regulations by FMCSA have been repealed due to not having sufficient data to support their assertions, this proposed ruling by the EPA seems open to challenge on the same basis. [EPA-HQ-OAR-2014-0827-1338-A1 p.2]

Thank you for the opportunity to comment; however, we strongly oppose this proposed ruling and ask that it be abandoned due to the reasons cited. [EPA-HQ-OAR-2014-0827-1338-A1 p.2]

**Organization:** Mondial Automotive

EPA and NHTSA have specifically requested comment on their proposed regulation of 'gliders' as part of the Phase 2 Proposed Rule. *Mondial Automotive, Inc.* appreciates the opportunity to submit its comments on the Phase 2 Proposed Rule. As used in the industry, a 'glider kit' is a new cab, front axle, and frame rail/chassis that uses existing or rebuilt drivetrain components (engine, transmission, and rear axle) to repair or extend the life of a used truck. Mondial Automotive, Inc. is a downstream supplier of Original Equipment Parts and Components that are used in the production of 'glider kits'. The 'glider kit' industry drives a significant volume of business to local economies such as our community of College Point, NY. [EPA-HQ-OAR-2014-0827-1337-A1 p.1]

**Glider History and its Economies** - Glider kits have been around for almost 50 years and are used for a number of reasons. Gliders are less expensive than new trucks and offer a more economical option for smaller fleets and owner/operators to maintain the reliability of their commercial trucking operations. The reused drivetrain components constitute approximately 30-50% of the value of a new truck, which generates significant cost savings for small businesses and owner-operators. Rebuilding an engine and transmission uses 85% less energy than manufacturing them new. and results in engines and transmissions that are more reliable and efficient than pre-rebuild. With improved aerodynamics and low

rolling resistance tires on trucks assembled from glider kits, these rebuilt vehicles actually have better fuel efficiency than when they were new. The engines most commonly used in gliders actually have better fuel economy and greenhouse gas ('GHG') emissions than today's ultra-low NO<sub>x</sub> engines (pre-EGR EPA98 S60s). Wrecked or otherwise damaged trucks can be put back on the road economically by placing the undamaged powertrain components in a new cab/chassis. In addition to the use of glider kits for rebuilds, many CNG fleet operators prefer to buy glider kits and power them themselves, often recycling the fuel system or saving money on CNG system installation. Hundreds of small businesses have come to rely on gliders over the past 50 years as a cost-effective way of doing business. These businesses include glider distributors, glider assemblers, small fleets, owner/operators, and other small businesses in the commercial trucking industry. [EPA-HQ-OAR-2014-0827-1337-A1 p.1-2]

## **I. Additional Considerations with Glider Provisions**

Although EPA states that it considered impacts on small businesses in drafting the Phase 2 Proposed Rule, the glider provisions particularly impact small businesses and it is not clear that EPA fully considered the consequences the proposed regulations will have or how they could be minimized. As EPA notes, the Small Business Advocacy Review Panel process—which EPA undertook to meet its legal requirements under the Regulatory Flexibility Act and Small Business Regulatory Enforcement Fairness Act—included only one glider assembler. As a result of this oversight, there are a number of additional ways that the proposal should be modified to mitigate the impacts of any glider regulation on small businesses, jobs, and the economy in general. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]

### **A. Economic Impacts**

- Gliders as a whole represent over 10,000 units annually. While this is insignificant as compared to new trucks sold it does support a very significant number of jobs both locally and nationwide. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]
- Mondial Employs 47 employees locally, predominately in a minority populated urban area. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]
- The end user of Gliders is the smaller business owner and employer who may not be economically competitive and is definitely at risk if such rulings were to attempt to force them to rely solely on new equipment. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]
- The independent truckers buying one or a few gliders does not have the purchasing power to buy new trucks at the same acquisition costs as a large fleet placing them at a disadvantage. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]
- OEM's like Daimler (DTNA) and Peterbilt and Kenworth (PACCAR), employ hundreds of men and women in the creation, support and manufacture of the base Glider chassis. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]
- Detroit Diesel, is the largest supplier of rebuilt engines and engine parts in support of gliders and maintains an entire manufacturing facility in Ohio that would be devastated by the current proposal. [EPA-HQ-OAR-2014-0827-1337-A1 p.2]

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approach would be to begin with a higher initial cap and gradually reduce it over time to allow large and small businesses in the glider industry to adapt to EPA's new requirements. Specifically, if EPA decides to implement a certification requirement for glider vehicles, the small business exemption should start with a cap equal to the 2015 sales levels of vehicles in 2020 (complying with the statutory lead-time requirement) and then reduce the cap annually in levels that give business time to adjust. Such a phase-down would allow these small manufacturers to transition to other lines of business and to move their employees to other types of work without extensive layoffs. Many small manufacturers will already be limited by their highest annual sales volume and will not be affected by the cap. The adjustment of the cap applicable to glider assemblers, coupled with the additional lead-time required under the CAA, is also critical to saving literally thousands of jobs. [EPA-HQ-OAR-2014-0827-1337-A1 p.2-3]

In closing Gliders are a necessity to our national commerce. Catering to the smaller businesses and truckers who survive using gliders as a necessary tool to compete in their markets. Gliders are indeed 'Green' in respects to the re-use of components, and putting cleaner and safer vehicles than those replaced components and vehicles that would have been on the road otherwise. The EPA falls well short in any assumption that restricting gliders unreasonably will drive our customers to in essence 'NEW TRUCKS'. This is simply not the case. [EPA-HQ-OAR-2014-0827-1337-A1 p.3]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

#### **Reconsider Actions Impacting Remanufactured Engines** [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

In addition to representing original equipment suppliers, MEMA also represents remanufacturers and their suppliers. The proposed rule seeks to regulate non-new products under Phase 2, including gliders and remanufactured engines. There remains a legitimate need and purpose for glider kits and remanufactured engines and our members would like to support the reduction of potential objectionable uses of the standards. However, MEMA is concerned that the direction being proposed by the agency is swinging the pendulum too far in the other direction and has the potential to significantly impact this industry segment. [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

Remanufactured parts are given an extended life, cost less to produce and purchase and minimize the impact on the environment by not ending up in the waste stream. The motor vehicle remanufacturing industry supports over 50,000 direct jobs in the U.S. and demonstrates a commitment to sustainability through product innovation and the incorporation of more environmentally-friendly manufacturing practices. The U.S. Congress has recognized the value of remanufactured parts and components as exemplified by the "Federal Vehicle Repair Cost Savings Act" (S. 565), which directs federal agencies to consider using remanufactured parts when maintaining federal vehicle fleets. This bill passed the Senate on June 15 and the House of Representatives on September 28. [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

Remanufacturing is a standardized industrial process by which previously sold, worn or nonfunctional products are refurbished to a better condition and performance in order to reuse resources and reduce waste. The process incorporates technical specifications, including engineering, quality and testing standards to yield warranted products. In addition to remanufactured engines other examples of remanufactured components include: transmissions, alternators, starters, turbochargers, steering and suspension components and electronic control modules. Remanufacturing preserves some of the value of the original manufacturing – including energy costs, investment in capital and labor inputs – which recycling alone cannot do. This process saves about 85 percent of the energy and material used to manufacture similar new products. [EPA-HQ-OAR-2014-0827-1274-A1 p.11]

MEMA has concerns about the NPRM’s approach on gliders – particularly the agencies’ proposals: [EPA-HQ-OAR-2014-0827-1274-A1 p.12]

- to define used and remanufactured engines/equipment as “new” engines/equipment; [EPA-HQ-OAR-2014-0827-1274-A1 p.12]
- to impose on remanufactured engines the same compliance criteria as actual new engines for the year in which it was remanufactured (for all emissions); and, [EPA-HQ-OAR-2014-0827-1274-A1 p.12]
- to assert an earlier compliance timeline of MY2018. [EPA-HQ-OAR-2014-0827-1274-A1 p.12]

It is important to note that while a remanufactured component can be “manufactured again” to extend the service life, there are constraints as to how much and to what degree you can alter a component to meet newer design performance criteria beyond its original design. This task becomes increasingly more challenging the more complex the component/system. Furthermore, the proposed scope of the requirements for remanufactured engines would not only include GHG standards, but also all applicable criteria pollutant emissions standards; yet this Phase 2 rulemaking is a GHG rule, not for other pollutants. Also, the proposed timeline would kick in much sooner (by MY2018) than the other compliance requirements (MY2021). This timeline is impractical in terms of production planning and the remanufacturing process. Absent from the proposed rule are the data to demonstrate that the proposal will have a net positive impact on reducing CO2 emissions; nor is there a full evaluation of the cost-benefit impacts the proposal will have on rebuilt and remanufactured engines and components. As a result, while the NPRM assures that this is not a “ban” of glider kits – the proposed changes have the potential to significantly burden and overwhelm the remanufacturing sector. [EPA-HQ-OAR-2014-0827-1274-A1 p.12]

For all of these reasons, MEMA recommends that the agencies strike and remove the additional text from the definition of “new” in part 1068.30 that states: “Note that in certain cases, used and remanufactured engines/equipment may be ‘new’ engines/equipment.” The remanufacturer members of MEMA and MERA are prepared to work with the agencies on a practical approach to address the government’s concerns while still retaining this important industry sector for its intended and legitimate role and purpose. As we represent different manufacturers in this space, we anticipate that they will address these and related concerns in more detail in their company comments. [EPA-HQ-OAR-2014-0827-1274-A1 p.12]

**Organization:** National Association of Clean Air Agencies (NACAA)

We are also very much in favor of EPA’s proposal to close the existing loophole for glider kits and glider vehicles, under which used pre-2013 engines – with no limit on age – may be installed into new glider kits without meeting applicable standards. We agree with EPA that its regulations should be revised to require that only engines that have been certified to meet the prevailing standards be eligible for installation into new glider kits. The sale of glider kits has increased 10-fold<sup>1</sup> since the implementation of federal 2007/2010 particulate matter (PM) and NOx emission standards. The proposed changes will stem the unrestricted sale of glider vehicles with older, higher-emitting engines. With respect to implementation of EPA’s proposed glider requirements, we believe this should occur as soon as possible but no later than January 2018. [EPA-HQ-OAR-2014-0827-1157-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.52.]]

1 U.S. EPA, Frequently Asked Questions about Heavy-Duty “Glider Vehicles” and “Glider Kits” (2015), <http://www.epa.gov/OMS/climate/documents/420f15904.pdf>.

**Organization:** National Automobile Dealers Association (NADA)

#### **IV. GLIDER KITS**

The Phase 2 proposal seeks to severely restrict the sale of glider kits by generally requiring that engines used in glider vehicles be certified to the standards applicable to the calendar year in which assembly of the glider vehicle is completed, and by requiring many rebuilders to obtain vehicle certificates. The Phase 2 proposal also contains new definitions of “glider vehicle” and “glider kit” ostensibly based on a common understanding of these terms.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1932-A1 p.3]

The Phase 2 proposal would continue to exempt small businesses using gliders to rebuild vehicles from the need to obtain vehicle certificates, but would limit the exemption to an annual production of 200 units (production in excess of the capped amount would be allowed, but subject to all otherwise applicable requirements including the Phase 2 standards). For example, a small business producing between 100 and 200 glider vehicles per year would be allowed to do so without having to certify them to current year GHG (and other emission) standards, so long as they meet applicable standards for the year of their manufacture. [EPA-HQ-OAR-2014-0827-1932-A1 p.3]

In its 2015 comments, NADA/ATD urged EPA and NHTSA to consider another alternative designed to harmonize with NHTSA’s long-standing “manufacture” exemption for vehicle rebuilding. That exemption keys on there being a single “donor” vehicle from which two of three used components (engine, transmission, and drive-axle) are incorporated into the rebuilt vehicle. This exemption from the definition of “manufacturing” allows the rebuilder to avoid having to meet NHTSA manufacturer registration and other requirements. NADA/ATD also suggested that when two of these three used components are incorporated into a rebuilt vehicle, using a glider kit, the used engine would only be required to meet emission standards applicable to its year of original manufacture and, if rebuilt, any subsequent running changes. Obviously, no emissions certification would be required. Under that alternative, it would matter not if the rebuilder was a small business or how many units were rebuilt in a year. [EPA-HQ-OAR-2014-0827-1932-A1 p.4]

With respect to the Memorandum referenced in the NODA, NADA/ATD is taking no position with respect to the legal opinions expressed therein. On the other hand, NADA/ATD has reviewed and does support certain additional glider engine considerations discussed in Section “I” of the Memorandum. These include no regulation of 2010 and later engines and engines less than three-years-old, the reuse of newer engines with remaining “useful life,” and the reuse of low mileage older engines. Lastly, NADA reiterates its support for the alternatives suggested in its 2015 comments. [EPA-HQ-OAR-2014-0827-1932-A1 p.4]

#### **Glider Kits**

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The Phase 2 proposal also would continue to exempt small businesses using gliders to rebuild vehicles from the need to obtain vehicle certificates, but would limit the exemption to an annual production of 200 units (production in excess of the capped amount would be allowed, but subject to all otherwise applicable requirements including the Phase 2 standards). For example, a small business producing between 100 and 200 glider vehicles per year would be allowed to do so without having to certify them to current year GHG (and other emission) standards, so long as they meet applicable standards for the year of their manufacture. [EPA-HQ-OAR-2014-0827-1309-A1 p.12]

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4 40 CFR 1037.801.

**Organization:** National Ready Mixed Concrete Association (NRMCA)

NRMCA supports maintaining the flexibility of ready mixed concrete producers to utilize their already purchased assets to their fullest capacity, such as with "glider kits." To this end, NRMCA opposes the proposal's suggestion to require glider kits contain Phase 2 compliant engines<sup>7</sup>. Continuing to allow ready mixed concrete producers the opportunity to utilize refurbished trucks, truck parts and engines is an entrepreneurial inventiveness affording industry members economic and productivity advantages and competitiveness. Changing the current glider kit system will undoubtedly cause undue harm and hardship for many ready mixed concrete companies that base their business model on glider kits instead of purchasing brand new trucks. [EPA-HQ-OAR-2014-0827-1146-A1 p.3]

Upending the current glider kit system serves as an unnecessary coercion on market forces that alone will inevitably pressure the phase out of pre-Phase 2 engines. Requiring glider kits to be Phase 2 compliant would be redundant, unnecessary, and unfairly expeditious on the ready mixed concrete industry. [EPA-HQ-OAR-2014-0827-1146-A1 p.3]

NRMCA opposes any changes to the current glider kit schemes. NRMCA would like to highlight comments recently reported on that were made by Matthew Spears, executive director of EPA's Heavy Duty Diesel Program at a recent session of the American Trucking Association's Technology & Maintenance Council (September 22, 2015)<sup>8</sup>, in which he noted that the Phase 2 program changes to glider kits may be left alone when applied to concrete mixer truck chassis. NRMCA would very much support such a carve-out for ready mixed concrete trucks. As much, mixer trucks do fall in line with any criteria that would exclude their coverage based on low-mileage and/or vocational use. [EPA-HQ-OAR-2014-0827-1146-A1 p.3-4]

7 80 Federal Register 40329, 40528

8 Tom Berg, "EPA Might Alter 'Implementation Roadmap' for GHG Phase 2 Rules,"

<http://www.truckinginfo.com/channel/fuel-smarts/news/story/2015/09/epa-might-alter-implementation-roadmap-for-ghg-phase-2-rules.aspx>, September 23, 2015).

**Organization:** Natural Resources Defense Council (NRDC)

### **Glider Vehicles and Glider Kits**

NRDC supports the EPA proposal to clarify requirements for glider vehicle and kit manufacturers and to require new gliders to use engines that meet the standards current to the year of the glider manufacturing. The EPA action will ensure that there is not a large and growing loophole allowing glider vehicles with high-emitting engines to displace new vehicles that meet current pollution standards. NRDC agrees that these requirements should apply equally for GHG and non-GHG pollutants. We also recommend that NHTSA move forward with implementing similar requirements for fuel consumption. [EPA-HQ-OAR-2014-0827-1220-A1 p.10]

**Organization:** Navistar, Inc.

Navistar supports the portion of the NPRM that addresses gliders. Further, Navistar suggests that the allowance is too high, and that gliders should either be limited to 200 per year or eliminated completely. [EPA-HQ-OAR-2014-0827-1199-A1 p.14]

**Organization:** Neapco

The proposed rule would have an unfavorable impact on Neapco Components. If we were unable to sell product to the glider kit industry, we would have to reduce our employment levels in Beatrice Nebraska and Pottstown Pennsylvania. [EPA-HQ-OAR-2014-0827-1134 p.1]

The proposed rule understates the benefits of a glider kit truck on the environment and also underestimates the benefits of improved highway safety by replacing an older trucks with a glider kit truck with many improved components. The option of purchasing a glider kit truck also benefits small businesses who the government reports to be the primary source of new jobs in our country. [EPA-HQ-OAR-2014-0827-1134 p.1]

**Organization:** NGVAmerica

### **K. Glider Vehicle Regulations [EPA-HQ-OAR-2014-0827-1270-A1 p.8]**

EPA has proposed for Phase 2 that no small business entity could produce more than 300 glider vehicles in any given model year without certifying (or recertifying) the vehicle and engine to the current EPA standards. This level of volume will limit the ability of OEM truck manufacturers to support their ongoing glider truck programs, which have proved beneficial to alternative fuel platforms and could be a solid foundation for the growth of alternative fuel usage. [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

NGVAmerica, however, supports the proposal to provide a limited exemption for small manufacturers who produce completed glider trucks using pre-2007 engines. As described elsewhere in our comments, EPA should use the small business definitions currently set out in guidance provided for light duty aftermarket retrofit manufacturers. SBA regulations, 13 CFR 121.201, define a "small business" by the maximum number of employees; for example, this is currently 1,000 for heavy-duty vehicle

manufacturing and 750 for engine manufacturing. These levels also should be used for purposes of the Phase 2 rules. [EPA-HQ-OAR-2014-0827-1270-A1 p.8]

We understand the concerns raised by EPA regarding the continued use of older engines in essentially new vehicles and the propensity for this to greatly extend the life of some engines thereby delaying improvements in emission benefits. This concern is well founded in cases where pre-2007 engines are simply rebuilt and used with no improvements in emissions. However, modifying in-use engines to operate on natural gas does lead to improvements and reductions in criteria emissions. Based on this fact, we would urge EPA to expand the ability of glider manufacturers to continue to make use of pre-2007 natural gas (or other alternative fuels) retrofitted engines that are certified or approved, and that demonstrate significant emission reductions in criteria pollutants such as nitrogen oxides and particulate matter. One way to accomplish this would be to provide a separate allowance for gliders equipped with alternative fuel engines, or increase the total number of allowances for companies utilizing alternative fuel engines. [EPA-HQ-OAR-2014-0827-1270-A1 p.9]

We also urge EPA to expand the opportunities for glider manufacturers to make use of 2010 compliant engines that are retrofitted by small volume manufacturers to operate on alternative fuels. Post-2010 engines do not present the same issue with regard to potential in-use emissions and thus should not be limited. We believe that adopting this policy comports with EPA's long standing policy of providing additional flexibility to small volume manufactures of alternative fuel systems and would help expand market opportunities for these companies and fleets interested in using alternative fuels. In some applications, such as larger engines, this may be the only way a fleet can expand its use of natural gas. [EPA-HQ-OAR-2014-0827-1270-A1 p.9]

Providing the flexibility described here will allow OEM Truck manufacturers to continue to produce a limited number of gliders each year, and will encourage greater use of alternative fuel trucks. [EPA-HQ-OAR-2014-0827-1270-A1 p.9]

**Organization:** North American Repower

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 309.]

You have asked specifically about the glider kits. In your Preamble, you say that people are going to glider kits to circumvent the Clean Air Act. That is not why they are doing it. Maybe you have more information than I do. Maybe there is somebody specifically trying to do that.

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

**The agencies should close the "Glider Kit" loophole.**

We strongly support the proposed measure to ensure that glider kits are subject to the same applicable regulations as other new trucks. This common sense measure will prevent gaming and will avoid significant amounts of unnecessary emissions of GHGs, NOx, and PM2.5. The agencies request comment on the appropriate magnitude of the exemption. While we agree that some minimal exemption opportunity is probably appropriate in limited cases, we urge the agencies to set this number as low as is practical without impeding small businesses with legitimate claims. [EPA-HQ-OAR-2014-0827-1221-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.139-140.]]

**Organization:** Nuss Truck & Equipment of Minnesota and Wisconsin

Nuss Truck & Equipment strongly supports the agencies' proposal to impose new requirements on companies assembling and offering for sale vehicles produced by installing used driveline components into new glider kits. EPA and NHTSA should require that manufacturers of these glider-based vehicles comply with all applicable and current greenhouse gas and criteria emissions standards. NHTSA should also enforce the existing regulations that require manufacturers of glider-based vehicles to comply with all applicable safety standards. Dealers such as ours have been subject to a growing unfair competition from this rapidly expanding market of non-compliant vehicles. [EPA-HQ-OAR-2014-0827-0918-A2 p.1]

Nuss Truck & Equipment sold glider kits in the past when our customers purchased to repair a wrecked truck, or worn out cab, hood and frame on a heavy duty truck, or because they owned a truck that recently had major investment in the powertrain, and it made sense to redeploy those components into a glider kit. Glider kit usage in the early 2000's dropped off significantly as our OEM manufacturers devoted time to building trucks to meet emission standards and not proposing a way around emissions (2002 - 2007). Now, truck purchasers have the ability to purchase a powertrain combination that they never owned in an existing truck, from assemblers who have chosen to exploit the law put in place that was intended to clean up air pollution. The original intent of selling glider kits has moved from a rebuilding mechanism to now mainly evading diesel emissions EPA mandates. We see many truck owners and small fleets from Minnesota and Wisconsin traveling long distances, passing by dozens of legitimate truck dealers, to purchase glider kits directly from a manufacturer in another state, just to avoid the current EPA emissions standards. That should not be a legally acceptable reason to purchase a glider kit, if we all want clean air. [EPA-HQ-OAR-2014-0827-0918-A2 p.1]

Nuss Truck & Equipment supports the application of glider kits as a means to repair badly damaged vehicles, while taking advantage of the remaining useful life in the damaged vehicle's driveline components. When conducted within the requirements of 49 CFR 571.(e), which sets forth NHTSA's rules for re-use of driveline components for installation into a glider kit, we have no specific concerns with such legitimate applications of glider kits. It's when these rules are violated, however, in an effort to offer for sale an essentially new vehicle whose production costs and total cost of ownership may be tens of thousands of dollars less than the fully compliant new products sold by our dealership that we strongly object to such an unfair disruption of market competition. Unfortunately, this practice has become widespread without consequence to the glider-based vehicle manufacturers, and it is unfairly and negatively impacting our business. In many cases, the manufacturers of glider-based vehicles are not collecting the 12% federal excise tax ('FET') that normally applies to new vehicle sales, giving customers even further financial incentive to purchase glider vehicles rather than fully compliant new vehicles. This abusive application of glider kits must be stopped; we strongly support the agencies' efforts to do so through appropriate new regulations and enforcement of existing regulations. EPA and NHTSA should seek to remedy this situation as soon as practicable, while protecting for the continued use of glider kits for legitimate purposes as we have described. [EPA-HQ-OAR-2014-0827-0918-A2 p.2]

We refer you to the comments of the Volvo Group North America for a more complete analysis and set of recommendations with respect to the regulation and enforcement of glider-based vehicles. Nuss Truck & Equipment supports the comments submitted by Volvo Group North America. [EPA-HQ-OAR-2014-0827-0918-A2 p.2]

The rapidly expanding glider-based vehicle market is seriously undermining the significant gains EPA, NHTSA, and the heavy-duty vehicle industry have made to reduce criteria and greenhouse gas

emissions, reduce fuel consumption, and improve roadway safety. The market availability of these non-compliant engines and vehicles poses an unfair competitive disadvantage to manufacturers that have undertaken the enormous effort and investment necessary to comply with all applicable emissions, fuel efficiency, and safety standards, and likewise an unfair competitive advantage to the dealer network representing those OEM's. It is therefore imperative that the agencies follow through by finalizing regulations that prohibit the production of glider-based vehicles for anything other than legitimate purposes, and that the agencies actively ensure compliance to those requirements. [EPA-HQ-OAR-2014-0827-0918-A2 p.2]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

To compound this problem, the new proposal would limit the number of glider kits that could be produced and sold –under the assumption that drivers who use them would have less incentive to purchase a new truck that would achieve even greater efficiency. The unavailability of gliders kits is not likely a sufficient factor to overcome the fact that new trucks may be prohibitively expensive for many truck owners. The agencies should not discourage the modification of older equipment at the expense of incremental environmental benefits. This is especially true considering that one of the major benefits of a glider kit is reduced fuel consumption. When a reliable engine is placed into a new aerodynamic tractor, this will clearly result in a reduction of GHG emissions, which should be applauded by the agencies. If the agencies wish to address glider kits in any way OOIDA believes this issue should be the subject of a separate rulemaking. [EPA-HQ-OAR-2014-0827-1244-A1 p.44-45]

**Organization:** PACCAR, Inc.

***I. Glider Standards: EPA and NHTSA Should Adopt Glider Regulations that Reflect the Needs of Customers and Manufacturers.***

Glidors are and have been for many years a key tool for fleet and individual vehicle owners to cost effectively use all the vehicle major components, such as the engine, transmission, and rear axles, to transport goods to the American consumer and to do so at the lowest cost possible. PACCAR understands EPA's concern regarding oxides of nitrogen (NOx) emissions that comes from earlier emission level engines that can be put into current model year gliders. Recognizing this concern as well as the needs of the market, PACCAR provides the following recommendation for glider provisions in the Phase 2 regulation. [NHTSA-2014-0132-0223-A1 p,2]

- GHG Vocational and Tractor vehicles should be allowed to have installed post-2010 emissions engines with no volume or no mileage limitations on the engine [NHTSA-2014-0132-0223-A1 p.2]
- Implementation of the requirement to install post-2010 emissions engines should be phase-in with full implementation tied to the start of the Phase 2 GHG regulation in 2021, except for Small Business as is noted below [NHTSA-2014-0132-0223-A1 p.2]
- EPA-defined Small Manufacturers would be exempt from the requirements of the GHG regulation through 2021. The volume limit of gliders for 2018 through 2021 will be their highest build volume between 2012 and 2014, inclusive, or 300 units, whichever is smaller. There is no restriction prior to 2018. As of 2022, the exemption requires the installation of post-2010 engines, same as for non-exempt businesses. [NHTSA-2014-0132-0223-A1 p.2]

*a. Glider Manufacturers Do Not Have All the Details about the Final Glider Configuration.*



In NODA document EPA-HQ-OAR-2014-0827-1627 titled “Legal Memorandum Discussing Issues Pertaining to Trailers, Glider Vehicles, and Glider Kits under the Clean Air Act” Section f. Controls on Manufacturers of Glider Kits, EPA states that “...glider kits include the entire tractor chassis, cab, tires, body, and brakes. Glider kit manufacturers thus control critical elements of the ultimate vehicle’s greenhouse gas emissions, in particular, all aerodynamic features and all emissions related to tire type.” EPA’s understanding of the content of a glider kit and the extent of the data knowledge of the glider manufacturer is incorrect. Gliders are built in a variety of configurations. Many do not have rear axles installed, thus no information is known by the manufacturer on the axle configuration, the rear axle ratio, or the rear tires. [NHTSA-2014-0132-0223-A1 p.2]

In some cases, the vehicle is modified during the assembly process to change the cab / sleeper configuration without the knowledge of the glider manufacturer. Other components that impact aerodynamics such as exhaust system configuration and roof fairing designs are not known by the manufacturer at the time of glider build. Thus the manufacturer does not always have the necessary data needed as input to GEM for that glider, which challenges the concept that the glider manufacturer is inherently the correct regulated entity for the glider as a finished vehicle. [NHTSA-2014-0132-0223-A1 p.2-3]

Additionally, in this same section, EPA states “Glider kit manufacturers also invariably know the final configuration of the glider vehicle, i.e. the type of engine and transmission which the final assembler will add to the glider kit. This is because the glider kit contains all necessary wiring, and it is necessary, in turn, for the glider kit manufacturer to know the end configuration in order to wire the kit properly.” Again, the reality is different from EPA’s understanding. The glider manufacturer does not always provide engine or transmission wiring for the major components that will be installed. Wiring harnesses can be ordered at the same time as the glider, but the reality is that the glider assembler often greatly modifies the harness so that it will work for a completely different and unintended engine. For example, wiring harnesses for a CAT engine are being reworked for a Detroit Diesel engine. It must be noted that even though these two engines are installed in significant numbers in gliders, neither of these engines are installed in PACCAR vehicles at the factory and have not been for nearly a decade. As a result, significant rework is required that is uncontrolled by PACCAR. Also, this means that the glider manufacturer does not necessarily know the engine or the transmission that will be installed. Transmission information is used only to determine the correct driveline length. Multiple transmissions that would have very different GEM inputs have the same effective lengths. Also, no information regarding manual versus automated manual configuration of a transmission are provided with the glider orders. [NHTSA-2014-0132-0223-A1 p.3]

*b. Labeling of Gliders as “Not for Tractors” Adds No Value Under PACCAR’s Proposal.*

In Section g. Alternative Provisions for Trailer and Glider Kit Manufacturers as Manufacturers of Motor Vehicle Parts, EPA proposes a unique label for gliders that will be used in Vocational applications. In the PACCAR proposal that is detailed at the start of this document, there is no difference between Tractor and Vocational vehicles, therefore there is no need for a unique labeling requirement. [NHTSA-2014-0132-0223-A1 p.3]

*c. Requirements for Rebuilt / Remanufactured Engines to Meet Current Engine Standards are Not Needed.*

The requirement outlined in Section h. Alternative Provisions for Engine Remanufacturers, that all engines that are rebuilt or remanufactured must meet the current model year engine standard if the engine is used in a glider is no longer required under the PACCAR proposal. Starting in 2021, all glider

engines must be post-2010 engines in compliant configurations with the appropriate aftertreatment system, thus eliminating this requirement and mitigating EPA's concern regarding pre-2010 engines being rebuilt or remanufactured for installation into gliders. [NHTSA-2014-0132-0223-A1 p.3]

*d. PACCAR Agrees with Provision for Installation of Post-2010 Engines Without Restriction*

PACCAR urges EPA to finalize the provision in Section i. Glider Vehicles Using Newer Engines, to allow the installation of post-2010 engines, those meeting the 2010 NOx and PM emissions standards, to be installed in gliders starting in 2021 without limitation to mileage, age, or quantity per manufacturer or assembler. [NHTSA-2014-0132-0223-A1 p.4]

*e. Delegated Assembly Provisions Should Reflect the Information Known by and Available to the Glider Manufacturer*

PACCAR also urges EPA to revise 40 CFR 1037.130 Assembly instructions for secondary vehicle manufacturers, to include only Sections (a), (b)(1), (b)(2), (b)(4), and (c) as the provisions required when delegated assembly is used to support the assembly of gliders by secondary manufacturers. [NHTSA-2014-0132-0223-A1 p.4]

PACCAR sells glider kits through the Kenworth and Peterbilt dealer networks. [NHTSA-2014-0132-0223-A1 p.4]

[Table can be found on p.4 of docket number NHTSA-2014-0132-0223-A1]

Supporting contracts, audits, affidavits, and documentation for each assembler and on-going support for each order of a glider are typically included with full delegated assembly provisions. EPA has not properly anticipated or included in the regulation development the associated burden for such a large number of assemblers if the Small Business exemption is removed. Limiting the delegated assembly requirements is the appropriate action, regardless of the decision on the Small Business exemption. [NHTSA-2014-0132-0223-A1 p.4]

PACCAR will work with the agencies on the appropriate content on gliders for end of year reporting. [NHTSA-2014-0132-0223-A1 p.4]

## **Gliders**

The current proposal limiting the build of glider kits per year with non-current emissions engines is extremely stringent and overly burdensome to manufacturers, customers, and dealers. Also the requirement that each non-exempt glider have a current year emissions engine will render many powertrains as scrap parts even though they have recently been manufactured and are capable of powering a new vehicle body. [EPA-HQ-OAR-2014-0827-1204-A1 p.26]

Over the last three years, PACCAR has sold glider kits through the Kenworth and Peterbilt dealer network to over 1,200 unique individual customers who have assembled gliders or had gliders assembled for them. For model year 2014 alone, this number was more than 500 customers. In that three-year period, PACCAR sold glider kits to support those customer through 78 different dealer groups comprised of over 215 separate Kenworth and Peterbilt dealer locations across the United States. The vast majority of these dealer groups purchased fewer than 50 glider kits from PACCAR each of these years. Of these groups, 14 did not purchase any glider kits from PACCAR in 2014, the year on which EPA proposes to base the limit for glider exemptions, but did purchase fewer than 50 glider kits

in one or both of the preceding or trailing years. If EPA finalizes the rule as proposed, these dealers would be unable to purchase PACCAR glider kits and provide customers with an option to retain powertrains after January 1, 2018. [EPA-HQ-OAR-2014-0827-1204-A1 p.26]

PACCAR understands EPA's concern about older, less efficient, higher-emission engines being installed into gliders when newer, more efficient, and cleaner powertrains are available. However, many glider purchasers have been involved in accidents, or have had other damage to the vehicle body, and are left with a fully functional powertrain. EPA's proposal would unduly penalize those operators and others who are not attempting to avoid purchasing newer-model year engines but are simply trying to continue to use an existing, undamaged powertrain. [EPA-HQ-OAR-2014-0827-1204-A1 p.26]

PACCAR recommends that the agencies extend the effective date of any limitation to January 1, 2021 to align with the Phase 2 regulation implementation, which will provide more lead-time for the industry to understand and accommodate the change in regulation. PACCAR also strongly recommends that the agencies provide more flexibility for entities that did not assemble any gliders in 2014 but which have done so between 2014 and the effective date of the Phase 2 final rule. Specifically, if the implementation is set at the recommended January 1, 2021 date, EPA should allow the assembly of up to 300 gliders per year for any individual company as exempt from the Phase 2 regulation, provided that the engine/powertrain to be installed meets MY2010 or newer emission standards. EPA also should allow without limit the assembly of gliders where the engine meets the emissions standard for the year the glider was assembled. [EPA-HQ-OAR-2014-0827-1204-A1 p.26-27]

If the implementation is set at January 1, 2018 as proposed in the NPRM, then EPA should allow all small businesses, as defined by federal regulations, to assemble a minimum of 50 gliders per year as exempt from the engine / vehicle model year requirements, regardless of the emission standard of the engine, and up to their maximum sales in 2013 or 2014, or 300. The agencies also should allow the installation of engines that meet MY2010 or newer emission standards without a volume limit for any company. This will mitigate the EPA concern about non-DPF engines from being installed at current volumes and eliminates the issues of recently built powertrains not being allowed for installation in new gliders. [EPA-HQ-OAR-2014-0827-1204-A1 p.27]

**Organization:** Reeves Brothers Trucking, Inc.

On The Economical End Of The Phase 2 Proposed By The EPA And NHTSA Regarding Greenhouse Gas Emissions And Fuel Efficiency Standards For Medium And Heavy Duty Engines And Vehicles, Gliders Are Less Expensive Than New Trucks And Offer A More Economical Option For Smaller Fleets And Owner Operators. [EPA-HQ-OAR-2014-0827-1465-A2 p.1]

A Glider Kit Trucks Is Not Considered A New Vehicle. It Has New Cab, Front Axle And Frame/Chassis with a Used Rebuilt Engine, Transmissions, Etc. Therefor Is Not Considered A New Truck Under The CAA. The Impact That Phase 2 Will Have On Small Business Would Bear Heavily On The Small Fleet and Single Owner/Operator. The Difference In A Glider Vehicle Compared To The Cost of A New Vehicle Could Mean Thousands Of Dollars When Purchasing One. Cost Is A Special Focus For Small Businesses. If The Price Is Unattainable They Are Less Likely To Purchase The Vehicle. In The End The Financial Burden Is On The Builders And Buyers. Small Businesses Do Not Have The Maintenance Capabilities Nor The Technology That Would Be Required To Keep New Vehicles Maintained And The Maintenance Up To Date. It Would Not Be Cost Effectively To The Small Businesses And The Burden Would Lie Upon Them. [EPA-HQ-OAR-2014-0827-1465-A2 p.1]

In Agreement, Rep. Diane Black Stated, The EPA's Phase 2 Proposal Would Unfairly Target the Glider Kit Industry and Limit the Buyer's Choices. The Builder of The Glider Kit Vehicle Provide Numerous Jobs To The Community And Surrounding Areas. If The Glider Kit Is Done Away It Would Be A Huge Blow To The Community As Well As The Suppliers And Not To Forget The Small Businesses And Owner Operators. The Bottom Line Is It Is Not An Economical Choice When Seen Thru The Small Businesses And Owner/Operator Eyes When Considering The Cost Of Glider Vehicle Compared To A New Vehicle Along With The Cost Of The New Technology And Maintenance It Would Require. [EPA-HQ-OAR-2014-0827-1465-A2 p.1]

**Organization:** Sierra Club

### **Close the glider kit loophole**

We applaud the agencies for the proposed treatment of glider kits. In recent years, sales of glider kits have skyrocketed, accounting for roughly two percent of all Class 8 vehicles manufactured annually. Many of the engines used on these vehicles emit substantially greater amounts of NOx and particulate matter than current emissions standards allow. Under the proposal, glider kit manufacturers will no longer be able to exploit a loophole leading to more health-threatening pollution. We urge you to finalize the provisions that would close the glider kit loophole. [EPA-HQ-OAR-2014-0827-1277-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.190.]]

**Organization:** Terex Corporation

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 105-108.]

Comment number one, page 40529 of the proposal says that EPA requests comment on whether we should allow larger manufacturers to produce some limited number of glider kits.

Therefore, Terex proposes that if the EPA sets limits on the quantity of gliders produced, it should not be based solely on the number of employees the glider manufacturer has, but should also be based on the number of on highway vehicles it produces similar to the way the off highway transition program for equipment manufacturers is set up.

For example, Terex Corporation has approximately 20,000 employees globally, but only approximately 220 are involved in the manufacturer of gliders at one small facility located in Fort Wayne, Indiana. Should the proposed regulations continue unchanged, it would result in the redundancy of some 70 team members at the Fort Wayne facility. Therefore, Terex proposes if a company manufactured fewer than 1,000 on highway vehicles annually between calendar years 2010 and 2014, then it should be eligible for the same exemptions as a small manufacturer under the proposed 1037.635(b).

Comment number two, the proposed definition number three of 'glider kit' on page 40662 says that a 'glider kit' means 'any other new equipment that is intended to become a motor vehicle with a previously used engine, include a rebuilt or remanufactured engine.' Terex requests further clarification and/or a definition of 'other new equipment.' The intention of this request is to eliminate confusion over whether certain new parts or assemblies that would be used to repair an existing vehicle would be considered as 'new equipment' by the EPA.

Comment number three, page 40229 says that building a glider out of salvaged powertrain from vehicles destroyed in accidents is 'an arguably legitimate purpose,' and Terex agrees with the agencies on that.

The proposed limitation on gliders doesn't distinguish between repaired vehicles and glider kits. Terex suggests that language be added that allows for a used powertrain to be installed onto a new chassis for the case of repairing a damaged vehicle, and not be subject to regulations that are newer than the original bill date of the damaged vehicle.

And then my final comment number four is regarding page 40186. It says that six by six and eight by eight vehicle configurations are only manufactured for specialized vehicles that require extra traction for off road applications. They are very low volume sales, and their increased fuel consumption and CO2 emissions are not significant in comparison to the overall reductions of the Phase 2 program.

Therefore, Terex suggests that vehicles with six by six and eight by eight configurations must be added to the last of exemptions under the proposed 1037.635(b) concerning glider kits. Because these vehicles operate off road, they are far more susceptible to wear and tear type frame damage that is premature compared to the engines that were designed to operate for a million miles. For this reason, glidering six by six and eight by eight vehicles is and has always been common industry practice, even before the arrival of after treatment systems on diesel engines.

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Glider Kits

The same problems noted above also would flow from the agencies' proposed treatment of glider kits. Glider-kit manufacturers should not be held responsible for the ultimate downstream configuration of the vehicle, so long as the glider-kit manufacturer has provided proper instructions to the vehicle finisher for the installation of emission-related components. Beyond that, and just as in the case of incomplete-vehicle manufacturers, the manufacturers of glider kits should not be transformed by regulation into the de facto guarantors of separate business entities that complete the manufacture of vehicles using glider kits. [EPA-HQ-OAR-2014-0827-1269-A1 p.36]

With respect to the agencies' other proposals for regulating glider kits, EMA supports the agencies' proposal to provide a small business exemption for any business entity that employs less than 1000 people and that falls under the production cap set forth in proposed section 1037.635(c). A small business exemption is necessary to avoid disproportionate impacts on a significant number of diverse business entities, including the small businesses that participate in the assembly of gliders. [EPA-HQ-OAR-2014-0827-1269-A1 p.36]

It should be noted that in their proposed regulation of glider kits, the agencies are, in effect, proposing to adopt regulatory requirements for vehicle parts, as opposed to motor vehicles. The CAA defines a "motor vehicle" as any "self-propelled vehicle designed for transporting persons or property on a street or highway." (See 42 U.S.C. §7550(2)). A glider kit is not self-propelled and so, on its own, is not a "motor vehicle" within EPA's regulatory jurisdiction. Thus, the glider kit manufacturer is not an entity over which EPA has regulatory authority. [EPA-HQ-OAR-2014-0827-1269-A1 p.36]

**Organization:** Truck Country of Wisconsin

As you know, there are differences between the two agency's in their respective views on regulatory frameworks for safety and air emissions and definitions of 'glider kits' [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

NHTSA defines a 'glider kit' as motor vehicle equipment that primarily includes the chassis cab, but generally does not include the engine or rear axles. EPA defines 'glider kits' to both the complete and incomplete vehicles and applies its regulations to both. (See 40 CFR 1037.801 of EPA's proposed regulatory text). [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

I support EPA's definition of 'glider kits' as an important step to ensure uniformity between EPA and NHTSA for the following reasons. [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

Air pollution and emissions are a significant problem with 'Glider kits' support EPA's definition 'glider kits' as an important step to ensure uniformity between the EPA and NHTSA for the following reasons:

1. We agree with EPA's assessment that most gliders manufactured today use remanufactured model year 2001 or older engines. Typically these engines have and NOX and particulate matter (PM) emissions 20 to 40 times higher than today's clean engines. Since 2010 when EPA's current NOx and PM standards for heavy duty engines took effect, glider sales have increased nearly 10-fold as compared to the 2004-2006 time frame. [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

2. We agree with EPA that this increase reflects an attempt to avoid using engines that comply with EPA's 2010 standards, and is an attempt to circumvent the Clean Air Act purpose to protect human health and the environment. [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

3. The Trucking Industry has made enormous investments in new engines standards to comply with past and future EPA regulations. We believe this circumvents these standards and will make it harder to meet compliance. [EPA-HQ-OAR-2014-0827-1468-A1, p.1]

4. We agree with EPA's Clean Air Act definition of 'new motor vehicle' is not based on the condition of the parts assembled to create the vehicle but rather encompasses the entire vehicle, even if they incorporate some previously used components. [EPA-HQ-OAR-2014-0827-1468-A1, p.2]

In conclusion, Truck Country supports the new EPA requirements are being proposed in the HD Phase 2 Notice of Proposed Rulemaking. By proposing new requirements beginning January 1, 2018 that would generally require engines installed in new gliders to meet the same requirements as new emissions-compliant engines- both for GHGs and for other harmful pollutants such as NOx and PM. Beginning in model year 2021, Phase 2 standards for heavy duty vehicles would also apply to gliders. [EPA-HQ-OAR-2014-0827-1468-A1, p.2]

In addition, we oppose the HD Phase 1 exemption for small businesses that manufacture gliders for model years 2018 and beyond and we fully support EPA's proposal to end this blanket exemption on January 1, 2018. We agree with EPA to limit the grandfathering of existing small businesses that currently install the used engines and other used parts into gliders. These special provisions allow too much discrepancy to continue production of assembled gliders creating an already air quality problem for industries who have to meet the Clean Power Plan and Ozone regulations. [EPA-HQ-OAR-2014-0827-1468-A1, p.2]

Finally, we believe EPA's approach in resolving this issue in proposing these changes is in the best interest to improving air quality in this country and create consistency between the two agencies. Properly regulating the 'glider kit' issue will improve the health care of all citizens as we try to address greenhouse gas emissions for future generations. [EPA-HQ-OAR-2014-0827-1468-A1, p.2]

**Organization:** Union of Concerned Scientists (UCS)

## GLIDER KITS

UCS supports the closing of a loophole that currently allows glider kits—chassis and powertrains assembled by a third party and sold as new trucks—to not comply with fuel economy, greenhouse gas, and other pollution control regulations. These vehicles have traditionally played an important role in maintaining investments when parts of trucks were rendered unusable due to accidents and until recently only a few hundred a year were sold. In recent years, however, thousands of glider kits have been sold annually to get around pollution control systems. This has led to extreme discrepancies in pollution from OEM-manufactured new vehicles and new glider kit vehicles. EPA analysis shows that while glider kits make up only 2 percent of Class 8 vehicle sales, they contribute nearly half of the total NOx and particulate emissions from all new Class 8 vehicles (EPA and NHTSA 2015). These glider kit vehicles should be regulated the same as any other new vehicle and this proposal will put them on equal footing with other new trucks. [EPA-HQ-OAR-2014-0827-1329-A2 p.13]

**Organization:** Volvo Group

### Glider Vehicles and Small Manufacturer Exemption

Volvo Group strongly supports the agencies' proposal to take action within this proposed rulemaking to require that companies selling new vehicles produced by installing used driveline components into new glider kits certify the compliance of these vehicles and their engines to the prevailing greenhouse gas and criteria emissions standards. The glider-based market, which has exploded over the last several years, is built upon the allure of simpler, lower maintenance engine designs of the pre-2004 emissions era, wherein these vehicles can be produced at a much lower cost due to the use of used driveline components and exclusion of emission and safety related systems. In Volvo Group's view, glider-kits can serve a legitimate purpose, that being a major repair to a vehicle that has been involved in an accident and is damaged to the point that only some driveline components are reasonably salvageable. Yet Volvo Group has deep concerns that the market which has emerged over recent years is one built upon circumvention of today's stringent emissions standards rather than a legitimate use of glider kits, and agrees with the agencies that the practice must stop or be significantly limited. [EPA-HQ-OAR-2014-0827-1290-A1 p.60-61]

Volvo Group also supports the agencies' proposal to eliminate the exemption to greenhouse gas and fuel efficiency requirements for small manufacturers, but proposes that the exemption sunset sooner than the agencies have proposed. [EPA-HQ-OAR-2014-0827-1290-A1 p.61]

### Glider Kits can serve a Legitimate Purpose

The "glider kit" emerged some decades ago as an assemblage of new vehicle components absent the engine, transmission, and rear axles (the "driveline"). These kits were produced by vehicle OEMs, and made available for sale to dealers and other vehicle repair centers as a means to repair a vehicle that had been badly damaged in an accident or similar event. This permitted re-use of driveline components that had not yet accumulated end-of-life mileage by the time of the accident. Volvo Group believes this is a reasonable and practical application for a glider-kit; namely as a means for an individual truck owner to recover from such an unexpected event that would otherwise cut short the lifetime of a purchased capital good. [EPA-HQ-OAR-2014-0827-1290-A1 p.61]

For purposes of establishing acceptable practices concerning the application of glider kits in these instances, and to clarify what practices would constitute creation of a new vehicle obligating the

assembler to certain requirements under NHTSA safety regulations, NHTSA adopted language as follows: [EPA-HQ-OAR-2014-0827-1290-A1 p.61]

49 CFR §571.7 Applicability.

(a) *General.* Except as provided in paragraphs (c) and (d) of this section, each standard set forth in subpart B of this part applies according to its terms to all motor vehicles or items of motor vehicle equipment the manufacture of which is completed on or after the effective date of the standard. [EPA-HQ-OAR-2014-0827-1290-A1 p.61]

\* \* \* \*

(e) *Combining new and used components.* When a new cab is used in the assembly of a truck, the truck will be considered newly manufactured for purposes of paragraph (a) of this section, the application of the requirements of this chapter, and the Act, unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.61]

Simply put, when assembling a motor vehicle using a new cab, as is the case with assemblies from glider kits, the final vehicle assembly is a new motor vehicle unless the engine, transmission *and* rear axle(s) are *all* used, *and* at least two of them come from the same donor vehicle. Said another way, if any of the three driveline components is new, the finished assembly is a new motor vehicle. Or, if all three are used components but were salvaged from more than two donor vehicles, the finished assembly is a new motor vehicle. The final assembler of any new motor vehicle is obligated, at minimum, to: (a) register with NHTSA as a vehicle manufacturer, (b) to create and register Vehicle Identification Numbers (VINs) with NHTSA, (c) certify compliance of the finished vehicle to all applicable NHTSA safety standards, (d) file reports regularly with NHTSA regarding safety defects, and (e) undertake recall obligations to correct certain safety defects. [EPA-HQ-OAR-2014-0827-1290-A1 p.61-62]

New Glider Kit Market is Based on Avoiding Emission Controls

**A new market has emerged based on use of glider kits to create essentially new vehicles that do not comply with applicable safety, criteria emissions, or greenhouse gas standards.**

While there is a limited, legitimate and practical application of glider kits in the heavy-duty truck market, a market has emerged whereby new vehicles are being assembled from glider kits -- not to repair a wrecked vehicle -- but rather to be offered for sale as new vehicles. These new vehicles are built with used or remanufactured engines that are not compliant with current criteria emissions standards at the time of vehicle manufacture. Similarly, neither these vehicles nor their installed engines are compliant to applicable greenhouse gas emissions and fuel consumption standards at the time of manufacture. Finally, these vehicles also do not comply with all applicable safety standards, and some glider vehicle manufacturers appear not to be complying with all obligations incumbent upon a new vehicle manufacturer per NHTSA regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.62]

Assemblers of glider vehicles (“glider vehicle,” as used herein, means a fully assembled vehicle, built from a glider kit, complete with used or remanufactured driveline components installed) have adopted a number of business practices for producing these vehicles. Often, the rear axles installed on glider vehicles are not, in fact, used components; they are actually new units as purchased from the glider-kit supplier. Some engines installed are rebuilt before installation, others are remanufactured engines purchased from a remanufacturing facility. The same holds true for transmission sourcing.



Remanufactured engines typically are produced from a process that renders it impossible to link a finished product to a source “donor vehicle.” None of these practices appear to be consistent with NHTSA regulations that allow the exception to the manufacturing of a new vehicle. [EPA-HQ-OAR-2014-0827-1290-A1 p.62]

Not only can these new glider-based vehicle assemblies be seen as a circumvention of regulatory obligations, they also set up an unfair competitive advantage to manufacturers of new motor vehicles who are complying with all applicable emissions, fuel consumption, and safety standards. Today’s cleanest, most fuel efficient and safest vehicles are necessarily tens of thousands of dollars more costly to produce, more expensive to maintain, and can cost more to operate, than glider-based vehicles. As such, heavy-duty truck OEMs and their dealers are unfairly forced to compete with these higher-emitting, less safe vehicles. Additionally, application of certain Internal Revenue Service rules can result in new vehicle sales where the purchaser is not obligated to pay the 12% Federal Excise Tax (FET) that normally applies to new vehicle sales, giving customers even further financial incentive to purchase glider vehicles rather than fully compliant new vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.62]

These unfair competitive advantages have led to a boom in glider vehicle sales in recent years. EPA and NHTSA state in the Preamble that total glider-based vehicle volumes were typically less than 1000 units prior to 2007. The Small Business Advocacy Review Panel for the Phase 2 proposal, however, notes that for 2011 and 2012, sales of glider vehicles “spiked to almost 4,000 per year.” Moreover, based on Polk registration data, Volvo Group estimates that 2014 glider-based sales were on the order of 6,000 units or more, about 3% of the total Class 8 market; and 6 times the pre-2007 estimates that EPA and NHTSA appear to rely on in the proposal. Some assemblers report that plans for major expansions of their assembly capacity are underway. Such a gross expansion will further frustrate the ability of OEM dealers to compete in the marketplace with fully compliant products. Without regulatory intervention, there’s little reason to expect this trend to be reversed, and therefore regulatory intervention is absolutely necessary. [EPA-HQ-OAR-2014-0827-1290-A1 p.62-63]

Glider-based Vehicles Have Huge Environmental Impact

**Glider-based vehicle assemblies are having a huge impact on the environment, and introducing undue risk to American roadways.**

In response to EPA’s Clean Diesel Program, manufacturers of heavy-duty engines introduced complex and expensive technologies including exhaust gas recirculation systems, diesel particulate filters, and selective catalytic reduction aftertreatment systems to achieve unprecedented reductions in NOx and particulate matter. Most glider vehicle manufacturers are installing pre-2004 engines, which lack all of the technologies mentioned above, and hence have substantially higher emissions. Even if these engines were fully compliant with all requirements in place prior to the advent of clean diesel technology requirements, the emissions from these engines compared to modern diesels are considerably higher. EPA’s own analysis as detailed in their recent glider Q&A document indicates that NOx and PM emissions from glider vehicles at current sales levels are equivalent to about 80 percent of the total NOx and PM emissions from the *entire* Class 8 sales fleet. Focusing on PM emissions, and applying the emissions levels indicated in Argonne National Lab’s recent update to the GREET Analysis<sup>13</sup>, at just 3% market penetration of the most egregious applications, the 2014 glider fleet emits *twice* the level of PM emissions that the 97% *entire* fleet of compliant vehicle sales emits that same year. [EPA-HQ-OAR-2014-0827-1290-A1 p.63]

These numbers are astounding; little more justification is needed to understand the importance of EPA taking action to address emissions from this market. [EPA-HQ-OAR-2014-0827-1290-A1 p.63]

While the impact of glider vehicles on heavy-duty greenhouse gas emissions and fuel consumption is not currently believed to be on the same scale as that of criteria emissions, the requirements promulgated in EPA's current and proposed greenhouse gas regulations, and the growth being witnessed in the glider market, will certainly lead to a huge compliance gap between glider vehicles and fully compliant vehicles. At present, the majority of manufacturers of glider vehicles fall under the small manufacturer exemption to the GHG Phase 1 regulation, relieving them of any obligation to certify their products to demonstrate conformance to EPA and NHTSA greenhouse gas and fuel consumption standards. [EPA-HQ-OAR-2014-0827-1290-A1 p.63-64]

Finally, with respect to safety, heavy-duty OEMs are making huge investments to fully comply with Federal Motor Vehicle Safety Standards ("FMVSS"), so as to verify and deploy the best known technologies to ensure the safety of American roadways. According to the current NHTSA regulation and our understanding of the assembly practices and component sourcing applied by glider vehicle manufacturers today, these manufacturers should likewise be responsible for all current applicable FMVSS standards. It appears, however, that they are not meeting all of these requirements, including full vehicle certification, safety defect reporting obligations, and reporting of vehicle VINs for purposes of potential safety recall obligations. This practice is putting the safety of America's roadways at risk and must be addressed. NHTSA must begin to take appropriate action to ensure these requirements are fulfilled by all manufacturers of heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.64]

#### Volvo Group Supports Action to Reform Glider Market

Based on all the foregoing arguments, Volvo Group supports the regulatory action that EPA and NHTSA are proposing to subject glider vehicles and their engines to the same criteria emissions and greenhouse gas emissions requirements as apply to other new vehicles manufactured for sale in the United States. Volvo Group believes that NHTSA also should take steps to fully enforce their existing vehicle safety requirements applicable to glider based vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.64]

With respect to EPA requirements, it is first important to recognize and clarify that vehicles produced from glider kits *already* are subject to GHG standards under 40 CFR Part 1037. This regulation applies to "all new heavy-duty vehicles, except as provided in § 1037.5" (40 CFR § 1037.1). With the exception of vehicles produced before 2014, none of the exclusions set forth under 1037.5 apply to vehicles produced from glider kits. Accordingly, these vehicles have been subject to EPA regulations since Jan. 1, 2014. EPA has recognized as much. In the proposal, the Agency states: "For EPA purposes, CO2 provisions of Phase 1 exempted gliders and glider kits produced by small businesses but did not include such a blanket exemption for other glider kits. Thus, some gliders and glider kits are already subject to the requirement to obtain a vehicle certificate prior to introduction into commerce as a new vehicle. *However, the agencies believe glider manufacturers may not understand how these regulations apply to them, resulting in a number of uncertified vehicles.*" 80 Fed. Reg. 40138, 40215. Furthermore, EPA has identified at least one glider manufacturer that does not qualify as a small manufacturer, [RIA, Section 12.4], and it is unclear whether those that do have followed the requirements to notify EPA of their intent to produce excluded vehicles and label those vehicles as excluded pursuant to 40 CFR § 1037.150(c). [EPA-HQ-OAR-2014-0827-1290-A1 p.64]

While EPA believes some in the industry simply do not understand the Agency's regulations, Volvo Group is concerned that EPA has underestimated the sophistication of many in this industry, for which

ignorance of the rules should not be an excuse for failure to comply. These include large glider vehicle manufacturers, which produce and sell complete glider vehicles that unquestionably are subject to GHG regulations. These are sophisticated operations that must be held accountable for complying with all EPA regulations to the same extent as other vehicle manufacturers. [EPA-HQ-OAR-2014-0827-1290-A1 p.64]

The small business exemption should be revoked sooner than EPA and NHTSA have proposed.

The sheer number of uncertified vehicles produced since 2014 also underscores a second significant shortcoming of EPA's Phase 1 rule, which must be addressed in Phase 2; the small manufacturer exemption at 40 CFR § 1037.150(c). The exemption, as currently applied, exempts manufacturers that employ fewer than 1,000 employees. As explained in Volvo Group's comments on the Phase 1 regulation, this exemption creates a sizable loophole for many manufacturers that produce substantial quantities of vehicles. [EPA-HQ-OAR-2014-0827-1290-A1 p.65]

EPA has proposed phasing out the small manufacturer exemption by 2022, or one year after all other manufacturers are required to comply with the Phase 2 requirements. Volvo Group does not believe the small manufacturer exemption was justified in Phase 1, and opposes further extension of this loophole for another seven years. Volvo Group believes that the Small Manufacturer Exemption should be phased out by January 1, 2018. Such a schedule gives these manufacturers *an additional* four years of lead-time to meet Phase 1 GHG standards, above and beyond the lead-time afforded to their competitors. Failing this, the agencies should simply eliminate the one year delay and remove the exemption for the entirety of Phase 2, starting with the 2021 Model Year. [EPA-HQ-OAR-2014-0827-1290-A1 p.65]

Volvo Group is uncertain of the correct interpretation of the provisions of 40 CFR 1037.635. This section is entitled "Glider Kits"; however, the agencies lay out the necessary conditions to qualify for the limited production exemption described in that section as, "...if you are a small manufacturer and you sold vehicles in 2014 under the provisions of § 1037.150(j)." The provisions at 1037.150(j) permit a manufacturer to install 2013 model year and earlier engines in vehicles (the provision has been revised in this proposal to sunset with vehicles having a date of manufacture January 1, 2018 or later). Many manufacturers, large and small, have installed 2013 model year engines in vehicles sold in 2014. This may have included vehicles having a 2013 date of manufacture, or having a 2014 date of manufacture, that were sold in 2014. There are no requirements to inform the agencies of the plan to sell vehicles under the provisions of 1037.150(j), nor to provide any reports to EPA. On its face, the limited volume exemption at 1037.635 effectively applies to *all* small manufacturers of vehicles. If this was the agencies' intent, Volvo Group opposes the provisions, and considers that small business should not be afforded any exemptions. If this was not the agencies' intent, then Volvo Group proposes that the agencies clarify the language to specify that the vehicles sold under the provisions of 1037.150(j) must have been vehicles produced by small manufacturers from glider kits, as the name of the section implies. [EPA-HQ-OAR-2014-0827-1290-A1 p.65]

#### EPA Should Review Glider Exemption and Stockpiling Potential

Since glider vehicle producers assemble vehicles from parts purchased from OEMs, engine remanufacturers and other suppliers, these companies do not require a substantial number of employees to be able to produce a substantial number of vehicles. In this regard, EPA's small manufacturer exemption also creates a sizeable loophole for many glider vehicle producers, which in turn were able to produce (and continue to be able to produce) substantial numbers of uncertified glider vehicles. For this reason, Volvo Group supports EPA's efforts to limit this loophole through the Phase 2 rulemaking, but

is concerned that the Agency's efforts may be too little too late in terms of stemming the impact of glider vehicles in undermining GHG and criteria emissions reductions achieved to date and in the future. At a minimum, EPA should impose the proposed 300-vehicle annual limit on the production of glider vehicles; although Volvo Group believes that even this limit likely far exceeds what is necessary to allow for legitimate use of glider vehicles while preserving important emissions reductions. [EPA-HQ-OAR-2014-0827-1290-A1 p.65-66]

EPA is proposing to provide an exemption that would allow most glider-vehicle manufacturers (those that qualify as small manufacturers) to avoid criteria emissions and greenhouse gas/fuel consumption requirements for a limited number of glider vehicle sales each year. The proposal would limit the number of exempt vehicles any manufacturer can sell in a given year, starting in 2018 with respect to engine compliance with criteria and CO<sub>2</sub> emissions/fuel consumption requirements, and 2022 with respect to vehicle compliance with CO<sub>2</sub>/fuel consumption requirements. The annual sales would be limited to the manufacturer's highest annual sales volume over the years 2010 through 2014, or 300 units, whichever is less. Volvo Group questions why such an annual exemption is deemed necessary or appropriate, especially in light of the considerations set forth herein. [EPA-HQ-OAR-2014-0827-1290-A1 p.66]

In the Regulatory Impact Analysis, the agencies cite the recommendations of the Small Business Advocacy Review (SBAR) Panel in support of the proposed glider provisions. In particular, the agencies note "The Panel stated that it believes that the number of vehicles produced by small business glider manufacturers is too small to have a substantial impact on the total heavy-duty inventory." (RIA at 12-6) Nowhere in either the RIA or the SBAR Panel report, however, do any of the agencies provide a basis for this conclusion. Significantly, there is no discussion of the "spike" in production in 2011 and 2012 that the SBAR panel otherwise describes. There is no discussion or investigation of corresponding and increasing spikes in 2013 and 2014; or any acknowledgment – never mind further investigation – of this alarming trend. And there is no analysis of the impact of increased incentives to produce glider vehicles that will be generated by the GHG Phase 2 proposal. In summary, the agencies rely on a conclusory finding to dismiss what is likely to be a potentially significant undermining influence on the effectiveness of the GHG and criteria emissions regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.66]

First, EPA fails to take into account the incentive it is creating for more companies to engage in the manufacture of glider vehicles by codifying an exemption to the GHG Phase 2 regulations for these vehicles. As discussed earlier, while the proposal would be limited to entities that both installed engines pursuant to 40 CFR §1037.150(j) and qualify for the small manufacturer exemption, the universe of entities that meet these criteria likely is larger than the universe of existing glider vehicle manufacturers. Any entity that sold vehicles under the provisions of 40 CFR § 1037.150(j), regardless of its size at that time, could enter the glider-vehicle business as long as it qualifies as a small manufacturer at the time it elects to sell glider vehicles. If it elects to provide an exemption for glider vehicles, EPA should limit the exemption to entities that both qualified as small manufacturers in 2014 and sold vehicles *produced from glider kits* under the provisions of 40 CFR § 1037.150(j). [EPA-HQ-OAR-2014-0827-1290-A1 p.66]

Second, it does not appear that EPA has adequately considered the impact of its decision to delay imposition of any limits on these vehicles until 2018, when it proposes to require currently certified engines. The Agency, in doing so, is creating still further incentive for substantially increased production in 2016 and 2017. While pre-buys are a known consequence of new regulatory requirements (as occurred in 2007 and could again in 2016 prior to the reduced engine GHG standards effective with the 2017 model year), EPA need not exacerbate them by providing a window for the unfettered manufacture of non-compliant vehicles. At a minimum, EPA should adopt additional stringent measures

to prevent the stockpiling of glider vehicles after new standards take effect, and/or pull forward the 2018 sunset date. [EPA-HQ-OAR-2014-0827-1290-A1 p.66]

Moreover, even if the Panel's conclusion were accurate when viewed on the basis of *production inventory*, this analysis makes no account of the impact these vehicles have on the *emissions* inventory. As illustrated earlier, we find the impact to be huge. Given the magnitude of the environmental impact these vehicles have compared to the fully compliant vehicles other manufacturers are obligated to sell, it would seem appropriate not to include any such exemption, or to limit the number to much less than 300. The Panel recommendations cited continue by saying, "The Panel also stated that there should be an allowance to produce some number of glider kits for legitimate purposes, such as for newer vehicles badly damaged in crashes." If the agencies are seeking to provide adequate volume to cover what have been characterized as "legitimate" applications of glider kits (wrecked vehicles and similar), it may be more appropriate to promulgate regulations that define allowed practices (repair of badly damaged vehicles) and prohibited practices (manufacture of new vehicles from new and used components that do not comply with current criteria and GHG emission requirements). If the agencies are seeking to provide a reasonable exemption to support the viability of small businesses already in existence today, we believe the recommendation of the panel to limit the exemption to "allow sales levels as high as the peak levels in the 2010-2012 timeframe," while retaining the condition that the annual volume never exceed 300 units per manufacturer, is the absolute maximum relief that should be granted. However, Volvo Group believes that the limit should be on the production of vehicles, rather than the sale. [EPA-HQ-OAR-2014-0827-1290-A1 p.67]

EPA has requested comment on whether the Agency should permit the sale of glider vehicles on the condition that they are equipped with 2010 or later model year engines, or somehow treat glider vehicles equipped with 2010 and later engines differently. It's unclear from the request for comment whether this provision would pertain to the units that are built under the limited annual small business exemption or to those that are produced by companies that do not qualify for the small business exemption (and those quantities sold in a year above the exemption cap). Anticipating that the latter is the intention, Volvo Group does not support such a relaxation of the "full compliance" obligation that EPA and NHTSA have proposed. [EPA-HQ-OAR-2014-0827-1290-A1 p.67]

#### Definition of "New Motor Vehicle," "Glider Kit" and "Glider Vehicle"

EPA has proposed adding new definitions of "glider kit" and "glider vehicle," and amending the definition of "new motor vehicle" to highlight that vehicles produced from glider kits are subject to the Clean Air Act, including 40 CFR Part 1037. As noted above, Volvo Group agrees with EPA that Part 1037, as currently drafted, already plainly covers these vehicles. That said, Volvo Group supports efforts to clarify the applicability of Part 1037 in this regard, including clarification of relevant definitions as appropriate. Volvo Group is concerned, however, that the proposed definitions and/or amendments related to glider kits and vehicles may create additional confusion. [EPA-HQ-OAR-2014-0827-1290-A1 p.67]

First, EPA proposes to add, for purposes of clarification, the following to the definition of "new motor vehicle": "*For example, vehicles commonly known as 'glider kits' or 'gliders' are new motor vehicles.*" Volvo Group strongly supports the inclusion of language specifically recognizing vehicles produced from glider kits in this definition. However, we are concerned with the inclusion of the term 'glider kit' in this definition in so far as it indicates that all types of glider kits – taken alone – are subject to Part 1037 and the Clean Air Act. Where such a kit is incapable of being "self-propelled," it does not fall within the definition of "motor vehicle" under CAA § 216(2). We would recommend EPA revise the

language to state, “For example, vehicles produced from ‘glider kits’ are new motor vehicles.” [EPA-HQ-OAR-2014-0827-1290-A1 p.67]

Second, Volvo Group recommends that EPA amend the proposed definition of “glider kit” as follows: Glider kit means a new vehicle that is incomplete because it lacks an engine, transmission, or drive axle. A glider kit may include previously used parts. A glider kit becomes a new motor vehicle upon the installation of an engine, transmission, and axles, regardless of whether the ultimate purchaser has received title or placed it into service. [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

Third, Volvo Group recommends that EPA amend the proposed definition of “glider vehicle” to state: Glider vehicle means a vehicle produced from a glider kit, or a new vehicle produced with a used engine. Volvo Group believes these definitions will more closely align EPA’s proposed regulations to current practices and ensure that vehicles produced from glider kits do not circumvent Clean Air Act requirements. [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

EPA and NHTSA Actions addressing Glider Kits are Appropriate

The rapidly expanding glider-based vehicle market is seriously undermining the significant gains EPA, NHTSA, and the heavy-duty vehicle industry have made to reduce criteria and greenhouse gas emissions, reduce fuel consumption, and improve roadway safety. Even at just a few percent of total Class 8 market sales, the level of PM and NO<sub>x</sub> emissions from these vehicles is on par with or exceeds the emissions from the balance of sales fulfilled by fully compliant products. The market availability of these non-compliant engines and vehicles poses an unfair competitive disadvantage to manufacturers that have undertaken the enormous effort and investment necessary to comply with all applicable emissions, fuel efficiency, and safety standards. It is therefore imperative that the agencies follow through by finalizing regulation that prohibits the production of glider-based vehicles for anything other than legitimate purposes and that the agencies actively ensure compliance to those requirements. [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

Also included in the NoDA were arguments related to the agencies’ authority to regulate glider vehicles and trailers. The Volvo Group fully supports EPA’s and NHTSA’s efforts to achieve efficiency gains and criteria emissions reductions as related to gliders and trailers, and offer our comments that follow accordingly. [EPA-HQ-OAR-2014-0827-1928-A1 p.3] [[This comment can also be found in section 1.3.1 of the Comment Summary.]]

#### **Comments on Legal Memorandum Pertaining to Trailers, Glider Vehicles, and Glider Kits under the CAA - EPA-HQ-OAR-2014-0827-1627**

Volvo agrees with EPA that the Agency has authority to establish emissions standards for complete new motor vehicles, and further that glider vehicles – or vehicles manufactured from glider kits – constitute complete new vehicles for purposes of the Agency’s authority to establish emissions standards.<sup>5</sup> Volvo further agrees that the installation of non-new engines, such as rebuilt or remanufactured engines or used engines from “donor” vehicles, in a glider vehicle in and of itself is not determinative of whether that vehicle is new for purposes of compliance with Clean Air Act requirements. As we noted in our comments on the Proposed Rule, glider kits can serve a legitimate purpose, such as allowing individual truck owners to re-use driveline components that had not yet accumulated end-of-life mileage following an accident or other event that renders the rest of the vehicle unusable.<sup>6</sup> Volvo agrees, however, that such legitimate uses should not become a loophole through which truck manufacturers are able to produce otherwise new vehicles not subject to current emissions requirements merely by installing a rebuilt, remanufactured, or otherwise non-new engine in the vehicle. For these same reasons, Volvo

agrees that the assignment of a vehicle identification number (VIN) from a pre-existing vehicle to a glider vehicle should not be determinative of whether the glider vehicle is new, as EPA notes.<sup>7</sup> Rather, EPA should consider a limited exemption for production of glider kits that permits their legitimate use as replacement components, similar to what the Agency already provides for new replacement engines. [EPA-HQ-OAR-2014-0827-1928-A1 p.24-25]

Volvo generally supports EPA's proposal to require that engines used in glider vehicles be certified to standards for the model year in which these vehicles are assembled. See 80 Fed. Reg. 40528. Volvo also agrees that this proposal is within EPA's legal authority given, as discussed above, glider vehicles are essentially new motor vehicles. Moreover, the regulatory language proposed by EPA is appropriately confined to a section of the regulations specifically applicable to glider kits, proposed 40 CFR § 1037.635. This is important, as this requirement, if applied more broadly, could impinge on the legitimate and legal use by vehicle manufacturers of engines that have a model year different from the calendar year in which a vehicle is assembled. For instance, vehicle manufacturers are permitted to use previous model-year engines that remain in a vehicle manufacturer's existing inventory, even if the engine model year differs from the calendar year in which the vehicle is manufactured. [EPA-HQ-OAR-2014-0827-1928-A1 p.25]

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5 EPA's position, as referenced here, is set forth in the document entitled Legal Memorandum Discussing Issues Pertaining to Trailers, Glider Vehicles, and Glider Kits under the Clean Air Act, USEPA February 2016 – Draft, at 2. (hereafter "Legal Memorandum").

6 Comments of the Volvo Group, Oct. 1, 2015, at 61.

7 Legal Memorandum at 2.

13 The GREET Model Expansion for Well-to-Wheels Analysis of Heavy Duty Vehicles, ANL/ESD-15/9, Argonne National Laboratory, May 2015

**Organization:** Worldwide Equipment Enterprises, Inc.

Worldwide Equipment strongly supports the agencies' proposal to impose new requirements on companies assembling and offering for sale vehicles produced by installing used driveline components into new glider kits. EPA and NHTSA should require that manufacturers of these glider-based vehicles to comply with all applicable and current greenhouse gas and criteria emissions standards. NHTSA should also enforce the existing regulations that require manufacturers of glider-based vehicles to comply with all applicable safety standards. [EPA-HQ-OAR-2014-0827-0948-A2 p.1]

Dealers such as ours have been subject to a growing unfair competition from this rapidly expanding market of non-compliant vehicles. Worldwide Equipment supports the application of glider kits as a means to repair badly damaged vehicles, while taking advantage of the remaining useful life in the damaged vehicle's driveline components. When conducted within the requirements of 49 CFR 571.7(e), which sets forth NHTSA's rules for re-use of driveline components for installation into a glider kit, we have no specific concerns with such legitimate applications of glider kits. It's when these rules are violated, however, in an effort to offer for sale an essentially new vehicle whose production costs and total cost of ownership may be tens of thousands of dollars less than the fully compliant new products sold by our dealership that we strongly object to such an unfair disruption of market competition. It is important to understand that the small number of companies ignoring the purpose and intent of the

glider kit regulations are creating significant environmental issues as between 8,000 to 10,000 of these noncompliant engines were put in to service in glider kit rebuilds last year alone. Unfortunately, this practice has become widespread without consequence to the glider based vehicle manufacturers, and it is unfairly and negatively impacting our business. [EPA-HQ-OAR-2014-0827-0948-A2 p.2]

In addition to not having to follow the environmental regulations that legitimate dealers like Worldwide have to follow, the manufacturers of glider-based vehicles, in many cases, are not collecting the 12% federal excise tax (“FET”) that normally applies to new vehicle sales, giving customers even further financial incentive to purchase glider vehicles rather than fully compliant new vehicles. In addition to creating an unfair financial advantage over legitimate dealers like Worldwide Equipment, this failure to collect the appropriate taxes hurts local and state governments as well which has a direct impact on the maintenance of transportation infrastructure that is so vital to the entire trucking industry. And this abuse of the glider kit regulations, as noted, creates significant environmental damage through the use of non-compliant engines and other components. [EPA-HQ-OAR-2014-0827-0948-A2 p.2]

This abusive application of glider kits must be stopped and Worldwide Equipment, Incorporated strongly support the agencies’ efforts to do so through appropriate new regulations and enforcement of existing regulations. EPA and NHTSA should seek to remedy this situation as soon as practicable. [EPA-HQ-OAR-2014-0827-0948-A2 p.2]

In conclusion, the rapidly expanding glider-based vehicle market is seriously undermining the significant gains EPA, NHTSA, and the heavy-duty vehicle industry have made to reduce criteria and greenhouse gas emissions, reduce fuel consumption, and improve roadway safety. The market availability of these non-compliant engines and vehicles poses an unfair competitive disadvantage to manufacturers that have undertaken the enormous effort and investment necessary to comply with all applicable emissions, fuel efficiency, and safety standards, and likewise an unfair competitive advantage to the dealer network representing those OEM’s. It is therefore imperative that the agencies follow through by finalizing regulations that prohibit the production of glider-based vehicles for anything other than legitimate purposes, and that the agencies actively ensure compliance to those requirements. [EPA-HQ-OAR-2014-0827-0948-A2 p.3]

**Response:**

*Environmental Impacts of Gliders*

Current standards for NOx and PM are at least 90 percent lower than the most stringent previously applicable standards, so the NOx and PM emissions of any glider vehicles using pre-2007 engines are at least ten times higher than emissions from equivalent vehicles being produced with brand new engines. 80 FR 40528. However, most gliders being produced today use engines originally manufactured before 2002. Since these pre-2002 engines lack both EGR and exhaust aftertreatment, they would have NOx and PM 20-40 times current engines. If miscalibrated, emissions could be even higher. Thus, each glider vehicle using an older engine that is purchased instead of a new vehicle with a current MY engine results in significantly higher in-use emissions<sup>233</sup>.

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<sup>233</sup> Thus, Mondial’s statement that the 10,000 plus glider vehicles now produced annually is insignificant compared to the total number of tractors produced is seriously misplaced. The 10,000 gliders have the environmental impact of *at least 200,000* fully compliant new tractors.



Clarke Power Services commented that the EPA has “not adequately defined the impact of the current number of Gliders which are assembled each year” and that “additional studies need to be made to adequately define the “right” number of Gliders allowed.” However, we do not see how the current rates of production would affect the “right number” to allow going forward. As described below, even a small number of glider vehicles using pre-2002 engines can have severe public health impacts. As described in Section XIII.B of the FRM Preamble, EPA’s final regulations focus more on the ensuring the right type of gliders are produced using the right type of engines, rather than the right number. In an effort to lessen economic impacts on small businesses, we are reluctantly allowing certain small businesses to produce a limited number of glider vehicles using the higher emitting engines. However, this allowance is not based on our estimate of current or future production rates.

While EPA does not have precise estimates of current glider production, it is clear that production of glider vehicles has increased by an order of magnitude from what it was in the 2004-2006 time frame – from a few hundred each year to thousands.<sup>234</sup> EPA has previously estimated environmental impact of 5,000 glider vehicles per year, which would be roughly 2% of the Class 8 vehicles manufactured annually. We estimated that at that rate, these gliders could account for as much as one-half of total NOx and PM emissions from all new Class 8 vehicles.<sup>235</sup> Several commenters supported EPA’s assessment of the environmental impacts of glider vehicles. Volvo suggested in its comments on the NPRM that the impacts were even greater, estimating that 2014 glider sales were “on the order of 6,000” and that they emit twice as many tons of PM as the rest of the 2014 vehicles. Similarly, as Volvo noted in its comments:

EPA’s own analysis as detailed in their recent glider Q&A document indicates that NOx and PM emissions from glider vehicles at current sales levels are equivalent to about 80 percent of the total NOx and PM emissions from the *entire* Class 8 sales fleet. Focusing on PM emissions, and applying the emissions levels indicated in Argonne National Lab’s recent update to the GREET Analysis<sup>236</sup>, at just 3% market penetration of the most egregious applications, the 2014 glider fleet emits *twice* the level of PM emissions that the 97% *entire* fleet of compliant vehicle sales emits that same year.

Even some commenters opposing EPA’s proposal acknowledged that glider sales are now over 10,000 units annually.<sup>237</sup> No commenters disagreed with EPA’s assessment of NOx and PM impacts. Clarke Power Services suggested that the growing shortage of older engines will limit the impact of gliders. However, as shown in Appendix A to this section, even a single year at current production rates has serious public health consequences.

For the final rule, EPA has updated its analysis of environmental impacts of gliders, reflecting the comments received. See Appendix A to this Section 14. We project that without the new restrictions, glider vehicles on the road in 2025 would emit nearly 300,000 tons of NOx and nearly 8,000 tons of diesel PM annually. Although glider vehicles would make up only 5 percent of heavy-duty tractors on

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<sup>234</sup> “Industry Characterization of Heavy Duty Glider Kits,” MacKay & Company, September 30, 2013.

<sup>235</sup> Frequently Asked Questions about Heavy-Duty “Glider Vehicles” and “Glider Kits”, EPA-420-F-15-904, July 2015.

<sup>236</sup> The GREET Model Expansion for Well-to-Wheels Analysis of Heavy Duty Vehicles, ANL/ESD-15/9, Argonne National Laboratory, May 2015.

<sup>237</sup> In its comments, Fitzgerald indicated that current sales of glider vehicles exceed 10,000 vehicles annually but termed these amounts “insignificant” compared with the total number of trucks. Unfortunately, as shown in the text above, this is not the case. Criteria pollutant emissions impacts of 10,000 glider vehicles is equivalent to at least 200,000 fully compliant new trucks.

the road, their emissions would represent about *one-third* of all NO<sub>x</sub> and PM emissions from heavy-duty tractors in 2025. Put into monetary terms using PM-related benefit-per-ton values described in Section IX.H, the removal of all unrestricted glider vehicle emissions from the atmosphere would yield between \$6 to \$14 billion in benefits annually (2013\$). It is clear that removing even a fraction of these glider vehicles from the road will yield substantial health-related benefits. Moreover, the PM valuation is for particulate matter generally. Although there is evidence suggestive of a causal relationship between long-term PM<sub>2.5</sub> exposures and carcinogenic effects (see 78 FR 3101/3 (Jan. 15, 2013)), the causal connection with diesel PM (diesel exhaust) and carcinogenic effects is stronger. As described in Preamble Section VIII.A (6), exposure to diesel exhaust was classified as likely to be carcinogenic to humans by inhalation from environmental exposures, in accordance with the revised draft 1996/1999 EPA cancer guidelines.<sup>238,239</sup> A number of other agencies (National Institute for Occupational Safety and Health, the International Agency for Research on Cancer, the World Health Organization, California EPA, and the U.S. Department of Health and Human Services) had made similar hazard classifications prior to 2002. EPA also concluded in the 2002 Diesel HAD that it was not possible to calculate a cancer unit risk for diesel exhaust due to limitations in the exposure data for the occupational groups or the absence of a dose-response relationship. In the absence of a cancer unit risk, the Diesel HAD sought to provide additional insight into the significance of the diesel exhaust cancer hazard by estimating possible ranges of risk that might be present in the population. An exploratory analysis was used to characterize a range of possible lung cancer risk. The outcome was that environmental risks of cancer from long-term diesel exhaust exposures could plausibly range from as low as 10<sup>-5</sup> to as high as 10<sup>-3</sup>.

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<sup>238</sup> U.S. EPA. (1999). *Guidelines for Carcinogen Risk Assessment*. Review Draft. NCEA-F-0644, July. Washington, DC: U.S. EPA. Retrieved on March 19, 2009 from <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=54932>.

<sup>239</sup> U.S. EPA (2002). *Health Assessment Document for Diesel Engine Exhaust*. EPA/600/8-90/057F Office of Research and Development, Washington DC. Retrieved on March 17, 2009 from <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=29060>. pp. 1-1 1-2.

A quantified risk analysis is included in Appendix A to this Section 14. As discussed further below, this analysis indicates that for a single model year, assuming the use of 5,000-10,000 high polluting engines in glider vehicles, PM<sub>2.5</sub>-related exposures are estimated to result in 350 to 1,600 premature mortalities. Several commenters argued that EPA is precluded from adopting any controls on installation of high polluting engines in glider vehicles until MY 2021. This could mean the production of 30,000 to 40,000 additional glider vehicles using the older high polluting engines. Using the same assumptions as above, these three additional model years of production are estimated to result in an additional 2,100 to 6,400 premature mortalities. Some commenters seemed to suggest that the trend of increasing production of glider vehicles with high polluting engines would eventually reverse itself, but this analysis shows that EPA cannot simply wait for this problem to go away on its own.

The EPA regards these estimates as significantly conservative. First, based on the public comments from both glider vehicle producers and producers of engines which comply with current standards, it likely underestimates the number of glider vehicles with high-polluting engines produced today. Second, the analysis considers only potential premature mortality attributable to exposure to PM<sub>2.5</sub>. This is conservative for at least three reasons. First, it does not account for the carcinogenic potential of diesel exhaust PM, which is a subset of PM<sub>2.5</sub>. Second, it does not consider other health and welfare benefits of reducing exposure to PM<sub>2.5</sub> (see Appendix Table A-5). Third, it does not quantify premature mortality and other health effects attributable to exposure to ozone. Although ozone is not emitted directly, the chief precursor is NO<sub>x</sub> (see Preamble section VIII.A (3) and 80 FR 65299-300 (Oct. 26, 2015)), which glider vehicles emit in huge quantities, as noted above.

Some commenters argued that gliders offer an efficiency advantage compared to continuing to use older trucks, and that glider use also resulted in reduced HFC emissions from the A/C systems. However, this is a false comparison. While it may have been valid when glider vehicle sales were less than 1,000 per year, it is not valid for current sales. As supported by comments from truck manufacturers and dealerships, glider sales now come at the expense of sales of fully compliant new trucks.<sup>240,241</sup> Nor is the commenters' assertion regarding HFC emissions persuasive given the A/C leakage controls for tractors adopted in the Phase 1 rules. Some commenters stated that remanufacturing an engine and transmission uses 85% less energy than manufacturing them new, but did not provide an analysis for EPA to

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<sup>240</sup> See, e.g., Comment from Nuss Truck: "Dealers such as ours have been subject to a growing unfair competition from this rapidly expanding market of non-compliant vehicles. ...[T]ruck purchasers have the ability to purchase a powertrain combination that they never owned in an existing truck, from assemblers who have chosen to exploit the law put in place that was intended to clean up air pollution. The original intent of selling glider kits has moved from a rebuilding mechanism to now mainly evading diesel emissions EPA mandates. We see many truck owners and small fleets from Minnesota and Wisconsin traveling long distances, passing by dozens of legitimate truck dealers, to purchase glider kits directly from a manufacturer in another state, just to avoid the current EPA emissions standards. That should not be a legally acceptable reason to purchase a glider kit, if we all want clean air."

<sup>241</sup> The comment of Truck Country of Wisconsin similarly describes the competitive conundrum facing dealers selling tractors with compliant engines: "1. We agree with EPA's assessment that most gliders manufactured today use remanufactured model year 2001 or older engines. Typically these engines have and NO<sub>x</sub> and particulate matter (PM) emissions 20 to 40 times higher than today's clean engines. Since 2010 when EPA's current NO<sub>x</sub> and PM standards for heavy duty engines took effect, glider sales have increased nearly 10-fold as compared to the 2004-2006 time frame; 2. We agree with EPA that this increase reflects an attempt to avoid using engines that comply with EPA's 2010 standards, and is an attempt to circumvent the Clean Air Act purpose to protect human health and the environment; 3. The Trucking Industry has made enormous investments in new engines standards to comply with past and future EPA regulations. We believe this circumvents these standards and will make it harder to meet compliance; and 4. We agree with EPA's Clean Air Act definition of 'new motor vehicle' is not based on the condition of the parts assembled to create the vehicle but rather encompasses the entire vehicle, even if they incorporate some previously used components."

evaluate. Clarke Power Services commented that newly rebuilt engines have lower criteria emissions than a “worn oil burning engine which is beyond its useful life.” However, that is not relevant to this discussion since engines can be rebuilt without replacing the chassis. The appropriate comparison is to new vehicles with fully compliant new engines. When compared to these engines, even the most carefully rebuilt and recalibrated 1998-vintage engine would have NO<sub>x</sub> and PM emissions at least 20 times as high as engines meeting current standards.

Finally, some commenters stated that glider engines actually have better fuel economy and greenhouse gas (“GHG”) emissions than today’s low NO<sub>x</sub> engines. However, this is not true. Even before Phase 1, engine manufacturers had improved fuel consumption significantly beyond 2009 levels. The 2014 Phase 1 standards required significant additional improvement and the Phase 1 2017 standards will result in even more improvement. Fleets purchasing gliders would thus see greater efficiency improvements by purchasing trucks meeting GHG standards for new vehicles and engines.

#### *Potentially Legitimate Purpose of Gliders*

Although EPA is addressing this issue because of the adverse public health and environmental impacts of glider vehicles, many commenters (including some who supported EPA’s proposed restrictions), commented that glider kits serve a legitimate purpose in some cases. Most identified cases in which relatively new vehicles suffer significant frame damage as the result of an accident or from a severe duty application, without significant damage to the driveline. Volvo stated:

The “glider kit” emerged some decades ago as an assemblage of new vehicle components absent the engine, transmission, and rear axles (the “driveline”). These kits were produced by vehicle OEMs, and made available for sale to dealers and other vehicle repair centers as a means to repair a vehicle that had been badly damaged in an accident or similar event. This permitted re-use of driveline components that had not yet accumulated end-of-life mileage by the time of the accident.

Some commenters misinterpreted EPA statements about the “most legitimate” use of gliders in the NPRM and NODA to be a determination that some use of glider kits is legitimate. Although EPA has not taken a position on whether such use of glider kits is truly legitimate, we do agree that circumstances such as those addressed by Volvo represent their most legitimate use. Volvo commented that any allowances for glider kits should be limited to these legitimate purposes. While we are generally sympathetic to the goal of limiting the use of glider kits to the most legitimate circumstances, we do not think it would be possible to enforce restrictions based on the intent of the operator or assembler, so that such a regime would invite abuse (and thus serve to perpetuate environmentally unsound practices). We are also concerned that it would be difficult to enforce requirements based on the condition of the donor vehicle as a proxy for intent since the donor vehicle will typically be destroyed as part of the process. To the extent we reflect any of these factors in our regulations, we believe it will be more enforceable to base the requirements on the age and mileage of the engine, as explained in the following section of this response.

Some commenters suggested that another legitimate purpose of glider kits is to improve efficiency. For example, Clarke Power Services stated that trucking fleets purchasing glider vehicles “are not motivated by circumventing the EPA policies, but are most interested in being more efficient by removing old equipment from service and introducing a significantly improved heavy duty truck in its place.” We do not agree. First, the significant adverse public health and environmental consequences of order of magnitude and greater increases in NO<sub>x</sub> and diesel PM emissions would exist even if the commenter were correct. The commenter is in any case mistaken in suggesting that glider vehicles have a fuel efficiency advantage over new tractors. As explained above, with the advent of the Phase 1 GHG and

fuel consumption standards, fleets purchasing gliders would see greater efficiency improvements by purchasing trucks meeting GHG standards for new vehicles and engines. Although this would cost more upfront, these costs would be recouped via greater fuel savings within the first few years of ownership.

#### *Treatment of Donor Engines within their Useful Life*

In section (i) of the legal memorandum on issues pertaining to trailers, glider kits, and glider vehicles accompanying the Notice of Data Availability, EPA requested comment on finalizing special provisions for gliders using engines that are still within their original regulatory useful life (10 years and 435,000 miles for Class 8 vehicles) that would allow relatively new engines to be reused in gliders without recertification to standards corresponding to the year of assembly of the glider vehicle. Such engines would necessarily be cleaner than the pre-2002 engines being used in most gliders today, and by 2021, all would be compliant with the 2010 standards. This allowance would also be inherently consistent with the most legitimate use of glider kits because no one would scrap a chassis within the useful life unless it was severely damaged. Commenters generally supported this approach. Many also supported the additional approach EPA discussed in conjunction with the NODA that would ignore miles if the donor engine is less than three years old and ignore years if the engine had less than 100,000 miles. (These additional allowances would provide some additional flexibility for an engine not fully within its useful life). Some commenters argued that such a provision should only apply with respect to miles, and that EPA should not restrict this flexibility based on engine age so as not to disadvantage engines in very low usage applications. E-One's comments suggested that EPA should adopt provisions to address emergency vehicles that last 10 to 20 years but may have traveled only 10-50,000 miles.

After considering these comments, EPA has decided to finalize the approach described in the NODA. (As described later, the proposed small business flexibility is also being adopted, but as an interim provision). We believe this addresses the most traditional, legitimate use of glider kits, which is for vehicles in severe duty applications (such as cement mixers and dump trucks) that incur substantial chassis damage before the engine reaches the 10-year end of its regulatory useful life. By 2020 nearly all glider vehicles would have to be produced using engines meeting the 2010 NO<sub>x</sub> and PM standards (since an older-than-10 year engine would be outside its regulatory useful life). Because the potential for adverse environmental effects from such vehicles is significantly reduced (compared to the more common current use of pre-2002 model year engines, with their much higher criteria pollutant emissions), EPA is allowing their continued use in glider vehicles without recertification to more stringent criteria pollutant standards, and without meeting GHG standards.

This approach provides this flexibility to very low use applications, such as those identified by E-One, where donor engines have less than 100,000 miles after 10 years. The final regulations will thus allow reuse of an engine more than 10 years old without recertification, as long as the engine can be shown to have fewer than 100,000 miles on it. The environmental impact of allowing this should be minimal because there should be very few engines that qualify and they will necessarily be in applications that operate infrequently. (Any vehicles that operate more than 10,000 miles per year would exceed 100,000 miles before 10 years).

At the other extreme, some Class 8 vehicles may reach 435,000 miles within a few years. Today's Class 8 engines and vehicles are generally expected to last well beyond this point, so such engines would be installed in glider kits only if the chassis was defective or had been in a major accident. The NODA approach, which is being adopted, treats these engines as being within their useful life as long as they are less than 3 years old. This approach was supported by NADA. The environmental impact of allowing this should also be minimal because there should be very few engines that qualify and they will necessarily be engines certified to 2010 or later standards.

### *Treatment of MY 2010 and Later Donor Engines*

Several commenters supported allowing unlimited production of glider vehicles if they use engines certified to 2010 or later NO<sub>x</sub> and PM standards, although Volvo opposed this concept. Daimler commented that “2010 and later engines are not currently being used in glider vehicles in large numbers,” but Clarke Power Services commented that the “industry is currently considering MY 2010 engines as the choice for Gliders moving forward.” EPA sees merit in this concept, but is concerned that it may not be appropriate in perpetuity. Obviously, reuse of engines originally certified to the 2010 standards for criteria pollutants would not have the same adverse environmental impacts as the current practice of reusing pre-2002 engines that have NO<sub>x</sub> and PM emissions 20-40 times higher than current engines. However, they would not necessarily be as clean for GHG or criteria pollutants as brand new engines with all new aftertreatment components. The Phase 1 and Phase 2 engine standards will result in brand new engines with lower GHG emissions (and better fuel efficiency) than pre-Phase 1 engines. And used 2010 aftertreatment components may be less effective at reducing NO<sub>x</sub> or PM than when new. Moreover, as described in Section I of the FRM Preamble, EPA may adopt more stringent NO<sub>x</sub> and/or PM standards for motor vehicles in the future. Thus, while using 2010 engines in glider vehicles would greatly reduce the concerns about NO<sub>x</sub> and PM emissions relative to current gliders, it would not eliminate all adverse public health and environmental impacts.

Sales patterns strongly support the idea that the surge in glider sales resulted from an attempt to avoid the 2010 criteria pollutant standards. Thus, it seems likely most purchasers of gliders today would not find gliders with 2010 engines nearly as attractive as they do current glider vehicles. Thus, we would not expect such an allowance to result in a continuation of the current surge in glider sales.

In an attempt to balance these factors, EPA is finalizing an interim provision – a provision which will sunset after EPA adopts new more stringent NO<sub>x</sub> standards – that will treat gliders using MY2010 and later engines the same as those using engines within their useful life. This would avoid most of the adverse impacts, especially for NO<sub>x</sub> and PM. Not requiring these engines to meet the latest GHG standards could have some impacts, but they would likely be small, especially if glider vehicle sales return to pre-2007 levels. EPA will continue to monitor sales patterns and may rescind this flexibility in a future rulemaking.

### *Legal Authority to Regulate Complete Glider Vehicles and Incomplete Glider Kits*

See Section 1.3.1 and preamble Section I.E.(1) for a discussion of EPA’s authority to regulate glider vehicles and glider kits. In addition, DTNA’s argument that this rulemaking should not address gliders because the primary focus of the rulemaking is control of GHGs rather than criteria pollutants, EPA notes that it gave ample notice of all issues relating to gliders, and provided multiple opportunities for public comment. The many comments on the issue from all types of stakeholders confirm the adequacy of notice here. The further comment that regulations on GHGs should not deal with other pollution has no legal basis. DTNA also commented that the engine rebuilding authority in section 202 (a)(3)(D) was not properly invoked because EPA had not proposed to amend the engine rebuilding regulations. EPA has included conforming amendments to 1037.150 (j), and 1068. 120 (f) in the final rules.

DTNA’s argument that the rule addresses vehicle rebuilding, rather than engine rebuilding, is not correct. In addition to the reasons addressed in Preamble Section I.3, it is clear that the statutory authority over engine rebuilding authorizes EPA to determine what standards a rebuilt engine shall meet. See CAA section 202 (a)(3) (D) stating that “the Administrator may prescribe requirements to control rebuilding practices, including standards applicable to emissions from any rebuilt heavy-duty engines (whether or not the engine is past its statutory useful life).” Comments from, e.g. Mondial and MEMA made clear that all of the donor engines installed in glider vehicles are rebuilt. See also

<http://www.truckinginfo.com/article/story/2013/04/the-return-of-the-glider.aspx> (“1999 to 2002-model diesels were known for reliability, longevity and good fuel mileage. Fitzgerald favors Detroit’s 12.7-liter Series 60 from that era, but also installs pre-EGR 14-liter Cummins and 15-liter Caterpillar diesels. All are rebuilt .....”).

### *Lead Time*

See Section 1.3.1 of this RTC and preamble Section I.E.(1) for a discussion of EPA’s statutory obligation for lead time with respect to gliders and glider kits. From a more practical perspective, we note that little lead time is needed for the changes being adopted. Glider kit manufacturers already offer comparable vehicles that are fully compliant with current standards, and thus do not need extensive lead time. Such vehicles are often identical to the completed glider vehicles other than the powertrains.

Most small glider vehicle assemblers do not need additional lead time because they will be allowed to continue assembling gliders at pre-2015 rates. We are aware of one glider kit assembler that produces more than 300 vehicles from glider kits each year and it will need to reduce its production in 2017 and later. However, we do not believe that manufacturer truly needs additional lead time. This manufacturer indicates that it fills orders for glider vehicles within three to six weeks from placement of the order, which means the new restrictions should not impact any existing orders.<sup>242</sup> Any vehicles that are already on order should be completed before 2017. For 2017, the regulations will allow this manufacturer to produce at its 2014 production rate. This 2017 restriction applies with respect to the total *annual* production for 2017, so the manufacturer will be allowed to gradually reduce its production of high polluting glider vehicles. This provides sufficient lead time for it to find compliant engines before its production limit drops to 300 in 2018. It is unclear that additional lead time would change anything for this manufacturer other than allowing it to produce additional high polluting glider vehicles.

Finally, any consideration of lead time must necessarily be balanced against the potential environmental and public health impacts. As shown in Appendix A to this section, even a small number of additional glider vehicles would have severe impacts. For example, a one-year delay that allowed 10,000 additional glider vehicles to be produced with high polluting engines would result in the following impacts:

- 415,000 tons of addition NOx emissions
- 6,800 tons of additional PM emissions
- 700 to 1,600 premature deaths
- \$3 to \$11 billion in PM-related monetized disbenefits

Given the severity of these impacts, delaying these provisions cannot be justified by merely the potential for inconvenience to the industry. Rather commenters would needed to have demonstrated that it is not feasible to comply with these requirements within the lead time provided. They have not done so. Most commenters supporting additional lead time focused on statutory requirements that were addressed in Section 1.3.1. Commenters that did address economic impacts merely speculated about the impacts or made vague references to jobs or small business impacts. Of course, as many commenters pointed out, glider vehicle production with high polluting engines comes at the expense of domestic manufacturers producing engines complying with the latest criteria pollutant and GHG standards. See further discussion of Economic Impacts below. No commenters provided any specific basis that would justify

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<sup>242</sup> [Advertisement](#) for Fitzgerald Glider Kits in Overdrive magazine (December 2015).

delaying the prevention of premature mortalities and billions of dollars of benefits achievable by implementing these provisions according to the final regulations.

### *Small Business Impacts*

Several commenters expressed concern about the impact of the proposed changes on small businesses that produce glider vehicles. However, commenters opposing the proposed requirements/clarifications did not address the very significant adverse public health and environmental impacts of the huge increase in glider vehicle production over the last several years. More importantly, EPA believes that with the changes being made in the final regulations, any small businesses that have been focused on producing gliders for traditional and legitimate purposes will not be significantly impacted by the new requirements, since they can use donor engines within their regulatory useful life for either age or mileage. Only those that have significantly increased production to create new trucks to circumvent the 2010 NO<sub>x</sub> and PM standards will have their sales significantly restricted. We are aware that Fitzgerald Gliders currently produces more than 300 vehicles from glider kits, and they appear to all use pre-2002 engines. It will need to cut back on its production of these vehicles (although it can continue unlimited production using low-polluting engines). Nevertheless, the company has previously acknowledged that they could “make a profit at 300 a year.”<sup>243</sup> Now Fitzgerald Gliders comments that “300 vehicles is too low given the abrupt change this regulation brings to the 50-year-old glider industry and the disproportionate impact it will have on small businesses.” However, it failed to acknowledge in its comments that for most of the “50-year-old glider industry” total industry-wide production of glider vehicles was much closer to 300 per year than to current production rates.<sup>244</sup> Fitzgerald Gliders also failed to note how rapidly they have increased production of glider vehicles over the last few years.

One commenter stated that EPA should also consider the impacts on small trucking companies. But here too, for the same reasons, trucking companies that seek gliders for traditional, legitimate purposes should be able to obtain them. Only those companies that seek to use older engines will be impacted, and these companies can produce glider vehicles using readily available compliant engines.<sup>245</sup>

Some commenters argued that EPA did not include enough glider manufacturers in the SBREFA process. However, EPA met its obligations under SBREFA. See generally RTC section 15.4. One of the Small Entity Representatives was a manufacturer of glider vehicles. Small businesses also had two opportunities to provide comments on the requirements. It is unclear how having additional glider manufacturers involved in the process would have changed its result.

Volvo also commented that EPA should clarify that the exemption is limited to entities that both qualified as small manufacturers in 2014 and sold vehicles produced from glider kits under the provisions of 40 CFR § 1037.150(j). We believe that this is what the final regulations clearly state. However, DTNA commented that “EPA’s current proposal unfairly penalizes those small businesses that did not sell gliders in 2014, but might have sold them in 2013 or 2015.” However, the small business provisions are intended to prevent the regulations from having a significant impact on the businesses. It is unclear how any restrictions of gliders could have any impact on a business that sold none in 2014 that would meet the threshold for “significant.” Clearly, glider sales cannot be an important portion of a company’s revenues if they sold none in 2014.

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<sup>243</sup> <http://www.truckinginfo.com/article/story/2013/04/the-return-of-the-glider.aspx>, accessed July 16, 2016.

<sup>244</sup> “Industry Characterization of Heavy Duty Glider Kits,” MacKay & Company, September 30, 2013.

<sup>245</sup> Memo to Docket, “Availability of Rebuilt Engines that Comply with 2010 Emission Standards”, August 2016.



PACCAR commented that EPA should eliminate the small business allowance altogether beginning in MY 2022 for gliders using pre-2010 engines. TCW opposed any relief for small businesses that assemble gliders, and Volvo commented that EPA should eliminate the small business exemption sooner than proposed. Consistent with Volvo's comments on the risk of a pre-buy, we are finalizing an additional restriction for 2017. Nevertheless, while EPA may eliminate or reduce the small manufacture provisions in a future rulemaking, such an action at this time would be inconsistent with the SBREFA Panel's recommendations, which EPA is choosing to largely follow to afford small businesses sufficient compliance flexibility, and to preserve opportunities for traditional uses of glider kits to provide a means of salvaging viable engines from non-viable powertrains. During the SBREFA process, EPA concurred with these recommendations, and without some more compelling reason, we believed it to be appropriate to allow this flexibility. Our recent reanalysis of the environmental impacts of even this small number of gliders suggests we may need to revisit it at some point within the Phase 2 time frame, especially if we find that this flexibility is being misused.

Terex Corporation comment that EPA should provide an exemption for any company manufactured fewer than 1,000 on highway vehicles annually between calendar years 2010 and 2014. However, we believe the other flexibilities allowing the use of newer engines will largely address Terex Corporation's concerns.

### *Sales Caps*

EPA received comments supporting higher caps and comments supporting lower caps. Commenters supporting higher caps did not argue that higher caps were necessary to allow for legitimate production at or below pre-2006 levels. Instead, these commenters seemed to be concerned solely about allowing continuation of very high sales. We see no basis for that. This would perpetuate the very conduct – continued use of high-pollution engines in contravention of standards for new vehicles and engines – which this action is intended to restrict. One commenter argued that the caps should be raised to account for the likelihood that the number of small businesses assembling glider vehicles would decrease as a result of the rule changes. However, we think the other revisions being made to allow additional glider vehicles to be produced without a sales cap (i.e. allowing continued use of donor engines within their useful life for either mileage or age) will offset any impacts on the availability of gliders that might result from a reduction in the number of businesses in this market.

Combined with the other flexibilities in the final rule, this small manufacturer allowance should allow the industry to produce glider vehicles near pre-2006 levels. While there may be disruptions for some companies, higher caps cannot be justified by merely the potential for inconvenience to the industry or even significant disruption for a few companies. Fitzgerald Gliders currently produces more than 300 vehicles from glider kits and is likely to be the small business that will be most impacted by this cap, but as noted above, they have acknowledged that they could “make a profit at 300 a year.”<sup>246</sup>

EPA also received comments supporting potentially lower cap levels. ICCT agreed that glider sales should be restricted to a number that is consistent with pre-emission-regulation glider production, which they stated should be on the order of hundreds of units per year industry wide. Navistar suggested the cap be lowered to 200 units per year. Volvo commented that the cap is too high and that small manufacturers should not be allowed to exceed “the peak levels in the 2010-2012 timeframe” to be consistent with the SBREFA Panel Report. EPA is not reducing the maximum cap level or basing it on only 2010-2012 sales at this time. As just noted, it is clear that the cap of 300 glider vehicles will allow existing small businesses to remain profitable. Thus, as an interim policy, we believe this level

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<sup>246</sup> <http://www.truckinginfo.com/article/story/2013/04/the-return-of-the-glider.aspx>, accessed July 16, 2016.

appropriately balances the environmental and economic impacts. See CAA section 202 (a)(3)(D) requiring consideration of “cost of compliance” as part of the standard setting process for rebuilt engines. Nevertheless, we recognize that this allowance will result in significant additional emissions of NO<sub>x</sub> and PM. We will continue to monitor this market and may lower these values in the future.

Consistent with Volvo’s comments, the final regulations apply the cap as a production cap rather than a sales cap.

### *Definitions*

Terex asked for clarification of the proposed definition 'glider kit' to mean 'any other new equipment that is intended to become a motor vehicle with a previously used engine, include a rebuilt or remanufactured engine.' We have added the clarifying condition that this includes only assemblies that are “substantially similar to” complete vehicles. Volvo suggested the following definition of “glider kit”:

Glider kit means a new vehicle that is incomplete because it lacks an engine, transmission, or drive axle. A glider kit may include previously used parts. A glider kit becomes a new motor vehicle upon the installation of an engine, transmission, and axles, regardless of whether the ultimate purchaser has received title or placed it into service.

EPA explained in Section 1.3.1 why we believe glider *kits* are new motor vehicles, albeit incomplete motor vehicles. See also preamble section I.E.1 explaining further that in any case, manufacturers of entities assembling glider kits are “manufacturers” under the Act and can consequently be required to test and certify. Volvo’s proposed definition would not be consistent with this. Nevertheless, we agree with Volvo that the glider vehicle provisions should not prevent vehicle manufacturers from using up their normal inventory of prior model year new engines when producing conventional new motor vehicles. The definitions being adopted will not interfere with this practice.

### *Identical Standards*

Daimler commented that EPA should define “identical standards” to avoid uncertainty. As an example, they stated it is “unclear whether, under EPA’s proposed regulations, an earlier model year engine could be used in a glider vehicle assembled in a year when new OBD requirements are in effect.” In other contexts (such as export exemptions) EPA has previously interpreted this term strictly. This would clearly not allow differences in something as important as OBD requirements.

### *Economic Impacts*

Commenters opposing the proposed changes argued that they would adversely impact hundreds of jobs. MEMA stated that the motor vehicle remanufacturing industry supports over 50,000 direct jobs in the U.S. Other commenters noted that allowing glider vehicle sales adversely impacts those producing and selling conventionally new vehicles, and penalizes those entities playing by the rules and producing new vehicles which pollute far, far less. In particular, several dealers that do not sell gliders commented that allowing gliders to circumvent newer emission controls creates an unfair competitive market. Volvo commented that gliders have an unfair competitive advantage because the “cleanest, most fuel efficient and safest vehicles are necessarily tens of thousands of dollars more costly to produce” than glider vehicles.

Considered together these comments suggest that jobs in the glider industry come at the expense of other jobs in the heavy-duty industry. Although EPA takes seriously any impacts on workers in the

glider industry, they do not justify allowing the continued avoidance of emission standards which results in millions of tons of additional pollution and substantial avoidable public health risks, especially considering the adverse impacts glider sales have on other workers in the U.S. Clarke Power Services commented that the “industry is currently considering MY 2010 engines as the choice for Gliders moving forward.” This suggests that any economic impacts compared to what would have happened without regulation are short-term rather than long-term.

Other commenters stated that gliders offer many advantages for operators over used trucks, including lower operating costs and improved safety. However, these operators could achieve these same or greater benefits by purchasing fully compliant new vehicles. MFX noted costs associated with the 2007-era vehicles, but they are no longer relevant. As noted above, with the advent of the Phase 1 standards, and even more so under the 2017 Phase 1 standards and, later, Phase 2 standards, operators will be able to purchase fully optimized Phase 1 or Phase 2 vehicles that will have much better fuel efficiency and reliability than the 2007 products.

Finally, some commenters argued that EPA should consider the economic impacts on small trucking companies that purchase glider vehicles or pay others to assemble glider vehicles from their donor vehicles. While we understand that small trucking companies may have less capital to purchase fully compliant new trucks than larger companies, we note that new glider vehicles are not inexpensive – generally costing at least two-thirds as much as a fully compliant new vehicles. Thus, any impact on these trucking companies would be marginal. Moreover, engines meeting the 2017 Phase 1 standards are likely to be more fuel efficient than the rebuilt pre-2002 engines, so these companies would likely recover the additional purchase costs from fuel savings.

#### *Used Engines*

One commenter suggested that EPA should prohibit the installation of used engines unless they have been rebuilt to the original certified configuration so as to (in the opinion of the commenter) reduce PM, NO<sub>x</sub>, and GHG emissions. However, as explained earlier, we believe the most legitimate use of glider kits is to salvage used components from newer vehicles that have been damaged in accidents. Thus, it would not be appropriate to ban used engines that have not been rebuilt to any particular configuration.<sup>247</sup>

#### *Labeling and Delegated Assembly*

PACCAR commented that EPA should not require a unique label for glider vehicles that will be used in vocational applications. However, because glider vehicles are new vehicles they must comply with the same Phase 2 requirements as any other new motor vehicles. This includes proper labeling identifying the standards to which the vehicle is certified.

Similarly, for all glider vehicles produced by multiple manufacturers, the manufacturers must comply fully with the requirements of §§1037.620 through 1037.622. PACCAR’s comments urging less rigorous requirements for glider kits miss the point of these requirements, which is to ensure that the completed vehicles are in their proper certified configuration when placed into service. It is the manufacturer’s choice to produce vehicles in this way. If they find it too difficult to ensure the completed glider vehicles conform to the regulations, they can simply not offer glider kits similar to

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<sup>247</sup> Note again that removal of engines from donor vehicles, and installation of that engine into another vehicle continues to fall under the engine rebuilding provisions of part 86.004-40. See 86.004-40 second sentence (referring to “removal” which encompasses removal and installation into another vehicle).

current competitors. Nevertheless, as described in Section 1.4.4 of this RTC, we have revised the proposed delegated assembly requirements more generally, which may address some of PACCAR's concerns.

### *Natural Gas*

NGV America commented that the regulations should allow greater flexibility for natural gas fueled gliders because they are cleaner than diesel gliders. Diesel 2 Gas, Inc. commented that glider kits "are the only means by which hundreds of thousands of Class 8 Trucks can have access to natural gas as an engine fuel." They stated that 2010 and newer engines "cannot be converted efficiently to dual fuel mode with any known technology" because of their electronics. However, we believe that the issue of circumvention is a concern for both natural gas and diesel gliders. We do not believe these comments justify special provisions for natural gas. Natural gas engines may be cleaner than diesel engines of the same vintage with respect to NOx and PM emissions, but natural gas conversions of older engines are not inherently cleaner than today's SCR and DPF equipped diesel engines.

As noted earlier, glider vehicles are new motor vehicles, even if they reuse an engine from another vehicle. This is even more obviously true when the engine is converted from diesel fuel to natural gas as part of the process of producing the new glider. Such a vehicle retains even less of a connection to any existing vehicle. Moreover, the nature of the process addressed by NGV and Diesel 2 Gas suggests the purpose is to produce a new natural gas vehicle, rather than to salvage a newer powertrain from a damaged chassis. Thus, an argument could be made that they deserve less (not more) accommodation. EPA has no objection to conversion of existing vehicles to natural gas. However, natural gas gliders are more likely competing against other new vehicles that are fully compliant with current standards for criteria pollutants, as well as for GHGs. If Diesel 2 Gas is unable to convert newer engines, they are free to convert the older engines that remain in the older chassis. By retaining the old chassis, they would not be subject to the new glider kit requirements.

### *Consideration of Existing NHTSA Regulations*

Some commenters suggested that EPA's regulations should reflect principles laid out in existing NHTSA regulations. For example NADA/ATD urged EPA to harmonize with NHTSA's regulations that require there to be a single "donor" vehicle from which two of three used components (engine, transmission, and drive-axle) are incorporated into the rebuilt vehicle. NADA/ATD further commented that "when two of these three used components are incorporated into a rebuilt vehicle, using a glider kit, the used engine would only be required to meet emission standards applicable to its year of original manufacture." However, those regulations were promulgated pursuant to different statutory authority. They were also developed for different, albeit related purposes. Thus, EPA does not consider them to be necessarily relevant to this action. More importantly, such comments ignore the severe public health impacts of glider vehicles. These impacts are not lessened in anyway if the components come from a single donor vehicle.

## **14.3 Technical Amendments - Heavy-Duty Vehicles Other than GHG**

1886

**Organization:** American Automotive Policy Council

### **Other Provisions**

#### Low Sulfur Labeling

regulation regarding Tier 3 fuels will remove this fuel from the marketplace. [EPA-HQ-OAR-2014-0827-1238-A1 p.36]

**Response:**

We amended 40 CFR 86.007-35(c) to discontinue vehicle labeling for ULSD, effective with model year 2014, on February 19, 2015 (80 FR 9101).

**14.3.1 Alternate Emission Standards for Specialty Heavy-Duty Vehicles 1887**

**Comment - Use of non-road engines in on-road vehicles**

The NPRM requests comment on the “technical and regulatory issues surrounding the use of engines from chassis-certified vehicles in certain heavy-duty vehicles” and “on all aspects of this program to create alternate motor-vehicle emission standards that allow certified non-road engines to be used in the identified types of heavy-duty highway vehicles.” CARB generally supports U.S. EPA and NHTSA’s desire to facilitate the certification of innovative technologies that reduce GHG emissions, recognizes why U.S. EPA and NHTSA are considering allowing non-road engine use in hybrids, and lauds U.S. EPA and NHTSA’s seeking to encourage development of hybrid technology. In fact, CARB staff is considering provisions in its proposed Innovative Technology Regulation that would similarly allow limited use of non-road engines in on-road heavy-duty hybrids, but only in well-defined, limited situations (more detail on the Innovative Technology Regulation is at <http://www.arb.ca.gov/msprog/itr/itr.htm>).<sup>39</sup> As discussed further below, CARB staff believes that certain safeguards must be incorporated in 40 CFR 1037.605 to ensure that the provisions for innovation do not inadvertently allow abuse and unintended emission increases. [EPA-HQ-OAR-2014-0827-1265-A1 p.91-92]

From a technical perspective, the proposal to allow the use of downsized engines, including non-road engines, in on-road hybrid vehicles is justifiable. The combustion engine that is sized for use in a specific heavy-duty vehicle class is, in some cases, oversized, when installed in a hybrid vehicle in the same vehicle class. This is due to the sharing of the vehicle power load requirements by the electric motor in a hybrid system. The result is the combustion engine is occasionally being forced to operate in non-optimal regions of its torque map, which could lead to reduced engine efficiency and increased criteria pollutant emissions, as we have observed in a recent CARB-funded study conducted by NREL (available on our website at [http://www.arb.ca.gov/msprog/aqip/hybrid\\_test.htm](http://www.arb.ca.gov/msprog/aqip/hybrid_test.htm)). We also agree that, if properly structured, using non-road downsized engines has the potential to reduce both fuel consumption and emissions in hybrid vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.92]

Using non-road engines in a hybrid vehicle makes the most sense in series hybrid configurations where the primary purpose of the combustion engine is to provide power to charge the batteries that are used to propel the vehicle. The combustion engine in a series hybrid configuration can then be operated in a narrow region where it is most efficient and where its emissions can be more effectively controlled. CARB staff recommends against allowing the use of non-road engines in parallel hybrid applications due to the larger range of engine operating parameters that must be controlled in order to minimize criteria pollutant emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.92]

CARB staff recommends that U.S. EPA and NHTSA be cognizant of the fact that non-road engines are generally higher emitting than on-road engines, are certified to higher emission standards with less stringent useful life and durability requirements, and often, unlike on-road engines, are certified without a DPF. For example, the NO<sub>x</sub> and PM emission standards (40 CFR part 1039) for compression ignition non-road engines for 56 kW (75 hp) to 560 kW (750 hp) are 0.40 grams per kilowatt-hour (g/kW-hr)

(~0.3 grams per brake horsepower-hour (g/bhp-hr)) and 0.02 g/kW-hr (~0.015 g/bhp-hr), respectively. In comparison, the current NOx and PM emissions standards for on-road heavy-duty diesel engines are 0.20 g/bhp-hr and 0.01 g/bhp-hr, respectively. Contrasting the useful life requirements for on-road heavy-duty engines of 435,000 miles or 22,000 hours with the useful life for  $\geq$ 37kW non-road engines of 8,000 hours, or 5,000 hours for lower powered non-road engines (Table 4, 40 CFR 1039.101), the large differences in the required useful life for on-road and non-road engines, and the attendant effects on warranty provisions, could give rise to durability issues that we believe are significant. Hence, their use should only be allowed in the narrow circumstances where an appropriate on-road engine is not available to facilitate the use of an advanced technology. [EPA-HQ-OAR-2014-0827-1265-A1 p.93]

CARB staff is also cognizant of the potential for abuse when flexibility provisions are worded too broadly and hence suggests that some restrictions be added to the provision to prevent inappropriate use of non-road engines in on-road vehicles, such as use of a non-road engine to power an on-road truck that is also connected to a small electric assist battery. CARB staff recommends the Phase 2 regulations include several safeguards to prevent the unintended use of non-road engines in on-road vehicles more broadly than intended. [EPA-HQ-OAR-2014-0827-1265-A1 p.93]

We recommend the following safeguards:

- First, the scope of applicability should be clarified in 40 CFR 1037.605(a)(1) such that the provisions are restricted to engines in vehicles with hybrid powertrains used exclusively to charge batteries and, by extension, not to vehicles with engines that can also directly propel the drive train as in a parallel hybrid electric vehicle. In other words, the provisions should be restricted to series hybrids only. [EPA-HQ-OAR-2014-0827-1265-A1 p.93]
- Second, the provisions should be limited to vehicles with significant zero-emission range (for example, 35 miles zero-emission range). [EPA-HQ-OAR-2014-0827-1265-A1 p.93]
- Third, the non-road engine must meet a 0.01 g/bhp-hr PM standard and be equipped with a DPF. [EPA-HQ-OAR-2014-0827-1265-A1 p.93]
- Fourth, non-road compression ignition engines with maximum engine power less than 56 kW should not be allowed. We realize that such a prohibition has been proposed for incorporation in 40 CFR 86.007-11(g) of the criteria pollutant standard setting part for highway vehicles, but CARB staff recommends that similar language also be explicated in 40 CFR 1037.605 of the GHG standard setting part itself, not just referenced as proposed, to avoid any confusion regarding the provisions applicability. Accordingly, CARB staff recommends that this concern be addressed via the inclusion of a qualifying phrase in the applicability portion of 40 CFR 1037.605, such as ". . . and the engines have maximum engine power ratings equal to or greater than 56 kW." (see underscored text in paragraph (a) of CARB staff's revised regulatory text on page 118 below). [EPA-HQ-OAR-2014-0827-1265-A1 p.94]

With these safeguards incorporated, CARB staff would support the proposed Phase 2 provisions allowing use of non-road engines for on-road series hybrids. [EPA-HQ-OAR-2014-0827-1265-A1 p.94]

In addition, CARB strongly urges U.S. EPA and NHTSA to protect against possible criteria pollutant increases associated with allowing non-road engines to be used in on-road heavy-duty hybrid systems. [EPA-HQ-OAR-2014-0827-1265-A1 p.5]

### **Oppose/Requested Change Comment**

#### **Comment - OBD flexibility for specialty heavy-duty vehicles**

CARB staff understands some manufacturers of hybrid engines and drivelines have had challenges meeting existing certification requirements, particularly for engine, driveline, and vehicle OBD. U.S. EPA and NHTSA's proposal would allow up to 1,000 hybrid engines and vehicles per manufacturer per year to meet significantly reduced OBD requirements, in order to help enable these technologies to come to market sooner. While we agree with the intent of this proposal, we are concerned it would enable hybrid engine, driveline, and vehicle manufacturers to sell a potentially unlimited number of vehicles with almost no diagnostic capabilities over a period of years, as long as each manufacturer's annual volume stays below 1,000. This approach could also provide an incentive for manufacturers to plan for low annual hybrid sales without ever having to invest in developing diagnostics capabilities. [EPA-HQ-OAR-2014-0827-1265-A1 p.94]

OBD is critical to not only ensure that vehicle after-treatment and other controls are working properly in-use, but also to address potential engine and driveline integration issues that can result in increased NOx emissions. While CARB staff concurs that integrating a fully functional diagnostic system into a vehicle utilizing an alternate standard engine may be challenging at first, the benefits of beginning the process early are worthwhile. Access to real-time/real-world data can only improve compatibility and accelerate refinements that will result in cleaner vehicles and more reliable diagnostic systems in the near term. [EPA-HQ-OAR-2014-0827-1265-A1 p.94-95]

CARB staff encourages U.S. EPA and NHTSA to set a sunset mechanism for the reduced OBD requirements that reflects the number of vehicles or amount of time needed for the hybrid truck market to launch. The NPRM suggests a few potential approaches to identifying an appropriate sunset mechanism.<sup>40</sup> CARB staff suggests U.S. EPA and NHTSA explore a sunset for the proposed hybrid certification flexibility, potentially based on phasing in full OBD requirements once 5,000 to 10,000 unit volumes per manufacturer have been produced. U.S. EPA and NHTSA could initially require engine manufacturers diagnostics (EMDB) systems for manufacturers wishing to sell only a small number of engines annually and increase to full OBD requirements as a manufacturer applies to sell more engines. While such a sunset mechanism may or may not be triggered within the Phase 2 implementation timeframe, it would send an important signal to hybrid technology manufacturers that as the technology matures, they must plan for eventual OBD compliance. Without such a sunset mechanism, the 1,000 annual volume limit for reduced OBD may mean hybrid manufacturers never develop effective OBD systems. [EPA-HQ-OAR-2014-0827-1265-A1 p.95]

As mentioned previously, California is developing a proposed Innovative Technology Regulation intended to provide hybrid medium- and heavy-duty engines, drivelines and vehicles with more flexible diagnostics and other certification requirements at time of market launch, ramping up to full OBD over time. CARB staff looks forward to continued coordination with U.S. EPA and NHTSA in developing the proposed Innovative Technology Regulation and in aligning it with the proposed federal program to provide heavy-duty hybrids with OBD flexibility where appropriate. [EPA-HQ-OAR-2014-0827-1265-A1 p.95]

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Alternate emission standards for specialty heavy-duty vehicles**

The NRPM requests comments on the technical and regulatory issues of heavy-duty vehicles that use an engine from a smaller vehicle that is already covered by chassis-based certification under 40 CFR part 86, subpart S. For these vehicles, it is proposed that alternate standards would apply to the engine certification-based emission standards and certification requirements while all vehicle-based

requirements for evaporative and greenhouse gas emissions would continue to apply as specified in the regulation. [EPA-HQ-OAR-2014-0827-1265-A1 p.107-108]

While an engine from a chassis certified vehicle may fulfill the charging demands of a series heavy-duty hybrid, tailpipe emissions, evaporative emissions and OBD performance may be significantly compromised when the engine is used in heavy-duty hybrid applications. In the hybrid application, the engine would likely be commanded to operate at optimal efficiency speed-load points, which could be conditions that do not have optimized emissions control on the chassis cycles (e.g., sustained high load on a gasoline engine might result in enrichment for catalyst over temperature protection; it may also result in inadequate canister purging). Further, the OBD system would be calibrated to yield good OBD performance under duty cycles typically encountered by the chassis certified vehicles, which may be significantly different than the duty cycle experienced in the hybrid. A likely consequence is that diagnostics simply won't experience the conditions necessary to execute (e.g., if the monitor in the chassis certified application is designed to detect malfunctions when the engine is idling and the engine is not idled in the hybrid application, the malfunction won't be detected). A less likely yet plausible concern is that monitors will make non robust decisions (i.e., the diagnostic will indicate a malfunction is present when there isn't one). Another consequence is that the correlation between emission levels and malfunction detection will be upset (e.g., malfunctions may likely be detected at much higher emission levels because the engine operates at higher duty cycles on average). These examples highlight the need to recalibrate the emission control system and OBD system to ensure good performance in the heavy-duty hybrid application. This can be difficult to achieve by the heavy-duty vehicle manufacturer wishing to design a heavy-duty hybrid if the vehicle manufacturer does not have the intimate knowledge of and ability to reprogram the original engine computer with a custom calibration. [EPA-HQ-OAR-2014-0827-1265-A1 p.108]

#### **Oppose/Requested Change Comment**

##### **Comment - Exemption from on-road engine criteria pollutant standard for engines in vehicles with maximum speed at or below 45 mph**

CARB staff recommends that the scope of the provisions be narrowed such that they do not apply universally to all vehicles with maximum speed at or below 45mph. The need to exempt engines solely on the basis of maximum speed is unclear and has not been thoroughly explained or justified in the Preamble. Furthermore, the use of an engine to directly propel a vehicle on the highway, even at less than 45mph, would necessitate the use of a highway certified engine per U.S. EPA and NHTSA's own Preamble arguments regarding the representativeness of duty-cycle operation. CARB would not be opposed to relief for specific applications in this category should the need for relief be justifiably explained, but as the provision stands now it seems to have more potential to create new business opportunities that rely on the use of less stringent engines than it does to drive innovation to reduce emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.129]

#### **Oppose/Requested Change Comment**

##### **Comment - Exemption of amphibious and speed-limited vehicles**

The proposed classification of amphibious and speed-limited vehicles utilizing alternate emission standards as, "exempt from the requirements for greenhouse gases" would make it extremely difficult, if not impossible, to enforce violations of these provisions should they occur. This would be especially true for individual states, such as California, which would only have the emissions labels and nationwide end-of-year production reports as the sole means of differentiating compliant vs. non-



compliant vehicles within their borders. Although U.S. EPA and NHTSA propose to limit these exempted vehicles to no more than 200 federal units per manufacturer per MY, there are no guarantees that these engines will end up distributed evenly with respect to each of the 50 states. In fact, states with either coastal access or numerous accessible waterways, such as California, will probably receive disproportionately larger numbers of amphibious vehicles than will other states that lack such features. Furthermore, trying to hold manufacturers accountable to any standard is often untenable when vehicles and engines are considered exempt from regulation. CARB staff believes the potential for abusing this provision is significant and recommends that U.S. EPA and NHTSA address the issue by requiring manufacturers using these provisions to be granted an “abridged” form of a Certificate of Conformity prior to the introduction of their engines into commerce. This would greatly facilitate the in-use tracking and identifying of improper applications of the provision. As a template, U.S. EPA and NHTSA might consider adopting an abridged Certificate of Conformity similar to the abridged Executive Order that California grants for off-road compression-ignition engine families certified under the relief provisions in the Transition Program for Equipment Manufacturers in California (13 CCR 2423 (h)). [EPA-HQ-OAR-2014-0827-1265-A1 p.129-130]

CARB staff’s suggested revisions to 40 CFR1037.605 based on the comments above are indicated below in strikeout/underline format. [EPA-HQ-OAR-2014-0827-1265-A1 p.130]

§1037.605 Installing engines certified to alternate standards for specialty vehicles. (a) General provisions. This section allows vehicle manufacturers to introduce into U.S. commerce certain new motor vehicles if the installed engines are certified to alternate emission standards that are equivalent to standards that apply for non-road engines under 40 CFR part 1039 that have maximum engine power ratings equal to or greater than 56 kW or part 1048. See 40 CFR 86.007-11(g) and 40 CFR 86.008-10(g). The provisions of this section apply for the following types of vehicles: [EPA-HQ-OAR-2014-0827-1265-A1 p.130]

(1) Vehicles with a hybrid powertrain in which the engine provides energy exclusively for the Rechargeable Energy Storage System. [EPA-HQ-OAR-2014-0827-1265-A1 p.130]

(2) Amphibious vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.130]

~~(3) Vehicles with maximum speed at or below 45 miles per hour. If your vehicle is speed limited to meet this specification by reducing maximum speed below what is otherwise possible, this speed limitation must be programmed into the engine or vehicle’s electronic control module in a way that is tamper proof. If your vehicles are not inherently limited to a maximum speed at or below 45 miles per hour, they may qualify under this paragraph (a)(3) only if we approve your design to limit maximum speed as being tamper proof in advance.~~ [EPA-HQ-OAR-2014-0827-1265-A1 p.130]

(b) Notification and reporting requirements. Send the Designated Compliance Officer written notification describing your plans before using the provisions of this section. In addition, by February 28 of each calendar year (or less often if we tell you), send the Designated Compliance Officer a report with all the following information: [EPA-HQ-OAR-2014-0827-1265-A1 p.131]

(1) Identify your full corporate name, address, and telephone number. [EPA-HQ-OAR-2014-0827-1265-A1 p.131]

(2) List the vehicle and engine models for which you used this exemption in the previous year and identify the total number of vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.131]

(c) Production limits. You may produce up to 1,000 hybrid vehicles and up to 200 amphibious vehicles, under this section in a given MY. This includes vehicles produced by affiliated companies. If you exceed this limit, the exemption provision is void for the number of vehicles that exceed the limit for the MY. ~~For the purpose of this paragraph (e), we will include all vehicles labeled or otherwise identified as exempt under this section. You must apply for and be granted an “abridged” Certificate of Conformity per the instructions in §1037.201(c)([to be determined])~~ to use the provisions of this section. [EPA-HQ-OAR-2014-0827-1265-A1 p.131]

(d) Vehicle standards. Hybrid vehicles using the provisions of this section remain subject to all other requirements of this part 1037. For example, you must use GEM in conjunction with powertrain testing to demonstrate compliance with emission standards under subpart B of this part. Vehicles qualifying under paragraph (a)(2) or (a)(3) of this section ~~are exempt from the requirements of this part, except as specified in this section; these vehicles~~ must include a label as specified in §1037.135(a) with the information from §1037.135(c)(1) and (2) and the following statement: “THIS [amphibious vehicle or speed-limited vehicle] IS ~~EXEMPT FROM GREENHOUSE GAS STANDARDS CERTIFIED UNDER THE SPECIAL ALLOWANCES OF 40 CFR 1037.605.~~ CERTIFIED UNDER THE SPECIAL ALLOWANCES OF 40 CFR 1037.605. [EPA-HQ-OAR-2014-0827-1265-A1 p.131]

**Organization:** Caterpillar Inc.

## **ALLOW FOR INNOVATION ? PROVIDE GHG BENEFICIAL PROVISIONS**

Caterpillar supports the EPA’s provision that allows nonroad CI and SI engines to be used in specialty vehicles as proposed in section 1037.605. Current new technology diesel engines for on-highway and nonroad are nearly identical in configuration and components, and thus, very similar in emissions. However, there are differences in the engine calibration and certification test cycles. Some of these differences potentially allow nonroad engines to be better suited in some on-highway applications. For example, nonroad constant-speed engines are better suited than on-highway engines in hybrid applications that rely on constant engine speed. The additional testing burden of the on-highway Federal Test Procedures adds certification burden and is not representative of in-use performance, thereby yielding zero environmental benefit in these applications. [EPA-HQ-OAR-2014-0827-1189-A1 p.4]

While we applaud the EPA for trying to address unnecessary burden and waste, we believe some of the parameters of the EPA’s proposed provisions may limit the benefit. First, a “hybrid powertrain” should not be limited to systems where the engine provides energy for a Rechargeable Energy Storage System (RESS). We recommend that, at the very least, it should apply to vehicles that have non-conventional powertrains, but have innovative, fuel-saving technologies. An example from Caterpillar’s nonroad experience would be the D7E track-type tractor. This product utilizes a compact electric drive train, centered on electric technology controlled by solid-state semiconductors, rather than the conventional mechanical drivetrain that is typically used in this size track-type tractor. Furthermore, we believe such provisions should not be limited to vehicles with a RESS, nor one where the engine must charge the RESS. The EPA should allow for all fuel-saving, innovative vehicle technologies to utilize the provisions of § 1037.605. [EPA-HQ-OAR-2014-0827-1189-A1 p.4]

Finally, the volume limit of 1,000 units per year suggests that the EPA expects this to be a small manufacturer exemption rather than a viable industry solution. We recommend the EPA not have a volume limit to this provision; however, if the EPA feels that a limit is necessary to constrain the

quantity of such vehicles, then we recommend the volume be set at the “small manufacturer” definition in §86.016-1 (10,000 units per year). [EPA-HQ-OAR-2014-0827-1189-A1 p.4]

**Organization:** Cummins, Inc.

*Cummins opposes the use of non-road engines in hybrid powertrains* [EPA-HQ-OAR-2014-0827-1298-A1 p.29]

A flexibility provision is proposed that allows certain specialty vehicles to use non-road engines certified to either 40 CFR 1039 or 1048 in place of on-highway engine standards (40 CFR 86). Eligible vehicles are amphibious vehicles, vehicles with max speed <45 mph and hybrid vehicles. As written, the use of these non-road engines would also preclude the engine and hybrid systems from the HD on-highway OBD requirements. Cummins opposes the use of non-road engines in hybrid vehicles, specifically, for several reasons. [EPA-HQ-OAR-2014-0827-1298-A1 p.29]

First, the proposed non-road provisions (40 CFR 1039, 1048) do not currently certify engines for GHG emissions and have differing criteria emission certification requirements (e.g., test cycles, useful life, emission stringency). As stated in the Preamble, engine standards provide enforceable standards that require manufacturers to optimize CO<sub>2</sub> and criteria emissions together. The lack of GHG standards for non-road engines eliminates this linkage between criteria and GHG pollutants no longer forcing consideration of all constituents during engine optimization, a key reason identified by the agencies for having separate engine standards (see 80 FR 40181). Furthermore, the on-highway in-use program would not apply to non-road engines, eliminating assurance and enforceability of NO<sub>x</sub> control in the real world. Finally, any potential CO<sub>2</sub> environmental benefit coming from using a hybrid system may be offset by unregulated levels of N<sub>2</sub>O and CH<sub>4</sub> that exceed the proposed emissions cap for on-highway engines. The ability to deliver regulatory integrity from the engine standards is called into question through use of non-road engines in the Phase 2 program. [EPA-HQ-OAR-2014-0827-1298-A1 p.29]

Second, the certification cycles differ between non-road and on-highway certification, so there is uncertainty in the impact on criteria emissions. The certification cycles were developed to specifically represent either non-road or on-highway application duty cycles. Therefore, it may not be appropriate to mix certification cycles. [EPA-HQ-OAR-2014-0827-1298-A1 p.29]

Finally, HD on-highway engines have been required to meet OBD requirements since MY10. By the start of the Phase 2 program, HD engines and hybrid systems would have contained OBD monitors for more than 10 and 8 model years, respectively. To meet these requirements, manufacturers have invested significant time and resources in developing and demonstrating OBD diagnostic capability. Since the proposed non-road engines do not contain such stringent diagnostics, the agencies lose the assurance of in-use compliance afforded by OBD, and an un-level playing field is created where manufacturers that have invested in OBD may be at a cost disadvantage compared to their non-road variants. [EPA-HQ-OAR-2014-0827-1298-A1 p.29]

*Cummins opposes use of chassis-certified engines in specialty vehicles* [EPA-HQ-OAR-2014-0827-1298-A1 p.33]

The agencies are requesting comment on the possibility of using engines from chassis-certified vehicles in certain heavy-duty vehicles, such as specialty vehicles (80 FR 40523). As stated previously, these engines are certified for specific vehicle attributes (e.g., weight, coastdown, etc.) which vary significantly from the wide array of available specialty vehicles. Furthermore, the agencies would need to fully study and understand if the chassis dynamometer test cycles can be appropriately applied for

medium- and heavy-duty specialty vehicles. Therefore, Cummins opposes the use of chassis-certified engines in specialty vehicles. [EPA-HQ-OAR-2014-0827-1298-A1 p.33-34]

**Organization:** Innovus Enterprise LLC

Suggested Alternatives and Comments.

***Item 1: Alternate Emission Standards for Specialty Heavy-Duty Vehicles*** On page 40522 of the proposed rules, under XIV A(1), it states; “*Development of EPA’s emission control programs is generally focused on a consideration for the technology, characteristics and operating parameters of conventional vehicles, and typically includes efforts to address concerns for special cases.*” EPA requests comment on all aspects of this program to create alternate motor-vehicle emission standards that allow certified non-road engines to be used in identified types of heavy-duty highway vehicles. The EPA recognizes that the costs of regulatory compliance and the mismatch to the specified duty cycle of some specialized vehicles can make it cost-prohibitive for engine manufacturers to certify such an engine under the heavy-duty highway engine program. Since the non-road duty cycles would generally better represent the in-use operating characteristics of these vehicles, the EPA expects the non-road test procedures to be at least as effective in achieving in-use emission control. EPA’s non-road emission standards have reached a point that involves near parity with the level of emission control represented by the emission standards for heavy-duty highway engines. [EPA-HQ-OAR-2014-0827-1116-A1 p.4]

**Innovus Enterprise LLC Suggestion:** §1037.605; In addition to the hybrid, amphibious and speed limited vehicle, add a fourth category as follows: [EPA-HQ-OAR-2014-0827-1116-A1 p.4]

1. §1037.605 (a)(4). Specialty vehicles that are designed primarily for high mobility or off-road use as well as to perform multi-role vocational work functions. These vehicles have specifically engineered drive trains and chassis for austere terrain conditions and work routines which are not typical in conventional highway vehicles. The vehicles accommodate various implements and attachments to perform these work functions. In addition to vehicle propulsion, the vehicle engine is used to power these implements and attachments while the vehicle is either standing still or in motion. The typical engine-driven power systems include power takeoffs, heavy-duty hydraulic systems and high-power electric control systems. [EPA-HQ-OAR-2014-0827-1116-A1 p.4]
2. §1037.605 (c) Add provision limiting this high mobility off-road category to 200 vehicles in a given model year. [EPA-HQ-OAR-2014-0827-1116-A1 p.4]
3. §1037.605 (d) In the third sentence, add the words “or (a)(4)” after the words “..under paragraph (a)(2) or (a)(3).” Also add the words “or high mobility off-road” to the last sentence within the brackets. [EPA-HQ-OAR-2014-0827-1116-A1 p.4]

**Rational:** Our innovative technology is capability technology as described in paragraphs 8, 9 and 10 above. The vehicles we manufacture employ innovative technology not available from any other manufacturer in America. Our environmental technology is cutting edge - already in sister configurations meeting Euro 6 and Tier 4 standards. Our vehicle/engine technology coupled with the unique characteristics and dynamic operating parameters mentioned above validate a special case for special provisions. The cost of regulatory compliance and the mismatch to the specified duty cycle indeed make it cost-prohibitive for us to certify such an engine for such a vehicle under the heavy-duty highway engine program. Of course EPA’s non-road emission standards have reached a point that is near parity with the level of emission control represented by the emission standards for heavy-duty highway engines. For this, we feel our situation fits very nicely into the spirit and intent of this new provision. Additionally, since these vehicles are for a niche market, the low volume of 200

vehicles/engines per year is reasonable and consistent with the amphibious and limited speed vehicle provisions. We also concur with the EPA's suggestion for simplified diagnostic controls for 40 CFR Part 1039. [EPA-HQ-OAR-2014-0827-1116-A1 p.4-5]

**Organization:** Daimler Trucks North America LLC

**Alternate Emission Standards for Specialty Heavy-Duty Vehicles** - The agencies requested comment on aspects of the program to create alternate motor-vehicle emission standards that allow certified nonroad engines to be used in the identified types of heavy-duty highway vehicles. 80 FR 40523. We are not certain that this alternative benefits any manufacturer, so we agree with the agencies' decision to exclude such a provision from the vehicle-side of the regulations. That is, we agree that all vehicle-based requirements should continue, regardless of the use of this alternative certification option. [EPA-HQ-OAR-2014-0827-1164-A1 p.102]

**Organization:** Allison Transmission, Inc.

### **Alternative Standards for Hybrid Systems Should Be Adopted With Changes To Account for Hybrid Manufacturing Process**

EPA has requested comment concerning a program for alternate motor vehicle standards for hybrid vehicles, specifically to allow the use of certified non-road engines in heavy-duty hybrid vehicles. Compression-ignition engines could be certified to alternative standards equivalent to those in 40 C.F.R. Part 1039; spark ignition engines could be certified to Blue Sky standards in 40 C.F.R. Part 1048. EPA proposes a limit of no more than 1,000 hybrid vehicles and no more than 200 amphibious or speed limited vehicles per manufacturer would be allowed to be certified to these alternative limits in any MY. [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

Allison Transmission believes that adopting this program could provide a large benefit to the HD hybrid landscape. Allison believes the current HD hybrid industry is fragile. At the current sales volume, forcing additional complexity on the industry may result in engine manufacturers abandoning the market and in innovative hybrid manufacturers avoiding the market altogether. By maintaining a reasonable engine emissions requirement and the same vehicle level GHG requirement, EPA will ensure environmental targets are achieved by these specialty vehicles. And by lessening the OBD requirement of the components, EPA is allowing the technical challenge of a HD hybrid to become manageable. Allison believes the ARB innovative technology program would benefit from this same approach, and we are hopeful that ARB can adopt this same strategy for their program. [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

Allison has reviewed the language on this matter in the Preamble of the proposed rule and the proposed regulatory text at 40 C.F.R. 1037.605 and submits the following comments/clarifications thereto: [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

(1) 40 C.F.R. 1037.605 as proposed allows vehicle manufacturers to introduce alternative standard vehicles into commerce. From the construction of this provision, i.e., the reference to "vehicles with a hybrid powertrain," it is assumed that all hybrid products would qualify for alternative standards, subject to limits on the volume of such vehicles in a MY. [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

(2) 40 C.F.R. 1037.605 also indicates that it allows a "vehicle manufacturer" to introduce vehicles into commerce that are certified to alternative emission limits. Given the structure of the hybrid market, however, Allison recommends that EPA consider whether it has authority to allow annual volume limits

to apply with respect to the hybrid manufacturer in addition to the vehicle manufacturer. [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

Although the vehicle manufacturer would still remain responsible for the certification of the vehicle, such a step would recognize the horizontal nature of the HD industry. [EPA-HQ-OAR-2014-0827-1284-A1 p.60]

The bulk of the investment into hybrid technology development has been done and is being done at the component supplier level, by hybrid system manufacturers, not by vehicle manufacturers. Thus, EPA should account for the fact that a vehicle manufacturer may acquire hybrid systems from several hybrid manufacturers and that a volume limit -- if applied solely to the vehicle manufacturer -- may not allow smaller hybrid manufacturers to benefit (e.g., if their systems were purchased after a vehicle manufacturer had reach the annual volume limit, they may not qualify for the alternative standards even if other hybrid manufacturers did qualify by being purchased earlier in the year). EPA could implement this recommendation through the clarification of the proposed regulatory language. Specifically, 40 C.F.R. 1037.605(c) as proposed should be revised as follows: [EPA-HQ-OAR-2014-0827-1284-A1 p.60]

“(c) Production limits.

(1) You may produce up to 1,000 hybrid vehicles under this section in a given model year. This limit applies both to the vehicle manufacturer and its affiliated companies and separately to other manufacturers who produce hybrid systems (i.e., hybrid system manufacturers). Hybrid system manufacturers may produce up to 1,000 hybrid vehicles under alternative emission standards that are equivalent to standards that apply for nonroad engines as referenced in subsection (a). A vehicle manufacturer must verify that any hybrid system manufacturer will not produce more than 1,000 hybrid systems in a year, including those incorporated into a vehicle receiving an alternative standard under this section. [EPA-HQ-OAR-2014-0827-1284-A1 p.60]

(2) A vehicle manufacturer may additionally produce up to 200 amphibious vehicles and up to 200 speed-limited vehicles under this section in a model year. For these vehicles, the production limits apply to vehicles produced by affiliated companies. [EPA-HQ-OAR-2014-0827-1284-A1 p.60]

(3) If a manufacturer exceeds any limit contained in this paragraph (c), the exemption is void for the number of vehicles that exceed the limit for the model year. For the purpose of this paragraph (c), we will include all vehicles labeled or otherwise identified as exempt under this section. [EPA-HQ-OAR-2014-0827-1284-A1 p.60]

(4) For purposes of this paragraph (c), a hybrid system manufacturer is defined as any person who manufactures or assembles the hybrid propulsion system of a vehicle, including the drive unit, power inverter, system controller and energy storage features other than a conventional battery system or conventional flywheel. Nothing in this paragraph shall be construed to require a hybrid manufacturer to obtain a certificate of conformity.” [EPA-HQ-OAR-2014-0827-1284-A1 p.60-61]

**Organization:** Navistar, Inc.

In addition, the hybrid OBD flexibility proposed under Section XIV.A.1 of the NPRM Preamble presupposes that manufacturers will be capable of cost-effectively complying with an as-yet-to-be-defined CARB certification flexibility with unknown stringency. The impact of OBD can easily be extended to include mild hybrids or those that rely on engine--off at idle systems to reduce GHG

emissions. In this example, OBD requirements which rely on threshold and in use performance monitoring, as well as readiness can be affected by changes in operational mode during key on, engine on/off operation. In addition prolonged engine off at idle strategies can impact the rate of heat loss from aftertreatment which may increase fuel consumption triggered by warm up strategies once the engine resumes operation. The trade off in engine durability also extends to turbocharger systems which rely upon a forced lubrication system to prevent coking and premature wear due to hot engine shutdown. The accelerated deterioration of either the aftertreatment or turbocharger system can have a significant impact on engine efficiency, as well as fuel economy and warranty cost. [EPA-HQ-OAR-2014-0827-1199-A1 p.39-40]

**Organization:** Union of Concerned Scientists (UCS)

## LOW VOLUME EXEMPTION FOR HYBRID MANUFACTURERS

Hybrid vehicles augment an engine with an electric motor and often utilize an engine outside of its typical operating regime. In some cases, this may also allow for a downsized engine, with the motor capable of providing sufficient additional power for the vehicle. Because of these operational characteristics, hybrids may therefore provide a unique challenge for criteria emissions (NREL 2015). [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

Because the engine is being run under atypical conditions, significant additional calibration and testing may be required in order to certify the powertrain. This testing can be expensive and time-consuming, particularly for small-volume manufacturers. For this reason, the agencies have proposed a 1,000 engine low-volume exemption for hybrid manufacturers, wherein they can certify up to 1,000 vehicles with engines certified only to non-road engine standards. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

This is a significant reduction in the test burden for small manufacturers and will help lower the barrier for innovative manufacturers. However, based on the results of the NREL study, which show substantially higher criteria emissions for certain hybrids, we find reasons for concern if there is not some reasonable limit to the longevity of this credit. The agencies should institute either a cumulative volume-limit or sunset date for this provision to ensure that it does not result in undue environmental damages. [EPA-HQ-OAR-2014-0827-1329-A2 p.24]

### **Response:**

California ARB made several suggestions to revise the proposed approach of setting alternative emission standards for specialty vehicles. We agree with some of these and have made appropriate revisions to the provisions. However, we disagree with others. Specifically:

- We do believe it is not appropriate to limit the alternative standards to certain kinds of hybrid vehicles, or to set minimum performance specifications as qualifying criteria for the alternative standards. This is largely because there are nearly infinite possible ways for manufacturers to configure their systems, which would make such a system review especially difficult. More importantly, our interest is driven primarily by the desire to ensure that vehicle manufacturers are able to get the engines they need to produce their vehicles. If a manufacturer needs a 70 kW engine for any kind of hybrid vehicle, and there is no such engine certified to the regular heavy-duty highway standards, we believe it is appropriate to allow for accessing the wider range of nonroad engines that is available through these alternative standards.
- We have revised the regulation to require manufacturers to meet a PM standard for compression-ignition engines that is equivalent to the highway standard (0.020 g/kW-hr

equates to 0.01 g/hp-hr standard when rounding is taken into account). As with the regular PM standard, it would not be appropriate for us to require that manufacturers use any particular type of technology.

- We are leaving other emission standards unchanged from those that apply under the respective nonroad programs. Any small loss in stringency or durability associated with the nonroad standards is mitigated by the low production volumes in question, and the fact that qualifying specialty vehicles will often be used far less than conventional vehicles. We do not expect hybrid vehicles in particular to cause a problem with increased emissions of criteria pollutants.
- We have revised the regulation to more directly state that the alternative standards do not apply for engines below 56 kW.
- We have revised the regulation to state that vehicle manufacturers can use an engine meeting the alternate emission standards only if there is no suitable engine already certified to the regular heavy-duty highway standards.
- We have revised the regulation to discontinue the provision for alternate standards for hybrid vehicles after model year 2027. This will allow a substantial period to develop and build the technology and market for hybrid technology. If hybrid technology reaches widespread use before that time, the production limits associated with the alternate standards will lead manufacturers to certify engines to the regular heavy-duty highway standards, including OBD, before 2027. On the other hand, if we see a need to extend the program beyond 2027, we may consider revising this sunset in a future rulemaking.
- California ARB properly recognizesWe acknowledge that our proposal to apply the alternate standards to speed-limited vehicles may create new business opportunities. However, we do not want vehicles to be locked out of the marketplace because they have specific engine needs that cannot be met with available highway-certified engines. Vehicles may be speed-limited for any number of reasons, but the unifying feature is that these vehicles will not (may not) operate on interstate highways, which means their purposes and operating characteristics will inherently different than conventional cars, trucks, and buses. For example, large truck-mounted cranes, aircraft de-icing vehicles, and integrated wood-chipping trucks may qualify as motor vehicles, but they are much more likely to have operating characteristics of nonroad equipment. In fact, some of these vehicles are mistakenly using nonroad engines today. This rule will allow us to constructively engage with these vehicle manufacturers to ensure that their vehicles can get the power they need with engines that are properly certified to EPA emission standards.
- The recommendation to require an abridged certificate of conformity to ensure compliance for amphibious and speed-limited vehicles is odd, given that we proposed a requirement for these engines to receive a full certificate of conformity demonstrating compliance with the alternate heavy-duty highway emission standards, with annual reporting of production volumes. We are also adding a requirement for engine manufacturers to have a request for these engines from the vehicle manufacturer before shipping engines certified to the alternate emission standards. It is true that amphibious vehicles are more likely to be used in areas with coastal access and accessible waterways; however, it is not clear that evenly distributing such vehicles across accessible waterways would lead to any greater proportion of vehicles being used in California.

Cummins also raised several points:

- We have revised the regulation to require that compression-ignition engines meet the same N<sub>2</sub>O standard that applies for other heavy-duty highway engines. Also, as noted above, we are adopting a more stringent PM emission standard for compression-ignition engines.



Other differences that might lead to a reduced level of control are mitigated by the low production volumes in question, and the fact that many qualifying specialty vehicles will often be used far less than conventional vehicles.

- We recognize that the nonroad duty cycles are different than those that apply for conventional heavy-duty highway engines. However, this is part of the rationale for adopting alternative standards. Specialty vehicles are unlikely to be used in ways that are well represented by the heavy-duty highway duty cycles, with respect to vehicle speed or acceleration, or with respect to engine speeds and loads. The nonroad cycles will likely provide a more appropriate means of measuring emissions from these engines.
- We agree that a manufacturer with an engine certified to the regular heavy-duty highway engine standards should not be overlooked by specialty vehicle manufacturers in the search for appropriate power selection. We have therefore revised the regulation to disallow the use of engines certified to the alternate standards if a suitable engine has been certified to the regular heavy-duty highway standards.
- We agree that it would not be appropriate to rely on an engine from a vehicle that had been certified to the chassis-based program as part of this program of alternate standards for specialty vehicles. We are therefore not allowing such certificates to serve as the basis for meeting alternate highway engine standards as described in this section.
- We agree that a manufacturer-run in-use testing program is a valuable tool for evaluating compliance with emission standards and are accordingly considering whether to pursue such a program for nonroad compression-ignition engines.

The provisions related to alternate standards for specialty vehicles represent a significant deviation from the standards and program requirements that apply to other highway engines and vehicles. As such, it is important to have clear, well-defined qualifying criteria. Hybrid engines and vehicles by their nature involve storing energy produced by the engine for later use to propel the vehicles (or perform some other function). We disagree with Caterpillar's assertion that some variety of innovative powertrains should qualify for the alternate standards. This would require that we draw clear lines where the technology does not support such a clear demarcation. Manufacturers may generate off-cycle credits for non-hybrid powertrain innovations to reduce fuel consumption.

We set the annual cap of 1000 hybrid vehicles based on the expectation that higher production volumes would allow engine and/or vehicle manufacturers to invest as needed to meet the OBD requirements, emission standards, and other provisions that apply for engines and vehicles not covered by these alternate standards. We are aware that nonroad duty cycles may be more appropriate than the highway duty cycles for engines installed in hybrid vehicles. If production volumes for any specialty vehicles exceed the limits imposed under § 1037.605, vehicle manufacturers would need to install engines certified to the regular highway standards, which might include different emission measurement protocol under 40 CFR 1065.10(c)(1) or (2). Depending on the specific circumstances, this may allow for certifying based on a different duty cycle if that better represents in-use operation, or if the engine cannot operate over the specified procedure.

The proposal by Innovus to include certain rough-terrain vehicles fits with the intent of the proposed alternative standards for specialty vehicles. The challenge is to describe these vehicles in a way that focuses vehicle characteristics that properly separate qualifying vehicles from other heavy-duty highway vehicles that may be designed for more severe duty, but that do not deserve special treatment for engine selection. We chose to focus on axle configurations that involve a substantial additional engineering and cost to manage rough terrain. Specifically, the final regulation defines qualifying vehicles as—

All-terrain motor vehicles with portal axles (i.e., axles that are offset from the corresponding wheel centerline by a gear assembly) or any axle configuration involving gear reduction such that the wheels rotate more slowly than the axle.

As suggested by Innovus, these vehicles would be subject to the same production limits and other provisions that apply for amphibious vehicles and speed-limited vehicles.

Hybrid vehicles using engines certified to alternate highway standards under 40 CFR 1037.605 must meet all the greenhouse gas standards that apply to the vehicle, in line with Daimler's recommendation. However, we specify that qualifying speed-limited vehicles, amphibious vehicles, and all-terrain vehicles are exempt from the vehicle-based greenhouse gas standards. This is very similar to the provisions adopted at 40 CFR 1037.631, except for the specified production limits. A significant reason for the differing treatment of these vehicle types is that manufacturers would be allowed to produce many more hybrid vehicles than the other vehicle types.

We affirm Allison's understanding that all hybrid powertrains would qualify as specialty vehicles under 40 CFR 1037.605. However, we believe it is necessary and appropriate to identify the vehicle manufacturers' production volumes as the basis for setting production limits, largely because they are the ones making the product that is subject to standards under 40 CFR part 1037. Any other approach would involve requirements for manufacturers that are not subject to certification requirements, and would inevitably involve disputes about who is responsible, or even how to count companies, in business arrangements involving multiple manufacturers. Allowing 1000 hybrid units to use engines meeting alternate standards under 40 CFR 1037.605 may allow for a greater number of systems than if we would limit the number of hybrid systems from hybrid manufacturers, but we expect vehicle manufacturers to have challenges meeting their own responsibilities with respect to sourcing engines and integrating hybrid powertrains with their overall vehicle designs.

Cummins appropriately raises a concern about companies gaining a competitive advantage by meeting the alternate standards, compared to other companies that have already put in the design work to meet the full standards. This highlights the competing concerns—wanting to provide relief to expand the availability of engines for specialty vehicles without harming those companies already offering compliant products. We continue to believe that alternate standards are needed in many cases to allow manufacturers of specialty vehicles to meet their unique demands for power in their unconventional vehicles. We have adopted three provisions to address the competitiveness concern. First, the sales limit ensures that the alternate standards are geared toward production of niche or pilot vehicle designs. If manufacturers need more than 1000 engines annually for hybrid vehicles, for example, we expect that there should be sufficient funds available for meeting the full set of highway standards for those engines. Second, the alternate standards for engines installed in hybrid vehicles expire after 2027. That transition period allows time for the incentive of increasing sales of hybrid vehicles, with the expectation that these designs will eventually no longer need to be treated as a niche product with relief from certification requirements. If we need to revise the regulations to accommodate unique designs or in-use engine operating schedules, we can pursue that in a later rulemaking. Third, we have added a provision to disallow using the alternate standards if there is an engine certified to the full set of requirements of 40 CFR part 86 that has the appropriate physical and performance characteristics to power the vehicle in question. This should limit the use of alternate standards to those cases, as intended, where vehicle manufacturers are unable to get the appropriate engine for their vehicle design without the alternate standards.

We disagree that the proposed alternate standards presupposes anything about California's policy on hybrid vehicles. We are adopting these provisions on their own merits and expect vehicle and engine manufacturers to pursue them as appropriate for their business and engineering interests. We expect manufacturers to account for the real-world impacts of hybrid powertrains on engine durability.

### **14.3.2 Chassis Certification of Class 4 Heavy-Duty Vehicles 1900**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

## **6. EPA should allow the optional use of chassis based dynamometer certification for over 14,000 lbs GVWR**

In the NPRM, at 80 FR 40523, EPA requests comments on the applicability of chassis-based certification and whether it should be available for vehicles over 14,000 lbs GVWR. Automakers support a change to the requirements that would make the choice of dyno for vehicles over 14,000 GVWR be optional according to the manufacturer, and that EPA perform confirmatory tests according to the dyno selected by the manufacturer (engine dyno confirmed on engine dyno; chassis dyno confirmed on chassis dyno). [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

**Organization:** Cummins, Inc.

*Cummins opposes chassis-certification of GHG emissions for Class 4-6 complete and cab-complete vehicles* [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

Under the current Phase 1 rule (40 CFR 1037.150(l)), HD spark-ignited vehicles above 14,000 lbs Gross Vehicle Weight Rating (GVWR) can certify to chassis standards based on a 'complete sister vehicle' concept for GHG emissions. However, such vehicles must be certified to engine dynamometer standards for all other emissions standards. Cummins opposes any regulation that allows for a mixed (engine and chassis dynamometer) certification of criteria and GHG emissions. The difference in chassis and engine dynamometer procedures (e.g., operating speeds and loads) provides a potential inconsistency between the control of GHG and criteria emissions under typical operation and undermines regulatory integrity. [EPA-HQ-OAR-2014-0827-1298-A1 p.32]

Vehicles above 14,000 lbs (e.g. class 4-6 vehicles) are typically engineered and marketed to meet vocational requirements. Many of the vehicles in this class are not sold as complete, ready to be placed into service, vehicles. The typical sales path to the end-user is through a specialty body or utility function builder. While the vehicle OEM can communicate parameters such as aerodynamic design standards to which the finish builders must comply, the finished body may exceed the frontal projection and/or may affect air flow quite differently than on a complete pickup truck or even on the bare "cab-complete" vehicle. Hence it is not appropriate to use coastdown and test weight information of a complete sister vehicle (in Class 2b/3) for chassis certification of vehicles above 14,000 lbs GVWR. [EPA-HQ-OAR-2014-0827-1298-A1 p.33]

For these reasons, we believe engine dynamometer certification for GHG, consistent with certification for criteria emissions, should be applied to this category of vehicles. [EPA-HQ-OAR-2014-0827-1298-A1 p.33]

*Cummins opposes chassis-certification of criteria and GHG emissions for HD vehicles above 14,000 lbs GVWR* [EPA-HQ-OAR-2014-0827-1298-A1 p.33]

The agencies are requesting comment (80 FR 40523) on allowing vehicles above 14,000 lbs GVWR to be certified on chassis dynamometers to demonstrate compliance to criteria and GHG emissions standards. The metrics used for chassis certification were developed and validated for vehicles with GVWR less than 14,000 lbs, without consideration of the heavier vehicles being regulated in this rulemaking. At a minimum, the agencies would need a detailed study to fully understand the applicability of the chassis certification protocols and standards to HD vehicles above 14,000 lbs. Also, as stated above, vocational vehicles are not typically sold as complete, so the final aerodynamic characteristics of the certified vehicle are not known at the time of certification. The agencies recognize this dynamic of the Class 4 and above market and determined the robust regulatory framework of

certifying criteria and GHG emissions on engine dynamometer test cycles as appropriate for these class of vehicles (for example, see 80 FR 40331). For these reasons, Cummins does not support chassis-certification of HD vehicles above 14,000 lbs GVWR. [EPA-HQ-OAR-2014-0827-1298-A1 p.33]

**Organization:** American Automotive Policy Council

### **Chassis certification option**

AAPC concurs that vehicles up to 16,000 lbs GVWR can be combined with Class 2b/3 heavy-duty chassis certified products and they would follow the applicable heavy-duty chassis certified emission regulations without seeking additional Agency approval. [EPA-HQ-OAR-2014-0827-1238-A1 p.28]

**Organization:** Allison Transmission, Inc.

### **Optional Chassis Certification Should Not Utilize Bright-Line Test Based on Weight**

EPA and NHTSA are proposing to continue Phase 1 provisions that allow optional chassis certification for vehicles over 14,000 lb GVWR. The agencies have posed several questions with regard to how such provisions might be retained or changed for Phase 2. [EPA-HQ-OAR-2014-0827-1284-A1 p.44]

Allison believes that EPA should not treat 14,000 lb GVWR as a bright line test, but instead allow for chassis certification above that weight in order to reduce the regulatory burdens associated with certification of such vehicles. Allison, however, favors a provision that would limit such a certification option to vehicles that share design characteristics with certified vehicles below 14,000 lb GVWR. As noted in EPA's discussion of this option, this approach would be similar to that taken by the State of California. Adopting this approach would alleviate some of the regulatory burden that might occur with differing treatment of this compliance option. If this approach is not allowed, then vehicles that straddle the 14,000 lb limit and share significant design characteristics would be subject to different certification rules that would force unnecessary complication and cost for manufacturers in that weight range. [EPA-HQ-OAR-2014-0827-1284-A1 p.44]

### **Response:**

We have revised the regulation to include a limited allowance for vehicles above 14,000 lbs GVWR to be certified to the chassis-based program in 40 CFR part 86, subpart S. This applies equally to criteria and greenhouse gas standards.

We agree with Cummins that the chassis-based program was developed for vehicles designed and manufactured as complete vehicles. We are accordingly specifying that vehicles above 14,000 lbs GVWR may be certified under the chassis-based program only if the vehicles are otherwise properly characterized as being part of a test group for certification under 40 CFR part 86, subpart S. This allows for a family of Class 2b and Class 3 vehicles to include some number of vehicle configurations that have features involving more robust frames and other systems to qualify for GVWR values above 14,000 lbs. This is very similar to the approach suggested by Allison and adopted by California ARB.

### **14.3.3 On-Board Diagnostics for Heavy-Duty Vehicles**

**Organization:** Truck & Engine Manufacturers Association (EMA)

EPA Alignment With CARB OBD Requirements

EPA seeks comment on whether the Agency should change its OBD requirements to simply require that manufacturers meet CARB's OBD requirements. EMA opposes any such change to EPA's OBD program. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

EPA's separate OBD requirements have proved beneficial and will continue to do so. For example, EPA used its OBD flexibility provisions to delay the OBD requirements for hybrid vehicles until the 2017 model year, which prevented significant market disruptions and allowed for the continued availability of 49-state certified hybrid vehicles. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

Moreover, CARB has created a regulatory paradigm where it preserves the ability to change the technical requirements of its OBD program every two years, which, in essence, creates an improper BACT-based approach for mobile source regulation. Because of the increasingly burdensome nature of CARB's OBD program, manufacturers need to preserve the option of certifying a 49-state engine for OBD purposes. Consequently, EPA should not opt-in to CARB's OBD program. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

**Organization:** Volvo Group

### **EPA Should Not Delegate Authority to Regulate OBD Systems to California**

In the proposed rule, EPA requests comment on: (1) whether EPA should amend its OBD regulations to require that manufacturers comply with California OBD requirements, (2) whether EPA should preserve its own specifications for on-board diagnostics for "any special situations," and (3) "the need to make any adjustments or allowances from the California ARB regulations to work for EPA implementation." [EPA-HQ-OAR-2014-0827-1290-A1 p.70]

Volvo Group does not oppose providing manufacturers with an option for complying with federal OBD requirements by demonstrating compliance with California OBD requirements. As EPA notes, this approach already is in place for light-duty vehicles and heavy-duty vehicles below 14,000 lbs. GVWR. *See* 40 CFR § 86.1806-17(j). For manufacturers that elect to certify products in both California and the 49 states, this flexibility can be beneficial in allowing them to adopt harmonized strategies for compliance. The existing regulation, however, *does not require* manufacturers to comply with California Air Resources Board (CARB); it merely provides that compliance with such is sufficient for meeting EPA OBD requirements. [EPA-HQ-OAR-2014-0827-1290-A1 p.70]

Volvo Group strongly opposes, however, any proposal that would *require* manufacturers to comply with CARB OBD (or other) requirements for purposes of 49-state certification. [EPA-HQ-OAR-2014-0827-1290-A1 p.70]

At the outset, Volvo Group believes EPA's proposal would amount to an unauthorized and inappropriate delegation of its authority and responsibility to promulgate mobile source regulations to the state of California. No provision of the Clean Air Act authorizes EPA to delegate its authority to promulgate mobile source regulations to states. Indeed, the statute expressly prohibits states from adopting their own mobile source regulations absent a specific waiver of federal preemption by the EPA Administrator. CAA § 209, 42 U.S.C. § 7543. Moreover, where Congress intended to allow EPA to delegate its CAA authority to states, it expressly provided for such. *See, e.g.* CAA §112(l), 42 U.S.C. § 7412(l) (Providing EPA authority to delegate authority to states for implementation of stationary-source air toxics programs). Again, Congress did not provide for this with respect to mobile source regulations under Title II of the Clean Air Act. Accordingly, Volvo Group does believe EPA has the authority to pass this responsibility on to the state of California. [EPA-HQ-OAR-2014-0827-1290-A1 p.70-71]

EPA's adoption of CARB OBD regulations, meanwhile, is inappropriate for a number of other reasons. First, as EPA presumably would not have any process in place for certification of OBD systems, this approach would force manufacturers to participate in the California certification process, regardless of whether they intend to sell vehicles in the state of California. Subjecting manufacturers to the jurisdiction of any particular state, even if they do not intend to transact any business in that state, for purposes of gaining approval to sell vehicles in other states represents an improper use of EPA's regulatory authority. If EPA intends to enforce standards applicable to vehicles, the Agency must adopt such standards itself through a formal rulemaking process, and must have its own process in place for granting related certificates. [EPA-HQ-OAR-2014-0827-1290-A1 p.71]

Second, by deferring to California OBD regulations, EPA would effectively be denying manufacturers and other parties the ability to participate in the rulemaking process envisioned by the Clean Air Act and the Administrative Procedure Act. Manufacturers and other parties would be required to participate in the California rulemaking process, pursuant to California law, for purposes of challenging a federally-imposed requirement. Likewise, they would be required to challenge federally applicable OBD regulations in California courts under California law, and would be stripped of their ability to challenge regulations under the Administrative Procedure Act and the Clean Air Act. [EPA-HQ-OAR-2014-0827-1290-A1 p.71]

Volvo Group also has concerns with regard to the practical implications of mandating that manufacturers comply with California OBD regulations for purposes of meeting federal requirements. Volvo Group supports and echoes the concerns raised by EMA in this regard. Specifically, Volvo Group is concerned EPA will eliminate important opportunities to ensure much needed flexibility is provided for under new OBD regulations. By deferring to California's requirements, EPA will not be in a position to provide flexibility and regulatory relief for vehicles sold in other markets. [EPA-HQ-OAR-2014-0827-1290-A1 p.71]

Volvo Group also agrees with EMA that the increasingly burdensome nature of CARB's OBD program necessitates that manufacturers have the option of certifying to a 49-state program if necessary. The need for such flexibility is demonstrated by the OBD experience to date. In its response to comments on the final rule establishing OBD requirements for 2010 and later heavy-duty engines, for instance, EPA acknowledged that it did not share CARB's position with respect to a "step-down" in increased stringency of OBD systems for malfunctions of aftertreatment devices in the 2013 and 2016 model years. EPA noted: "The California Air Resources Board is willing to go forward with some uncertainty as regards the ability of manufacturers to meet the complete set of 'stepped down' thresholds in 2013 and 2016. EPA is not so comfortable moving forward with that level of uncertainty." [EPA-HQ-OAR-2014-0827-1290-A1 p.71-72]

Similarly, there are a number of OBD monitors that EPA has acknowledged are technically infeasible, but CARB has required nonetheless. EPA, for instance, eliminated the OBD thresholds associated with monitoring of NMHC converting catalysts and feed gas in the final OBD rule. *See* 74 Fed. Reg. 8310, 8323 (Feb. 24, 2009). As EPA noted, the Agency "made these changes for the final rule because we have been convinced by manufacturers that there exists no robust method of detecting loss of NMHC conversion at the levels required for threshold monitoring." *Id.* CARB, however, elected to adopt OBD monitoring requirements for these functionalities, notwithstanding. Another example is CARB's requirement to reduce the DPF OBD monitor threshold in 2016, which will force manufacturer's to require a PM sensor for the first time. This is not yet a requirement for EPA certification. In addition, there are notable differences between monitors required by CARB and EPA for DOC NMHC conversion, DPF NMHC conversion, DOC feed gas, DPF feed gas, DPF filtration efficiency, and miss-fire. [EPA-HQ-OAR-2014-0827-1290-A1 p.72]

Finally, it also bears noting that CARB has adopted questionable testing requirements related to OBD systems that impose extremely burdensome, costly and unjustified requirements on engine and vehicle manufacturers with little to no corresponding benefit. *See* 13 CCR § 1971.5 Manufacturers who do not elect to sell vehicles in California should not be subject to these requirements, but could be if EPA elects to adopt CARB requirements. In fact, these regulations underscore the inherent problem with EPA's proposed approach insofar as they were challenged, and ultimately upheld by a *California court based on California law. Engine Manufacturers Ass'n. v. California Air Resources Board*, 180 Cal.Rptr.3d 667 (Calif. Ct. Ap. 2014). There has never been a determination as to whether EPA would have authority to enforce the same requirements under federal law. EPA's adoption of California OBD requirements could raise multiple questions along these lines, prompting potentially costly litigation over EPA's authority to impose CARB regulations with each new iteration of such regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.72]

**Organization:** Cummins, Inc.

*Cummins opposes changes to EPA OBD regulations to require manufacturers meet ARB OBD requirements* [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

EPA is requesting comment on changing their OBD regulation to require manufacturers to meet ARB OBD requirements. For reasons outlined in EMA's comments, Cummins opposes this approach. [EPA-HQ-OAR-2014-0827-1298-A1 p.28]

**Organization:** Daimler Trucks North America LLC

## 9. OBD

**GHG Phase 2 OBD** – The agencies requested comments regarding OBD certification provisions in the Phase 2 proposal. 80 FR 40524. In particular, the agencies asked about the need to preserve EPA specifications for on-board diagnostics for any special situations and the need to make any adjustments or allowances from the California ARB regulations to work for EPA implementation. DTNA recommends that EPA maintain its current practice of approving OBD systems that have been approved by ARB. However, DTNA also recommends that that EPA preserve its own OBD specifications so as to provide flexibility that may arise in the future as ARB promulgates new requirements that may, as has been the case for hybrid technology, become a barrier to implementation of new technologies. [EPA-HQ-OAR-2014-0827-1164-A1 p.29-30]

DTNA also requests the agency look at the history of work required to meet OBD requirements and, when setting the timing of emission change overs, consider the future work that will be required. The efforts spent on OBD development essentially are equal to those spent on emissions development, but on top of this the ARB layers the additional burden of improving OBD systems every year. OBD development becomes a particular timing challenge because time consuming final development and validation testing of OBD calibrations can only begin after near production calibrations are finalized. Because of OBD demands it is no longer possible to finalize production calibrations close to start of production as had been the case prior to inception of OBD. The agencies should recognize the new realities of development needs and provide at least 5 years between each emission change. [EPA-HQ-OAR-2014-0827-1164-A1 p.30]

**Organization:** Innovus Enterprise LLC

**Item 3: 40CFR 86.010-18 On-Board Diagnostics for Heavy-Duty Vehicles.**

On page 40523 of the proposed rule, EPA requests comments on the need to preserve EPA specifications for OBD and on the need to make adjustments or allowances from the CARB regulations to work for EPA implementation. It is our position the EPA should not default to CARB for setting what would in effect be national standards. On the contrary, we should be working towards harmonization back to the EPA national standards. We should have standards which cross all 50 States and standards where authentic promulgation of regulation is conducted. We will stop and leave the political discussion as to whether there truly is efficiency and effectiveness in the CARB mobile source program for another forum. However, the fact many large manufactures certify now to CARB standards for a 50 state solution should not be misconstrued as being a favored option but one out of necessity. Our suggestion: Yes, keep the EPA specifications, especially for small business such as ourselves who are trying to work through an EPA certification plan for HDDE and OBD. [EPA-HQ-OAR-2014-0827-1116-A1 p.8]

**1906Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – OBD for heavy-duty vehicles**

The NRPM requests comment on the proposal to change U.S. EPA and NHTSA regulation to simply require manufacturers to meet the California OBD requirements. Given that, as U.S. EPA and NHTSA state, manufacturers in almost all cases certify based on the California regulations and procedures today, CARB staff generally supports this proposal. However, because California OBD requirements are in some cases more stringent than federal OBD requirements, it is important to note that some vehicles and engines currently certified through U.S. EPA and NHTSA alone as federal certifications may not be able to comply with California requirements without significant improvements to their OBD systems. If a manufacturer seeks certification of previous federal only system in California, CARB staff will require necessary improvements, which could be a significant increase in workload for the applicant and staff and could consequently increase certification timing for all applicants, depending on the additional volume of certifications. Additionally, staff has some questions regarding those situations in which U.S. EPA and NHTSA would continue to reserve the right to certify vehicles or engines as “Federal Only” certifications. Specifically, if U.S. EPA and NHTSA desire to maintain special situations it must be made clear that the vehicle is not certified to the California OBD regulation by CARB and the OBD compliance parameter identification (PID) from the scan tool (PID \$1C in SAE Standard J1979) would need to report that it is a federal vehicle, even if U.S. EPA and NHTSA used the California requirements as the basis for their certification. Also, it is not clear whether U.S. EPA and NHTSA would select separate engine families for demonstration under 40 CFR 1971.1 (i) that are independent and addition to the families selected by CARB. [EPA-HQ-OAR-2014-0827-1265-A1 p.109]

**Organization:** Odyne Systems LLC

There are still open questions around the central operator of the Malfunction Indicator Light (MIL) for Heavy-Duty Onboard Diagnostics (HD OBD) systems. As Odyne is a systems provider and not an OEM, we manage the diagnostics of our system and not the vehicle. Since OBD can be handled differently by each OEM and is not standardized, it is difficult for Odyne to understand how we fit into the process. EPA may seek to have every vehicle fully OBD compliant, though it will be critical to differentiate between the conversion technology and its basic diagnostics limitations. There must be a clear definition and understanding of the difference between full OBD and basic diagnostics. For example, we have basic diagnostics incorporated into our system, though we are not certain if this meets base requirements. In this case, we do not trigger the MIL since we use our own operator display. We



have also run into issues relative to vehicle emissions readiness during testing. Again, since we do not have control over the vehicle, and do not have OEM support; it is very difficult to figure out how to pre-condition the vehicle to get the monitors ready and working. Also each OEM / vehicle may have different strategies for operating their monitors. We can demonstrate that we do no harm and do not create any MIL/DTC, but it is very difficult to address the monitors without support. Another issue we experienced is that there are not common or standardized scan tools to use, so we have had to work with several tools to cover all the vehicles we manage. Overall, we would like to urge EPA to allow for flexibility in allowing innovative and smaller manufacturers to navigate OBD issues. [EPA-HQ-OAR-2014-0827-1239-A1 p.24-25]

### **EPA Must Ensure Flexibility in Implementing California OBD Requirements**

Under 40 C.F.R. 1806-17, specified LDVs, medium-duty passenger vehicles and certain HD vehicles must comply with the 2013 OBD requirements adopted for California (with certain enumerated exceptions). EPA has requested comment on whether the agency should require that manufacturers meet California OBD requirements in a manner similar to that contained in this provision. [EPA-HQ-OAR-2014-0827-1284-A1 p.58]

While Allison believes that there is a benefit from aligning EPA and California OBD requirements, we have concerns that adopting California OBD standards could limit the ability to utilize alternative approaches, such as those outlined in the Proposed Rule at Section XIV(A)(1) with respect to the certification of hybrid vehicles. Within the final rule, EPA must maintain the ability to address the sometimes difficult problems that arise with regard to certification; any provision to implement this concept should allow for the development of a common set of requirements that may be applied nationally and contain needed flexibilities. [EPA-HQ-OAR-2014-0827-1284-A1 p.58]

While EPA has not put forward proposed regulatory language for such a provision, Preferences 40 C.F.R. 1806-17. This specifies a particular California OBD-II requirement (California 2013 OB-II requirements contained in 13 C.C.R. 1968.2, as enacted on July 31,2013). Any reference to California regulations with regard to future HD OBD standards must follow a similar course. That is, EPA should reference an existing California provision with specificity so as to remove any suggestion that updates or revisions to the current regulation are allowable solely at the behest of the state. In addition, as provided within 40 C.F.R. 1806-17,EPA should also allow for certain exceptions to apply and not merely incorporate the California regulation by reference. That is, EPA should retain within the regulation the ability to revise requirements or grant exceptions. [EPA-HQ-OAR-2014-0827-1284-A1 p.58]

Alternately, California is working on “Proposed Regulation to Provide Certification and Aftermarket Conversion Flexibility for Innovative Medium- and Heavy-Duty Engine and Vehicle Emission Reduction Technologies (Innovative Technology Regulation).”<sup>95</sup> EPA should evaluate this approach in order to develop common approach to standards in this area. Volume thresholds contained in the California initiative, however, would need to be adjusted upwards to reflect the national scope of the program. [EPA-HQ-OAR-2014-0827-1284-A1 p.59]

### **Response:**

We have decided not to act on the request for comment related to heavy-duty OBD certification. This preserves the existing policy of allowing manufacturers to meet federal requirements by demonstrating compliance with California ARB’s OBD standards, while keeping the analogous OBD standards in EPA’s regulations. See Section 14.3.1 for responses to comments related to alternate engine standards (including alternate diagnostic requirements) for some specialty vehicles including hybrids.

### **14.3.4 Nonconformance Penalties (NCPs) for Heavy-Duty Vehicles 1908**

**Organization:** Volvo Group

#### **Revisions to Non-Conformance Penalty Provisions**

EPA regulations currently establish three criteria for determining whether, as a result of adopting a new or revised emission standard, non-conformance penalties (NCPs) allowing manufacturers to circumvent the standards are necessary and justified. These criteria are: (1) that the emission standard in question must become more difficult to meet; (2) that substantial work must be required to meet the standard; and (3) that there is likely to be a manufacturer that cannot meet the standard for technical reasons (a “technological laggard”). These criteria have served as the backbone for previous NCP rulemakings, and further serve as important markers for manufacturers and other parties to gauge whether an NCP is justified. [EPA-HQ-OAR-2014-0827-1290-A1 p.79]

In the NPRM, EPA now states in response to comments raised in the 2012 NCP rulemaking process that the existing NCP regulations do not require the Agency to find these criteria are met for purposes of setting an NCP. Specifically, EPA states “the actual regulatory text has never stated that EPA may establish NCPs only if all criteria are met, but rather that EPA shall establish NCPs ‘provided that EPA finds’ the criteria are met.” 80 Fed. Reg. at 40525. Volvo Group disagrees with this assessment, which appears to make a distinction without a meaningful difference. EPA must make a finding on each of the criteria, and that finding must be subject to public review and scrutiny. This is imperative to a robust NCP-setting process that adequately protects complying manufacturers’ competitive interests. [EPA-HQ-OAR-2014-0827-1290-A1 p.79-80]

The Agency then proposes language that “would explicitly state where EPA cannot determine if all of the criteria have been met, we may presume that they have.” *Id.* In other words, EPA wants to change the language to allow it to set NCPs without having to prove that the criteria are met, and thus eliminate any challenge to an NCP rule based on the criteria. [EPA-HQ-OAR-2014-0827-1290-A1 p.80]

To achieve this goal, EPA proposes that it be allowed to simply presume, without more evidence and analysis, the first two criteria have been met, and base the NCP decision solely on whether there is a technological laggard. 80 Fed. Reg. 40556. Proposed 86.1103-2016(c)(4) states: “*Where we are uncertain whether the first and/or second criteria have been met, we may presume that they have been met and make our decision based solely on whether or not the third criterion has been met.*” There is no valid reason for the regulations to allow such broad discretion without any required standard or review to be met or any real opportunity for review. Under the proposal, EPA would effectively be able to issue NCPs without giving the public any meaningful opportunity for reviewing and – where necessary – contesting the decision. [EPA-HQ-OAR-2014-0827-1290-A1 p.80]

As if such deference is not enough, EPA further proposes that the Agency may *presume* that a manufacturer is a technological laggard: (c)(4) as proposed states: “*Where we find that a manufacturer will fail to meet a standard but are uncertain whether the failure is a technological failure, we may presume that the manufacturer is a technological laggard.*” *Id.* [EPA-HQ-OAR-2014-0827-1290-A1 p.80]

Thus, EPA proposes that it may assume criteria one and two have been met, and then may presume, without more evidence and analysis, that a manufacturer is a technological laggard. Together, these two proposed changes vitiate the criteria. If this language becomes the rule, EPA will in effect delete the three criteria from the rule, and could simply flip a coin when it comes to deciding whether to

promulgate an NCP rule. It does not provide a process under which EPA would be accountable to the public, and would allow the Agency to establish NCPs for any reason – without any real possibility of public review. The proposed language indicates that EPA believes it should be allowed to avoid examining the facts against the criteria, and make a decision regarding NCPs without any public accountability. As proposed, this language represents a significant change in how EPA would evaluate and promulgate NCPs. Accordingly, Volvo Group opposes the proposed amendments to the NCP provisions related to the criteria for determining whether an NCP rule is justified. [EPA-HQ-OAR-2014-0827-1290-A1 p.80]

Instead, we call on EPA to strengthen the regulatory requirements to ensure that the Agency appropriately reviews the existing criteria. Further, EPA should be held accountable to the statutory requirement to only promulgate NCPs if needed, and ensure that the penalty be set to “remove any competitive disadvantage to manufacturers whose engines or vehicles achieve the required degree of emission reduction ....” This process must be conducted in full view of the public; with the Agency’s cost basis and calculations an open book for public input and comments. [EPA-HQ-OAR-2014-0827-1290-A1 p.80]

**Response:**

EPA agrees with Volvo statement that the “criteria . . . serve as important markers for manufacturers and other parties to gauge whether an NCP is justified.” However, we disagree with Volvo that these criteria were originally intended to create a burden of proof for EPA or to limit EPA’s ability to establish NCPs. As explained in the NPRM we believe they were established merely “to clarify that manufacturers should not expect EPA to initiate a rulemaking to establish NCPs where these criteria were not met.”

More importantly, we believe Volvo ignores the actual language of the statute, which makes no mention of these criteria. In §206(g)(1), the Act states:

In the case of any class or category of heavy-duty vehicles or engines to which a standard promulgated under section 7521(a) of this title applies, except as provided in paragraph (2), a certificate of conformity shall be issued under subsection (a) of this section and shall not be suspended or revoked under subsection (b) of this section for such vehicles or engines manufactured by a manufacturer notwithstanding the failure of such vehicles or engines to meet such standard if such manufacturer pays a nonconformance penalty as provided under regulations promulgated by the Administrator after notice and opportunity for public hearing. In the case of motorcycles to which such a standard applies, such a certificate may be issued notwithstanding such failure if the manufacturer pays such a penalty.

Thus, the Act seems to presume that NCPs will be available and *requires* EPA to allow certification in most cases. To the extent there is a burden of proof on EPA, it would seem to be a burden to prove that NCPs are not appropriate rather than a burden to prove that they are. The criteria were created to help EPA show when NCPs are not appropriate. Volvo imagines a “statutory requirement to only promulgate NCPs if needed” but offers no basis for this belief.

Volvo also overstates the discretion EPA could exercise under the proposed regulations. The text to which Volvo objects merely explains how EPA would make its decisions when it is *unclear* whether the criteria are fully met. It does not envision that EPA would make a decision contrary to the facts, but rather that EPA may sometimes be forced to evaluate the criteria with limited information. Since the Act seems to presume that NCPs will be available, we believe that EPA should be allowed to establish NCPs when the extent to which the criteria have been met is unclear. Moreover, EPA would continue to

solicit public comments on its assessment of the criteria, allowing the public to provide any additional information that could change EPA's assessment.

Finally, we note that as long as any NCPs are high enough to remove any competitive disadvantage to complying manufacturers, there is no harm to the complying manufacturers.

### **14.3.5 Modifying Certified Vehicles for Competition**

**Organization:** Specialty Equipment Market Association (SEMA)

The EPA included a proposal hidden within the rulemaking to make it illegal for certified motor vehicles to be converted into vehicles used solely for competition. Specifically, the proposed rule ("Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles--Phase 2") would add the following language to 40 C.F.R. Part 86(40 C.F.R. § 86.1854), a section of the regulations applicable to new and in-use vehicles, including light duty vehicles:

"Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines." 80 Fed. Reg. 40138, 40565 (July 13, 2015). [EPA-HQ-OAR-2014-0827-1469-A1, p.1]

These comments are limited to that topic. Although the comments are filed after the October 1, 2015 deadline, SEMA contends the change regarding competition use only vehicles is not within the scope of the GHG rulemaking for medium- and heavy-duty vehicles and that the public was not adequately put on notice of its inclusion. The comments will also address the merits of the issue. [EPA-HQ-OAR-2014-0827-1469-A1,p.1]

#### **EPA Policy on Motor Vehicles Used for Competition**

The proposed rule is attempting to bring vehicles used solely for competition within the purview of the Clean Air Act's definition of "motor vehicles" required to be certified to relevant mobile source emissions standards and remain in their certified configuration. This interpretation of the Clean Air Act's definition of "motor vehicle" is not in line with the statutory language or legislative history. [EPA-HQ-OAR-2014-0827-1469-A1, p.5]

In the Motor Vehicle Air Pollution Control Act of 1965, Congress first defined the term "motor vehicle" for the purpose of regulating air pollution as "any self-propelled vehicle designed for transporting persons or property on a street or highway." See Motor Vehicle Air Pollution Control Act, Pub. L. No. 89-272, 79 Stat. 992 (1965) at § 208(2). The 1965 Act sought to regulate emissions from new motor vehicles by making it illegal for "any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser." Id. at § 203(a)(3) (hereinafter, the "anti-tampering provision"). [EPA-HQ-OAR-2014-0827-1469-A1, p.6]

In 1970, Congress passed the Clean Air Amendments of 1970 (hereinafter, the "1970 Clean Air Act"). Clean Air Act, Pub. L. No. 91-604, 84 Stat. 1676 (1970). The 1970 Clean Air Act created an unprecedented scheme for regulating both stationary and mobile sources of air pollution. The 1970 Clean Air Act did not disturb the definition of "motor vehicle" put in place in 1965 (nor did any other subsequent amendments to the law), but lawmakers did add language to regulate vehicles after first retail sale. The lawmakers expanded the anti-tampering provision to add that no person could render the

emissions controls inoperative “after such sale and delivery to the ultimate purchaser.” *Id.* at §7(a)(3). Despite this intent to regulate some vehicles after first retail sale, Congress did not intend the 1970 Clean Air Act to extend the purview of the law to cover vehicles manufactured or modified for racing. The following clarification on this point was made during the House consideration of the congressional conference committee report on the Clean Air Act as signed into law by President Nixon (H.R. 17255):

MR. NICHOLS. I would like to ask a question of the chairman, if I may. I am sure the distinguished chairman would recognize and agree with me, I hope, that many automobile improvements in the efficiency and safety of motor vehicles have resulted from experience gained in operating motor vehicles under demanding circumstances such as those circumstances encountered in motor racing. I refer to the tracks at Talladega in my own State, to Daytona and Indianapolis, competition.

I would ask the distinguished chairman if I am correct in stating that the terms “vehicle” and “vehicle engine” as used in the act do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events which, of course, are held very infrequently but which utilize all types of vehicles and vehicle engines?

MR. STAGGERS. In response to the gentleman from Alabama, I would say to the gentleman they would not come under the provisions of this act, because the act deals only with automobiles used on our roads in everyday use. The act would not cover the types of racing vehicles to which the gentleman referred, and present law does not cover them either. [EPA-HQ-OAR-2014-0827-1469-A1, p.6]

House Consideration of the Report of the Conference Committee, Dec. 18, 1970 (reprinted in A legislative history of the Clean air amendments of 1970, together with a section-by-section index, U.S. LIBRARY OF CONGRESS, ENVIRONMENTAL POLICY DIVISION, Washington: U.S. Govt. Print. Off. Serial No. 93-18, 1974, p. 117). [EPA-HQ-OAR-2014-0827-1469-A1, p.7]

Neither the 1977 nor the 1990 revisions to the Clean Air Act altered this definition of “motor vehicle” as commented upon by Representatives Nichols and Staggers. See Clean Air Act Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (1977); see also Clean Air Act Amendments, Pub. L. No. 101-549, 104 Stat. 2399 (1990). [EPA-HQ-OAR-2014-0827-1469-A1, p.7]

While it is clear from the legislative history that the Clean Air Act was not intended to regulate race vehicles, that fact should have become even clearer as a result of the 1990 Amendments to the Act. The amendments were made to provide EPA with authority to regulate non-road vehicles and the engines used therein. See 42 U.S.C. § 7550(10)-(11) (2015). Since the term “nonroad vehicle” could easily have been interpreted to include race vehicles, Congress used language to unequivocally exclude vehicles used solely for competition from the definition of “nonroad vehicle.” See *id.* (“The term ‘nonroad vehicle’ means a vehicle that is powered by a nonroad engine and that is not a motor vehicle or a vehicle used solely for competition.”). [EPA-HQ-OAR-2014-0827-1469-A1, p.7]

The fact that Congress separated out “vehicles used solely for competition” from “motor vehicles” in the definition of “nonroad vehicle” is also instructive, as it indicates the term “motor vehicle” was not understood as covering a “vehicle used solely for competition.” See 42 U.S.C. § 7550(10) (2015) (defining a nonroad motor vehicle as “not a motor vehicle or a vehicle used solely for competition”) (emphasis added). It is also noteworthy that Congress referenced racecars as vehicles used solely for competition – not vehicles built solely for competition. [EPA-HQ-OAR-2014-0827-1469-A1, p.7]

Based on the statutory text and the legislative history, it is clear that vehicles used solely for competition, including a race vehicle that has been created by converting a certified vehicle to a racecar,

are not within the purview of the Clean Air Act. Administrative rulemaking is not a process by which an agency is permitted to circumvent Congress, however, it appears that the EPA is attempting to alter current law as it relates to vehicles used solely for competition. The EPA's proposal would alter current law by adding the following provision to the regulations: "Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines." See Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles--Phase 2, 80 Fed. Reg. 40138, 40565 (July 13, 2015). This new language is in conflict with the statutory text and legislative history and should not be inserted into the regulations unless Congress indicates an intent for such a rule to be put in place. [EPA-HQ-OAR-2014-0827-1469-A1, p.7]

## Conclusion

Based on the foregoing, SEMA objects to the inclusion of language relating to vehicles used solely for competition in this greenhouse gas rulemaking and requests that it be removed. Among other problematic rhetoric unnecessarily included in the proposal, the following new language regulating all vehicles, including light-duty vehicles, is especially out of place in a rulemaking for greenhouse gas standards covering medium-and heavy-duty vehicles. The language is also out of sync with governing law. [EPA-HQ-OAR-2014-0827-1469-A1, pp.8-9]

Therefore, we specifically request the EPA remove the following proposed language:

§ 86.1854-12 Prohibited acts.

\* \* \* \* \*

(b) \* \* \*

(5) Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1469-A1, p.9]

## Administrative Procedure Act

Overview: The Administrative Procedure Act (hereinafter, the "APA") establishes the process by which federal agencies develop and issue regulations. See Administrative Procedure Act, 5 U.S.C. § 553 (2015). Among other considerations, the law is intended to provide adequate opportunity for the public, and interested parties in particular, to comment on proposed rules. SEMA contends that the EPA failed to comply with the APA when it proposed changes to the regulations to prohibit conversion of certified motor vehicles to competition use only vehicles. SEMA's analysis below includes factors that courts have considered when evaluating agency compliance with the APA. [EPA-HQ-OAR-2014-0827-1469-A1, p.2]

Failure to Alert Public of Rulemaking: The table of contents for the 629-page rulemaking does not alert the public that the EPA is proposing a significant policy change on how competition use engines/vehicles are regulated. The table of contents does not include reference to "Competition Use Engines/Vehicles." The topic is covered along with other seemingly minor issues under the heading "XIV. Other Proposed Regulatory Provisions." [EPA-HQ-OAR-2014-0827-1469-A1, p.2]

Non-Germane: The subject rulemaking will establish the next generation GHG emissions and fuel economy standards for medium- and heavy-duty engines and vehicles. The subject matter referenced in the rulemaking's title and considered within the broader scope of the rulemaking does not logically

encompass the modification of a certified vehicle for competition use. Further, this is not the first time the EPA has issued GHG emission standards for medium- and heavy-duty engines/vehicles. Therefore, inclusion of an unrelated topic within a continuing series of rulemakings is unexpected, if not unprecedented. [EPA-HQ-OAR-2014-0827-1469-A1, p.2]

**Rulemaking Does Not Cover Light-Duty Vehicles:** By its terms, the rulemaking covers medium- and heavy-duty engines and vehicles. It does not apply to light-duty engines and vehicles, which are regulated under separate EPA rulemakings. Nevertheless, many certified light-duty vehicles may be modified for competition use, and the section of the rules into which the EPA seeks to insert a prohibition against street-to-race vehicle conversions is applicable to light-duty vehicles. The public has not been put on notice that the rule governing medium- and heavy-duty engines/vehicles potentially applies to certified light-duty engines/vehicles. [EPA-HQ-OAR-2014-0827-1469-A1, p.2]

**Change of Policy:** Before the Clean Air Act was enacted and since that date, thousands if not millions of certified vehicles have been modified to become vehicles used solely for competition. Products have been manufactured, sold and installed on these competition vehicles throughout this time. SEMA has been working with the EPA on ways to regulate potential dual-use products, defined as products that could be used on both competition-use only and certified motor vehicles. However, the EPA has never implemented a policy making it illegal for certified vehicles to become competition-use only vehicles. Such a policy would overturn decades of understanding within the regulated community and expose that community to unfair findings of noncompliance and civil penalties. [EPA-HQ-OAR-2014-0827-1469-A1, pp.2-3]

**Arbitrary, Capricious and an Abuse of Discretion:** The EPA is seeking to change policy that has been in place for decades and it does not adequately address this change in the summary or explanatory text published in the Federal Register. The only text that could be read as explaining the proposed addition of the language to prohibit street-to-race vehicle conversions are the following paragraphs within the 629-page proposed rule, which do not even reference the part being changed – part 86:

The existing prohibitions and exemptions in 40 CFR part 1068 related to competition engines and vehicles need to be amended to account for differing policies for nonroad and motor vehicle applications. In particular, we generally consider nonroad engines and vehicles to be “used solely for competition” based on usage characteristics. This allows EPA to set up an administrative process to approve competition exemptions, and to create an exemption from the tampering prohibition for products that are modified for competition purposes. There is no comparable allowance for motor vehicles. A motor vehicle qualifies for a competition exclusion based on the physical characteristics of the vehicle, not on its use. Also, if a motor vehicle is covered by a certificate of conformity at any point, there is no exemption from the tampering and defeat-device prohibitions that would allow for converting the engine or vehicle for competition use. There is no prohibition against actual use of certified motor vehicles or motor vehicle engines for competition purposes; however, it is not permissible to remove a motor vehicle or motor vehicle engine from its certified configuration regardless of the purpose for doing so. [EPA-HQ-OAR-2014-0827-1469-A1, p.3]

EPA is proposing in 40 CFR 1037.601(a)(3) to clarify that the Clean Air Act does not allow any person to disable, remove, or render inoperative (i.e., tamper with) emission controls on a certified motor vehicle for purposes of competition. An existing provision in 40 CFR 1068.235 provides an exemption for nonroad engines converted for competition use. This provision reflects the explicit exclusion of engines used solely for competition from the CAA definition of “nonroad engine.” The proposed amendment clarifies that this part 1068 exemption does not apply for motor vehicles. [EPA-HQ-OAR-2014-0827-1469-A1, p.3]

See Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles--Phase 2, 80 Fed. Reg. 40138, 40527, 40539 (July 13, 2015). [EPA-HQ-OAR-2014-0827-1469-A1, p.4]

SEMA contends that to change the policy now, without proper public notice, would be considered arbitrary, capricious and an abuse of discretion under the APA. If the EPA intends to change decades of previously applied policy, SEMA contends such a change must take place within a separate rulemaking. Further, as will be explained below, SEMA contends that existing law establishes a clear policy for vehicles used solely for competition and that only Congress has the authority to make the proposed policy change, not the EPA through a rulemaking. [EPA-HQ-OAR-2014-0827-1469-A1, p.4]

The EPA's proposed policy change has no basis in the evidence or analysis presented. Under the APA, an agency has an obligation to publish a statement of reasons that will be sufficiently detailed to permit potential judicial review. In this instance, the EPA has placed the burden on the public to provide justification for maintaining decades of previous interpretation of marketplace activities affirming that street vehicles can be modified to create vehicles to be used solely for competition. The EPA notes expanded powers when it states: "This allows EPA to set up an administrative process to approve competition exemptions, and to create an exemption from the tampering prohibition for products that are modified for competition purposes." While threatening in potential scope, this statement is unexplained and fails to meet a conclusion of reasonableness and rationality. For example, the term "administrative process" could be interpreted as authorizing the EPA to establish a database of motor vehicle registrations to confirm that none of the millions of vehicles in the national vehicle fleet have been converted to competition use. [EPA-HQ-OAR-2014-0827-1469-A1, p.4]

#### Due Process Considerations

Constitutional due process demands agencies provide adequate notice to regulated individuals. This notice can be made through the informal notice and comment rulemaking process using the Federal Register, or actual notice may be provided directly to interested members of the public. As settled Supreme Court precedent instructs: "An elementary and fundamental requirement of due process in any proceeding which is to be accorded finality is notice reasonably calculated, under all the circumstances, to apprise interested parties of the pendency of the action and afford them an opportunity to present their objections." See *Mullane v. Cent. Hanover Bank & Trust Co.*, 339 U.S. 306, 314 (1950). [EPA-HQ-OAR-2014-0827-1469-A1, p.5]

The EPA has failed to provide actual notice of their proposed changes to the regulated industry despite ample opportunity to do so. SEMA has been in discussions with the EPA for years on the issue of street-to-race vehicle conversions. The discussions have focused on helping the EPA find ways to prevent racing products from finding their way onto street vehicles. In fact, EPA personnel participated in a presentation at an industry trade show sponsored by SEMA on November 5, 2015 to speak to this very issue and made no mention of the pending rulemaking proceeding. It does not seem unreasonable that the EPA should make some effort to communicate to the industry a rulemaking that seeks to regulate street-to-race vehicle conversions in light of this extensive history between the Agency and the regulated entities. [EPA-HQ-OAR-2014-0827-1469-A1, p.5]

Where the Federal Register is used to provide constructive notice to interested parties, the entry should at least be drafted in a manner reasonably calculated to inform the reader that the agency is attempting to regulate in a particular area. In this instance, the EPA has titled its rulemaking "Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles--Phase 2," and its summary provides insufficient notice that light-duty engines and vehicles, specifically those



used solely for competition, are affected by the proposed rule. [EPA-HQ-OAR-2014-0827-1469-A1, p.5]

#### Other Implications and Considerations

The proposed rule would create new law without adequate notice to the regulated parties, most importantly the motorsports industry, and upset decades of industry practice. The National Association for Stock Car Auto Racing (NASCAR) was founded in 1948 on the premise that ordinary street cars could be converted into racing machines. Conversely, participants in demolition derbies seek to destroy other former street vehicles that have been modified for potential destruction. In between these two extremes are a myriad of other types of racing events, with participants that range from professionals to novices using vehicles that have been modified for racing use. If the EPA intends to continue its push for a policy prohibiting conversion of street vehicles to vehicles to be used solely for competition, it must put the motorsports industry on proper notice and explain its rationale, including the statutory authority for such a prohibition. [EPA-HQ-OAR-2014-0827-1469-A1, p.8]

#### **Response:**

The proposal included a clarification related to vehicles used for competition to ensure that the Clean Air Act requirements are followed for vehicles used on public roads. This clarification is not being finalized. EPA supports motorsports and its contributions to the American economy and communities all across the country. EPA's focus is not (nor has it ever been) on vehicles built or used exclusively for racing, but on companies that violate the rules by making and selling products that disable pollution controls on motor vehicles used on public roads. These unlawful defeat devices lead to harmful pollution and adverse health effects. The proposed language was not intended to represent a change in the law or in EPA's policies or practices towards dedicated competition vehicles. Since our attempt to clarify led to confusion, we have decided to eliminate the proposed language from the final rule.

We will continue to engage with the racing industry and others in its support for racing, while maintaining our focus where it has always been: reducing pollution from the cars and trucks that travel along America's roadways and through our neighborhoods.

### **14.4 Additional Technical Amendments**

#### **14.4.1 Miscellaneous Amendments to 40 CFR Parts 85, 86 and 6001915**

**Organization:** Daimler Trucks North America LLC

**Part 85 Changes** - We agree with all the changes or modifications done to Part 85. Daimler also described several provisions requiring further discussion. [EPA-HQ-OAR-2014-0827-1164-A1 p.121]

**Organization:** California Air Resources Board (CARB)

#### **Support Comment**

##### **Comment – CARB Staff Supports Improved Definitions**

The CARB staff supports U.S. EPA and NHTSA's proposed addition of, and clarification to, definitions throughout the proposed language, specifically in 40 CFR 86.1803-01, the addition of definitions for a cab-complete vehicle, an incomplete vehicle, transmission type, the addition of automated manual and continuously variable transmissions to the list of basic transmission types (page 40573 of the NPRM). [EPA-HQ-OAR-2014-0827-1265-A1 p.188]

## **Support Comment**

### **Comment – Miscellaneous support**

The CARB staff supports the addition of DPF filters to the list of items that require a regular maintenance interval of 50,000 miles/1500 hours (40 CFR 86.004-25 (b)(4)(i)). [EPA-HQ-OAR-2014-0827-1265-A1 p.189]

### **Response:**

We are adopting the provisions as proposed and as supported by the commenters.

## **14.4.2 Applying 40 CFR part 1068 to Heavy-Duty Highway Engines and Vehicles**

**Organization:** American Automotive Policy Council

### **Emissions Defect Reporting Provisions**

The Heavy-Duty GHG Proposal includes changes to the Emissions Defect Reporting for heavy-duty vehicles and engines. Full-line manufacturers have been reporting emission defects for many years. These manufacturers have consistent tools and processes for both light-duty and heavy-duty vehicles and engines. The proposed regulatory changes to § 85.1901 would force full-line light- and heavy-duty vehicle manufacturers to use two separate defect reporting processes, adding little value at the cost of unwarranted complexity and opportunity for error. EPA should allow full-line manufacturers that have robust emissions defect reporting processes to continue to use the existing emissions defect reporting regulations for all vehicles. [EPA-HQ-OAR-2014-0827-1238-A1 p.35]

**Organization:** Volvo Group

### **Defect Reporting and Recall Procedures**

Manufacturers should retain the option to submit defect reports and manage recalls under the provisions of Part 1068 or Part 85 [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

EPA proposes that heavy-duty engine and vehicle manufacturers submit emissions related defect reports according to the provisions of 1068.501, effective in 2018. Currently, heavy-duty manufacturers have the option of submitting defect reports according to the procedures detailed in §85.1901, or using the procedures in §1068.501. [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

Volvo Group has invested considerable time and resources to improve the processes and systems used to identify, track, quantify, and characterize defects so as to reliably and accurately keep EPA informed according to the requirements of §85.1901. These improved processes and systems are now, and have been for some years, quite robust. A number of the tracking mechanisms and information sources contained in §1068.501 that are used to identify emissions-related defects are already integrated into systems being used today to identify and track emissions related defects according to §85.1901. The one that is not, in-use testing, is not believed to be a viable means for discovering systemic failures of emissions related defects. As an integrated manufacturer, we have no external vehicle manufacturers that could be a source for defect information. [EPA-HQ-OAR-2014-0827-1290-A1 p.68]

Volvo Group does, in fact, have a system for reporting defects according to California warranty reporting requirements. This system is currently adapted to the volume of engines sold in California. To adapt that system to support nation-wide sales would potentially affect the accuracy of the report and would be cost prohibitive with little gain because, as mentioned earlier, most of the information sources required per Part 1068 are already integrated into existing systems used for defect reporting under Part 85. Furthermore, the thresholds defined in Part 1068 are more forgiving than those currently defined in Part 85 as followed by Volvo Group, and therefore may be less, rather than more informative to the Agency for purposes of controlling and addressing emissions related defects. [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

Considering the foregoing, and considering the investment made to build a robust system for reporting defects under the provisions of Part 85, Volvo Group proposes that EPA maintain the option to heavy-duty highway engine and vehicle manufacturers to report under the provisions of Part 85 or Part 1068. While 1068.501 (a)(6) already provides that “You may ask us to allow you to use alternate methods for tracking, investigating, reporting, and correcting emission-related defects...,” Volvo Group proposes that you explicitly state the manufacturer’s option to report defects and manage recalls under Part 85. [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

**Response:**

EPA is concerned that the defect-reporting provisions of 40 CFR part 85 are outdated. They rely on manufacturers to set up their own reporting protocol, with the expected result that compliance practices will vary widely from one manufacturer to another. It is also the case that the reporting threshold of 25 vehicles is far too low in the context of engine and vehicle models that with annual production volumes of 50,000 units, or much more. We adopted defect-reporting provisions in 40 CFR part 1068 that address these concerns in a way that provides realistic thresholds that are dependent on production volumes, with an additional feature to provide an initial, higher threshold to allow for filtering out defects that turn out to be unrelated to emissions. We intend to pursue similar changes for light-duty vehicles in a future rulemaking, as noted in the next section. The question for this rulemaking is whether to make changes to all light-duty vehicles and heavy-duty engines in one later rule, or to make progress in this rule by migrating the defect-reporting requirements for heavy-duty engines now.

AAPC states a preference to change nothing. We believe, rather, that it is in the interest of both EPA and manufacturers to migrate to updated defect-reporting requirements in stages, gaining experience that will further inform later stages of rulemaking changes.

It is not clear how Volvo can have a system that already aligns closely with the new requirements, yet claims that it would be cost-prohibitive to make the change. It is also unclear why information from in-use testing is considered non-viable for purposes of identifying emission-related defects. The new defect-reporting program simply requires the manufacturer to make note of information revealing that engines have emission-related defects. If in-use testing does not reveal engine defects, it is not factored into the assessment; conversely, if in-use testing reveals engine defects, those should be counted along with defect information from other sources. We are aware that the new thresholds allow for a greater number of defects that go unreported; we count that as a positive feature of the new program because, as noted above, a defect-reporting threshold of 25 units is badly matched to production volumes of heavy-duty highway engines.

The provision in §1068.501 allowing for an alternate defect-reporting plan says that we may approve plans that are at least as effective as the new program. We will not approve methods based on 40 CFR part 85 as an alternate method.

### **14.4.3 Applying 40 CFR part 1068 to Light-Duty Vehicles, Light-Duty Trucks, Chassis-certified Class 2B and 3 Heavy-Duty Vehicles and Highway Motorcycles**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

#### 1. Emission defect reporting, recall and hearing provisions should be proposed in a separate rulemaking

We do not support the proposal to amend the emission defect, recall and hearing provisions for any on-highway vehicles in this rulemaking. The emission defect and recall provisions are well established regulatory processes with well understood inputs and outputs. Any proposal to amend them warrants consideration via a rulemaking process that evaluates the opportunities, benefits, burdens, and costs of any changes. Although we would be prepared to offer comment and input to such a rulemaking in the future, we do not at this time support further action on it in this proposal. [EPA-HQ-OAR-2014-0827-1271-A1 p.3-4]

While the Preamble does contain some discussion with respect to the movement of recall- and hearings-related general compliance provision for the LD sector into Part 1068 (see 80 FR 40530), the NPRM contains virtually no discussion of the LD proposal to require a transition to the emission defect reporting provisions in Part 1068. There is only a cursory, one-paragraph mention of the issue (80 FR 40526), as if to suggest that changes in defect reporting requirements are a matter of little consequence. In the context of this 629-page rulemaking, Alliance and Global Automakers members nearly missed the issue. Given the minor mention and lack of substantive discussion, it is not clear to the industry whether EPA's intention was simply to get an initial industry reaction to the proposal, or whether the Agency is really intending to finalize defect reporting changes as part of this HD rulemaking. [EPA-HQ-OAR-2014-0827-1271-A1 p.4]

Current regulations allow manufacturers of heavy duty on-highway engines to optionally use the defect reporting provisions of 1068.501. This allows for manufacturers who only produce heavy duty on-highway engines and other off-highway engines already subject to 1068.501 to use a single defect reporting process. This also allows for manufacturers who produce both light duty and heavy duty on-highway products to use a single harmonized defect reporting process. The proposed regulatory changes to section 85.1901 would force full-line light and heavy duty vehicle manufacturers to use two separate defect reporting processes, adding little value at the cost of unwarranted complexity and opportunity for error. [EPA-HQ-OAR-2014-0827-1271-A1 p.4]

If the Agency wishes to eliminate the flexibility described above, we think it should explain its reasons for doing so. However, the NPRM offers no insight into EPA's thought process, options it considered, projected impacts on manufacturers, or overall benefits and costs of the proposal. In the absence of this kind of substantive analysis, we do not think the issue is adequately teed up for rulemaking. In discussions with EPA Staff, EPA indicated that it is only seeking comments on light-duty defect reporting issue at this time and that EPA will conduct a separate rulemaking on this issue at some future date. [EPA-HQ-OAR-2014-0827-1271-A1 p.4]

In light of the above, we do not support EPA's proposal to change the defect reporting requirements at this time. We recommend that EPA's final rule not include any provisions for changing emission defect, recall and hearing procedures as proposed. However, the Automakers are committed to working with EPA on issues of this kind, through meetings, workshops and other opportunities for dialogue. If EPA continues to believe that changes to the defect reporting provisions are desirable, we would be happy to engage in further discussions with EPA Staff. We think that further dialogue of this nature would

benefit both the Agency and the industry ahead of any proposal to alter the defect reporting requirements as part of a future rulemaking on this issue. [EPA-HQ-OAR-2014-0827-1271-A1 p.4-5]

Finally, we note there is a typographical error in 1037.250(b)(5): “Also identify the technologies that make up the certified configuration for each vehicle your produce.” [EPA-HQ-OAR-2014-0827-1271-A1 p.15]

**Organization:** Daimler Trucks North America LLC

**Defect reporting provisions for LDVs** – The EPA proposes to revise defect reporting provisions covering, among other things, light-duty vehicles. 80 Fed. Reg. 40530 and 40 CFR § 1068.501 (July 13, 2015). DTNA agrees with the position conveyed by the Alliance of Automobile Manufacturers: while adjusting the defect reporting provisions looks like a good idea, the information presented by EPA is too general and imprecise for us to truly understand how the rules would impact manufacturers. The proposal needs to be elaborated in much more detail before we can comment adequately. That said, we are generally interested in replacing a fixed threshold of 25 defects as the basis for defect reporting with a scaled approach that would require defect reporting only after the manufacturer finds some larger number of actual emission-related defects. For example, investigating once possible defects exceed 5 to 10% of production, with a requirement to report defects if confirmed defects exceed a rate of 1 to 2% of production or 25 defects, whichever is greater, may be a workable approach. Note that we think it still important to include the 25 defect threshold so that small production runs are not inadvertently drawn into excessive amounts of reporting. We wish to add that we recommend that California adopt a similar system to the EPA, so that we can have one system nationwide. [EPA-HQ-OAR-2014-0827-1164-A1 p.136]

**Applying the General Compliance Provisions of 40 CFR Part 1068** – The agencies request comment on requiring manufacturers to follow the California defect-reporting scheme for their EPA-certified vehicles. We have one concern with the California reporting requirements, which require reports at numerical thresholds based on one state’s worth of defects, being used for reporting on 50 states’ vehicles or engines; the impact would be to require many reports in cases where there are no significantly repeated problems. However, there may be some benefits to a change, in particular because we think that Part 1068 requires reporting too early in a process, when a manufacturer is not sufficiently certain there is even a problem to report—potentially resulting in the agency getting too many unnecessary reports. Additionally reporting per failure mode would be preferred over providing unfiltered warranty claims, as this would allow manufactures to do deep analysis of potential defects and report defects that are known to potentially affect emissions. Reporting of unfiltered warranty claims would require significant resource of EPA to analyze data, and duplicate the same work done by a manufacturer, as any one component may have several potential different failure modes, and some may have no effect on emissions. [EPA-HQ-OAR-2014-0827-1164-A1 p.117]

**Organization:** Motorcycle Industry Council, Inc. (MIC)

#### 1. Proposal to Apply Part 1068 General Compliance Provisions to Highway Motorcycles.

MIC supports this proposal as a general proposition. It should provide needed harmonization with other products, such as off-highway motorcycles and ATVs, which are also manufactured by a number of our members and which are already subject to Part 1068. Harmonization will promote better understanding of EPA requirements by all our members, and help promote compliance. [EPA-HQ-OAR-2014-0827-1158-A1 p.1]

## 2. Proposal to Apply Subpart F (Reporting Defects and Recall) of Part 1068 to Highway Motorcycles.

EPA is asking for comments in particular on its proposal to include the reporting and recall provisions in Subpart F of Part 1068 to highway motorcycles. MIC agrees that Subpart F, including the proposed amendments to Secs. 1068.501, 1068.505 and 1068.515, should be included and made applicable to highway motorcycles, as part of the overall movement toward harmonization. However, MIC is strongly opposed to the suggestion (at 80 FR 40530) of adopting the California regulations governing reporting of defects and recall on a national basis. While the concept of uniform national provisions for reporting and recall is an appealing one, we believe that objective should be achieved by extending EPA regulations to California, rather than by applying California's regulations nationally. California's reporting and recall regulations (13 CCR 2111-2121 and 2122-2135) are unnecessarily burdensome and complex (with no less than three overlapping types of reports) and have a history of causing disputes and even litigation. The EPA regulations appear to be much clearer and less complex, and would be the preferred model for nationalization. We encourage EPA to work with the California Air Resources Board on extending the EPA regulations to California. [EPA-HQ-OAR-2014-0827-1158-A1 p.1-2]

### **Response:**

In the final rule we are adopting the proposed migration of hearing procedures to 40 CFR part 1068. As described in the Preamble, this change aligns with regulations adopted by EPA's Office of Administrative Law, and provides a unified set of hearing provisions for all sectors covered by emission standards under Title II of the Clean Air Act. The old and new hearing procedures are nearly identical, so we expect no adverse circumstance to result from the migration.

We are retracting the proposed change to migrate recall provisions for vehicles certified to standards under 40 CFR part 86, subpart S. We believe this would involve only very minor changes, but we agree with the industry that this is better accomplished in a later rulemaking with greater opportunity for deliberation. In particular, we are currently in the process of exploring implementation of recall provisions in a way that will likely lead to a better understanding of the practical opportunities and limitations under the current recall regulations. We will likely be ready to propose regulatory changes in the near future that streamline requirements, reduce unnecessarily restrictive specifications, and improve our ability to effectively manage the overall recall experience.

We did not propose to migrate defect-reporting requirements for vehicles certified under 40 CFR part 86, subpart S, but rather requested comment on the idea in an effort to explore interest. We are aware that the current defect-reporting protocol in 40 CFR part 85 has led to widely varying implementation practices by different manufacturers. This may lead to a competitive advantage for companies that take a more lenient approach. We expect to pursue this migration to 40 CFR part 1068 in a later rulemaking. We will at that point be ready to work with manufacturers, individually and collectively, to design an updated defect-reporting program that is streamlined and effective, and provides a level playing field for all manufacturers.

We look forward to updating the certification and compliance regulations for highway motorcycles similar to what has been done for recreational vehicles and other sectors. While we contemplated a head start on this migration for recall and defect-reporting, we are not finalizing those changes in this rule. We believe it is most important to adopt updated recall and defect-reporting procedures for highway motorcycles and light-duty vehicles at the same time. This will allow us to consider these sectors together in determining any appropriate provisions that should apply differently than what we have already adopted in 40 CFR part 1068. It will also allow us to update reporting software for both as part of a single effort.

### **14.4.4 Amendments to General Compliance Provisions in 40 CFR part 1068**

**Organization:** Daimler Trucks North America LLC

We agree with the changes done on Part 1068. [EPA-HQ-OAR-2014-0827-1164-A1 p.121]

**Organization:** Truck & Engine Manufacturers Association (EMA)

The Preamble description of the proposed change to §1068.201 references the ability to change an engine from one exemption to another. This clarification is welcome, but the proposed regulatory language change in §1068.201(c) falls short of clarifying the ability to change labels when making such an exemption change. EMA requests that the regulatory requirements as described in §1068.201(c) be revised to clarify that labels can be changed for exemptions that are allowed, without approval by the Agency. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

**Response:** We have removed the proposed changes to §1068.201 from this rulemaking, which will allow us to address issues related to redesignating exempt engines in a future rulemaking. We note that current regulations at §1068.101(b)(7) describe provisions related to removing and replacing incorrect emission labels.

The Preamble discussion of §1068.240 describes a requirement to identify the disposition of the engine being replaced in addition to a revision to the reporting requirements. The proposed regulatory language includes the welcome change to the reporting requirements, but does not include any requirements associated with the disposition of the replaced engine. EMA supports the lack of regulatory requirements associated with the disposition of the replaced engine, and therefore requests that EPA not implement any requirements associated with engine disposition without a subsequent notice and comment rulemaking process. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

**Response:** The revised regulation clarifies that an engine may count as a tracked replacement engine under §1068.240(b) only if the manufacturer meets all applicable requirements by the (revised) due date for the required report. It is clear that the disposition of the engine is one of the conditions for tracking under paragraph (b), so this particular point does not need to be called out separately. We will consider adding this to the regulation if there is any uncertainty on that point for implementation.

EMA also supports the proposed amendment to §1068.240(c)(3), which would change the reporting requirement for replacement engines from March 31st to September 30th. However, EMA requests clarification regarding the proposed regulatory language stating that “you must also include the total number of replacement engines you produced under paragraph (b), (d), and (e) of this section.” Currently 40 CFR 1042.615(a) specifies that it applies in lieu of §1068.240(b), and includes the reporting requirements as specified in §1042.615(a)(3). To avoid confusion and the potential for duplicate reporting, EMA requests that §1068.240(c)(3) be revised to state: “you must also include the total number of replacement engines you produced under paragraph (b), (d), and (e) of this section, including engines previously reported per 40 CFR 1042.615(a)(3).” [EPA-HQ-OAR-2014-0827-1269-A1 p.85-86]

**Response:** We have revised §1068.240 to reference the marine engines as suggested by EMA.

The substantial revision to Subpart G providing clarification regarding the available hearing procedures may be both necessary and desirable to address the wide diversity of products regulated per Part 1068. However, EMA objects to the proposed regulatory provisions to the extent that they are inconsistent with any provisions of the federal Administrative Procedures Act (including section 553 through 557 of

Title 5), section 307 of the CAA, or subpart 22 of Title 40 of the Code of Federal Regulations. [EPA-HQ-OAR-2014-0827-1269-A1 p.86]

**Response:** We believe the hearing procedures as adopted in 40 CFR part 1068, subpart G, are wholly consistent with the Administrative Procedures Act. We will be ready to adopt any amendment that may be needed to achieve this objective.

The changes proposed to section 1068.505, which relate to remedial requirements regardless of age or extent of service, require clarification. The qualifying requirement that “a determination is made that a substantial number of properly maintained and used engines/equipment do not conform” assumes that the vast majority of the affected engines/equipment are still within their regulatory useful life as prescribed by the applicable regulatory sub-part. However, the related provisions regarding the need to contact the current owners of engines/equipment, regardless of age, are not feasible for nonregistered engines/equipment. Accordingly, EMA recommends that the regulatory language be modified to clarify that while engines/equipment cannot be excluded, the Agency’s determination will include an assessment of the ability of the recall to be effective given the manufacturer’s ability to identify engines/equipment that are subject to the recall. [EPA-HQ-OAR-2014-0827-1269-A1 p.86]

**Response:** We disagree that the qualifying requirement involves any assumption about the status of in-use vehicles. This is merely establishing a principle that manufacturers may not exclude older vehicles from a recall action on the basis of age, once a recall order is issued. It is always understood that manufacturers will be able to perform recall repairs only to the extent that the vehicles are available.

The proposed change to section 1068.505(c) revising the response time for manufacturers required to submit a remedial plan from 60 days, to a designated date but no less than 45 days, provides needed flexibility for circumstances where the 60-day mandate is not feasible. However, the “no less than 45 days” requirement results in significant concern that the 45-day minimum will become the Agency default, regardless of the complexity of the required remedial plan. Accordingly, EMA recommends that the language be revised to require the submission of a preliminary remedial plan allowing the Agency and the manufacturer to determine the appropriate additional required information in accordance with the provisions in 40 CFR 1068.510. [EPA-HQ-OAR-2014-0827-1269-A1 p.86]

**Response:** The manufacturer’s submitted plan is understood to be subject to EPA review for completeness. If there are some things that cannot be addressed or resolved in this timely submission, EPA will work with the manufacturer to supplement that initial submission as needed for an effective recall. It is also understood that manufacturers will respond to EPA input on revisions to the draft remedial plan in a timely manner. We believe the regulatory language as proposed aligns with the suggested approach.

The proposal to change the language in section 1068.515(c) from stating “where” the repair or inspection was completed to “the facility” is acceptable, but EMA requests that the Agency recognize that an electronic tracking system may be a viable option for providing the detailed information, thereby allowing the required label to be significantly less space-consuming. [EPA-HQ-OAR-2014-0827-1269-A1 p.86]

**Response:** We agree with the comment and have revised the regulation accordingly.

**Organization:** Volvo Group



Part 1068 scope of recall and labeling provisions are unduly burdensome with little gain [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

Addressing specifically the provisions of Part 1068, we have concern about the requirements in 1068.505(a) which states “You must remedy at your expense noncompliant engines/equipment that have been properly maintained and used, as described in § 1068.510(a)(7), *regardless of their age or extent of service accumulation at the time of repair.*” [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

While we agree that it is correct to focus the consideration for a recall on products that are within their useful life, we have concern that the language EPA proposes to add could be interpreted to require the recall of all vehicles and engines still in operation, regardless of whether they have exceeded their useful life. This is beyond the requirements of the regulation and the Clean Air Act. Specifically, the Clean Air Act provides: [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

...the manufacturer of each new motor vehicle and new motor vehicle engine shall warrant to the ultimate purchaser and each subsequent purchaser that such vehicle or engine is (A) designed, built, and equipped so as to conform at the time of sale with applicable regulations under section 7521 of this title, and (B) free from defects in materials and workmanship which cause such vehicle or engine to fail to conform with applicable regulations *for its useful life* (as determined under section 7521(d) of this title). *42 U.S.C. 7541(A)* (Emph. added) [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

EPA, therefore, should either eliminate the proposed language, or clarify it to state: [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

You must remedy at your expense noncompliant engines/equipment that have been properly maintained and used and are still within their useful life, as described in § 1068.510(a)(7). [EPA-HQ-OAR-2014-0827-1290-A1 p.69]

This is important for practical as well as legal reasons. Engines and vehicles that exceed their useful life are typically under a second or even third owner, so the opportunity to locate the owners is limited. Further, compared to the cost, there is little value to performing repairs on engines or vehicles that are approaching the end of their productive life. Most older vehicles are in less intensive operations, and so their emissions contribution is limited. The scope of the recall should therefore be limited to those units that are within their useful life. This makes the requirement similar to the NHTSA practice of limiting the scope of the recall to engines/vehicles no more than 10 years old. [EPA-HQ-OAR-2014-0827-1290-A1 p.70]

Another point we'd like to address are the provisions set forth in 1068.510 and 1068.515 requiring that a label be installed on each engine or vehicle that has been repaired in a recall. This requirement would be new for the industry, and is unduly burdensome because it would add unnecessary expense and complication to the recall process without significant benefit. Achieving good adhesion of a label to a vehicle and especially an engine surface is an engineering challenge, even in the controlled and clean conditions of the new product manufacturing facilities. It's all the more difficult in the service bay with engine installed in a vehicle. Finding a visible, flat, cleanable surface to apply a label that will remain free from damage and debris is a surprisingly difficult challenge under the hood of a heavy duty vehicle. Such a surface would also have to be clear from sources of excessive heat or engine fluids. In lieu of such a label, a more reliable and simpler access to any recall status for an engine or vehicle is available from dealer and manufacturer electronic records. We would propose that the labeling requirement be removed. [EPA-HQ-OAR-2014-0827-1290-A1 p.70]

**Response:**

While the regulatory useful life defines a parameter to characterize a manufacturer's obligation to design and produce engines, the statutory direction to execute a recall describes an obligation to remedy nonconformities on all properly maintained and used vehicles. CAA section 207(c)(1) follows:

If the Administrator determines that a substantial number of any class or category of vehicles or engines, although properly maintained and used, do not conform to the regulations prescribed under section 202, when in actual use throughout their useful life (as determined under section 202(d)), he shall immediately notify the manufacturer thereof of such nonconformity, and he shall require the manufacturer to submit a plan for remedying the nonconformity of the vehicles or engines with respect to which such notification is given. The plan shall provide that the nonconformity of any such vehicles or engines which are properly used and maintained will be remedied at the expense of the manufacturer.

As noted above recall effectiveness always depends on an imperfect ability to identify and procure subject vehicles. However, we believe the statute and therefore the regulations should not allow manufacturers to elect not to remedy a nonconformity under a recall simply because a vehicle is no longer within the useful life period specified in the regulation.

Recall labels are already required for motor vehicles and motor vehicle engines under 40 CFR 85.1803(c). We believe manufacturers can accomplish the engineering necessary to find a location and apply a label with good adhesion to recalled vehicles.

**1924Organization:** American Automotive Policy Council

AAPC has the following concerns: [EPA-HQ-OAR-2014-0827-1238-A1 p.35]

- The proposal would require defect reports to be submitted as soon as an investigation is initiated and investigation progress reports must be submitted twice a year until the investigation closes, which could be the full useful life of the vehicle. Thus, manufacturers could be required to file numerous "defect reports" even if the ultimate outcome of the investigation is that there is no defect. This increases both manufacturer and EPA workload for no apparent benefit. EPA should only require reports when defects have been identified, per 40 CFR 1068.501(c). [EPA-HQ-OAR-2014-0827-1238-A1 p.35]
- Current Emissions Defect Reporting requirements apply for five years from the end of the model year in which such vehicles or engines were manufactured. The proposed provisions require emissions defect reporting for the full useful life of the engine/vehicle. This will require substantially more resources for manufacturers and Agencies to monitor and track. This is not value added; it is highly unlikely that defects in design, materials, or workmanship will only become evident more than five years after the end of the model year in which the vehicle was produced. In addition, as time passes the investigation will be confounded by whether the issue identified is normal wear and tear or a defect. [EPA-HQ-OAR-2014-0827-1238-A1 p.35]
- The proposal requires manufacturers to monitor warranty claims and conduct an investigation when the warranty claims and/or other indicators exceed a specified threshold. This may discourage manufacturers from offering any additional warranty, including extended service plans, beyond five years or the regulated warranty. [EPA-HQ-OAR-2014-0827-1238-A1 p.35]

For these reasons, we recommend that the Emissions Defect Reporting requirements continue to apply for five years from the end of the model year in which such vehicles or engines were manufactured. [EPA-HQ-OAR-2014-0827-1238-A1 p.36]

AAPC makes the following recommendations: [EPA-HQ-OAR-2014-0827-1238-A1 p.36]

- EPA should only require reports when defects have been identified, per 40 CFR 1068.501(c). [EPA-HQ-OAR-2014-0827-1238-A1 p.36]

Emissions defect reporting requirements continue to apply for five years from the end of the model year in which such vehicles or engines were manufactured. [EPA-HQ-OAR-2014-0827-1238-A1 p.36]

**Response:**

The innovation of the defect-reporting methodology for §1068.501 is to set a relatively high threshold for unscreened defects, which triggers the need for an “investigation.” This prospective investigation involves a greater effort to evaluate future defects to confirm whether or not they are emission-related defects. This allows the manufacturer to apply a more focused attention after processing a relatively large number of defects where it is not clear that the defect is emission-related. The lower threshold for confirmed emission-related defects benefits from this screening approach, with the result that defect reports are more likely to involve substantial nonconformity.

It is true that investigation reports are ongoing, but we note that these reports (and the corresponding investigation) are triggered by a high enough level of observed defects that the manufacturer should be paying more attention to determine the cause of the problem. This should align well with the manufacturer’s own interest to address defects, whether or not they are emission-related. Investigation reports may ultimately lead to a defect report, but we find investigation reports to be of significant value in either case.

Manufacturers are expected to monitor warranty claims and other indicators of defects. We would expect manufacturers to never see warranty claims beyond the first five years of a vehicle’s life. Other indicators, such as orders for replacement parts do not involve greater effort to include older vehicles. There may be more incidences of normal wear, but that can be accounted for in considering whether there are emission-related defects. We believe it is appropriate to keep the requirement to monitor for defects throughout the useful life.

The manufacturers’ option to offer extended warranty provisions to their customers is a business and marketing decision for the companies. This may be affected by statutory and regulatory requirements related to emission standards, but this should not cause us to change the way we implement emission standards and related requirements.

**Organization:** Motorcycle Industry Council, Inc. (MIC)

As an additional amendment to Subpart F, we recommend that EPA add provisions to Sec. 1068.505 making it clear that recalls may be made applicable to engine/equipment family subgroups, and not necessarily to full engine families, so that, where a subgroup is the principal or only source of a defect, a targeted recall of smaller scope can be implemented. This would avoid the problem of over-broad recalls that has been a matter of contention in the past under the California program. [EPA-HQ-OAR-2014-0827-1158-A1 p.2]

MIC is not opposed to this amendment [to 40 CFR 1068.27], but because confirmatory testing has the potential for causing a manufacturer undue hardship by delaying production for weeks and even months,

we request that language be added to specify, where EPA performs confirmatory testing for statistical or market coverage reasons, and not based on evidence suggesting that a vehicle or engine will likely be in noncompliance, that EPA will in such cases issue a conditional certificate of compliance. The conditional certificate would provide that the manufacturer must effect repairs, including recall if necessary, to correct vehicles or engines shown by testing not be in compliance. We suggest adding a new subsection (d) to sec. 1068.27, to read as follows: [EPA-HQ-OAR-2014-0827-1158-A1 p.2]

(d) When we perform confirmatory testing and do not have any prior evidence or cause to believe that the engines/equipment cannot comply with applicable regulations, we will issue, at the manufacturer's request, a certificate of conformity that is conditional on test results demonstrating compliance with all the regulations of this chapter. If our testing demonstrates noncompliance, the manufacturer must make all repairs required to bring the engines/equipment into compliance, including, where we order it, non-voluntary recall as specified in Subpart F of this Part. [EPA-HQ-OAR-2014-0827-1158-A1 p.2]

**Response:**

We believe the recall provisions already allow EPA to order a recall for a subset of engines or vehicles from a family.

Manufacturers should plan their timelines for submitting applications for certification to allow for confirmatory testing by the Agency. Note that the regulation at 40 CFR 1068.103(c) allows manufacturers to start production once they submit an application; however, those products may not be shipped before the certificate is issued.

**Organization:** Navy

Navy requested that we expand the automatic exemption for national security to address concerns about access to low-sulfur diesel fuel outside the United States. See Section 14.4.9.

#### **14.4.5 Amendments to Light-Duty Greenhouse Gas Program Requirements 1926**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

#### **2. Changes to Global Warming Potentials must be accompanied with evaluation and adjustment of GHG standards to maintain existing stringency of the GHG standards**

In the NPRM, at 80 FR 40206, EPA proposes to adopt an updated value from the IPCC Fifth Assessment Report for the global warming potential (GWP) of methane (CH<sub>4</sub>), which would increase the value for CH<sub>4</sub> from 25 to a range 28-36. However, neither in the NPRM nor in the RIA is there any discussion about the effects on the stringency of meeting existing LD GHG standards. Automakers do not support the change to GWP of CH<sub>4</sub> without a change to the stringency of the GHG rules. We note that EPA, in promulgating the LD GHG rules, stated that it was committed to maintain the stringency of GHG standards [See 77 FR 62777 (October 15, 2012); CH<sub>4</sub> emissions make up a component of CREE calculations used to determine compliance with the GHG standards. [EPA-HQ-OAR-2014-0827-1271-A1 p.5]

**Response:** We are changing the methane GWP, but we are not applying this change to light-duty vehicles in this rulemaking.

### **3. Regulatory flexibilities being proposed for HD should be extended to LD as well**

#### **a. The ability for chassis certified HD vehicles to attest to N<sub>2</sub>O compliance using an engineering statement (in Part 86 Subpart S 86.1819-14(e)(6)) should also be allowed for LD**

In the NPRM at 80 FR 40342, EPA proposes to maintain in the HD GHG Phase 2 program the N<sub>2</sub>O compliance provisions from the Phase 1 program, and to allow attestation to the N<sub>2</sub>O standards. We recommend that the ability for chassis-certified HD vehicles to attest to N<sub>2</sub>O compliance using an engineering statement (in Part 86 Subpart S 86.1819-14(e)(6)) should also be allowed for LD. EPA should allow the continued use of attestation to N<sub>2</sub>O standards, including the attestation to higher N<sub>2</sub>O caps (i.e., alternate N<sub>2</sub>O standard), for all gasoline powered EDVs and FEDVs. [EPA-HQ-OAR-2014-0827-1271-A1 p.5]

The measurement of N<sub>2</sub>O is still evolving, and since it currently requires many non-automated operations, it greatly increases resource burdens in high-volume production testing LD laboratories. Since most vehicles will meet the N<sub>2</sub>O cap standards while still meeting the NOX or NMOG+NOX standards, allowing attestation to the standard would still allow the agencies to test for N<sub>2</sub>O and maintain applicability of N<sub>2</sub>O standards while reducing costs and testing burden. [EPA-HQ-OAR-2014-0827-1271-A1 p.5]

**Response:** Revisiting issues related to N<sub>2</sub>O measurement for the light-duty program are outside the scope of this rulemaking. See the earlier rule for a discussion of N<sub>2</sub>O measurement.

#### **b. Any option for smaller ETW increments/classes or to analytically adjust FE/GHG test results for HD vehicles should also be made available for LD vehicles**

In the NPRM, at 80 FR 40531, the EPA proposes to allow the use of smaller equivalent test weight (ETW) classes for HD vehicles. We support the availability of an option for manufacturers to use smaller ETW increments/classes or to analytically adjust FE/GHG test results for HD vehicles and recommend that these same options be made available for LD vehicles, provided that the option is allowed at the Test Group or Engine Family Level. [EPA-HQ-OAR-2014-0827-1271-A1 p.6]

At this time, the ability of manufacturers to perpetuate an ETW increment change through their respective fleets is unknown. The Automakers are currently investigating the added test burden and workload of developing data at more discrete ETW intervals and anticipate submitting supplemental comments providing this information to the HD GHG NPRM docket. [EPA-HQ-OAR-2014-0827-1271-A1 p.6]

The smaller ETW bins should be allowed at the test group level. Besides test burden and related workload, allowing smaller ETW bins at the test group level will lead to more manufacturers using said bins. This is primarily due to how vehicle programs are managed. Using smaller ETWs would be difficult to implement across an entire manufacturer because program planners are often only responsible for mass within a given platform, model, or even test group. Typically, mass reductions must be justified as narrowly as the test group. Forcing mass reduction justifications beyond the test group level will likely lead to manufacturers maintaining the status quo with respect to ETW. By restricting ETW options to the test group level, manufacturers will not be able to “pick and choose” on a sub configuration level. Test group implementation will allow manufacturers to move vehicles to the smaller ETW bins in a stepwise manner. [EPA-HQ-OAR-2014-0827-1271-A1 p.6]

Also, expanded use of either Analytically Derived Fuel Economy (ADFE) or Analytically Derived CO<sub>2</sub> (ADCO<sub>2</sub>) due to smaller ETW bins should not infringe upon the maximum allowed. This can be justified in that new use of ADFE or ADCO<sub>2</sub> would likely only adjust data within a test group, platform, or model. [EPA-HQ-OAR-2014-0827-1271-A1 p.6]

ADFE and ADCO<sub>2</sub> as a result of ETW changes should also not be subject to the same confidence level adjustments, or penalties, as traditional analytical adjustments because adjustments due to ETW are between vehicles that are very similar and any confidence penalties, although small, could have a significant impact on small GHG gains due to smaller ETW bins. [EPA-HQ-OAR-2014-0827-1271-A1 p.6]

**Response:** The suggested changes for the light-duty program are outside the scope of this rulemaking.

**4. Comments on EPA’s proposed changes to 40 CFR 600.116-12 (80 FR 40533, 80 FR 40574) and proposals to make minor changes to correct errors and clarify regulations; Comments to NHTSA regarding related provisions of 49 CFR 538.5 and 538.6**[EPA-HQ-OAR-2014-0827-1271-A1 p.7]

In the NPRM, at 80 FR 40574, EPA proposes to add a new paragraph (c)(2) to 40 CFR 600.116-12, pertaining to the treatment of plug-in hybrid electric vehicles for the purposes of Corporate Average Fuel Economy (CAFE). Although further explanation of the intent and reasoning of the changes is limited in the Preamble [80 FR 40533], we make the following comments based on the apparent intent of the proposed regulatory text as currently drafted. [EPA-HQ-OAR-2014-0827-1271-A1 p.7]

**a. Application of 49 CFR 538.5 requirements to determine appropriate method of calculation of fuel economy performance for hybrid electric vehicles which have plug-in capability** [EPA-HQ-OAR-2014-0827-1271-A1 p.7]

In the proposed paragraph (c)(2), the agency sets forth methods to calculate the fuel economy performance for hybrid electric vehicles which have plug-in capability, distinguishing between those which do, and those which do not, qualify as dual fueled automobiles under 49 CFR 538.5. The Automakers note that 49 CFR 538.5 pertains only to passenger automobiles, not to non-passenger automobiles such as light trucks or medium-duty passenger vehicles. For example, 49 CFR 538.5(b) reads, “The minimum driving range that a passenger automobile using electricity as an alternative fuel must have in order to be treated as a dual fueled automobile pursuant to 49 U.S.C. 32901(c) is . . .” [emphasis added] Therefore, the agency proposed language is not clear as to how non-passenger automobiles are to be treated. The Automakers recommend that EPA draw a distinction in calculation method based only on the existing definition of “dual fueled automobile” found at 40 CFR 600.002, which appropriately notes the limitation of the minimum driving range requirements to only passenger automobiles. [EPA-HQ-OAR-2014-0827-1271-A1 p.7]

**b. Applicability of “utility factor”-based calculations to vehicles that qualify as dual fueled automobiles** [EPA-HQ-OAR-2014-0827-1271-A1 p.7]

At the proposed paragraph (c)(2)(ii) (80 FR 40574), for vehicles that qualify as dual fueled automobiles, there are two options for manufacturers: (1) determine fuel economy using utility factors, but without the petroleum equivalence factor as described in the proposed (c)(2)(i); or (2) determine fuel economy using the harmonic average of the fuel economy in charge sustaining mode and the miles per gallon equivalent measured while operating on electricity, adjusted using the petroleum equivalence factor. In the first option, the manufacturer receives potentially greater weighting of electric operation, but is

prevented from applying the petroleum equivalence factor. In the second option, the petroleum equivalence factor is permitted, but the weighting of the two values is defined as equal (50% charge-sustaining miles per gallon, and 50% electric operation). [EPA-HQ-OAR-2014-0827-1271-A1 p.7]

The proposed approach is inconsistent with 49 U.S.C. 32905(e), as amended by the Carl Levin and Howard P. “Buck” McKeon National Defense Authorization Act for Fiscal Year 2015. The amended statute permits a manufacturer to apply a utility factor-based approach and the petroleum equivalence factor in combination for 2016 and subsequent model year vehicles or, at the manufacturer’s option, an equal weighting with the petroleum equivalence factor. The Automakers recommend redrafting the text to permit a manufacturer to choose a utility factor based approach in combination with the petroleum equivalence factor for model years after 2015. [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

Specifically, we recommend the following changes to the proposed text for the added paragraph 40 CFR 600.116-12(c)(2) (redline relative to proposed text in the NPRM): [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

(2) Determine fuel economy values to demonstrate compliance with CAFE standards as follows: [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

(i) For vehicles that do not qualify as dual fueled automobiles under 49 CFR 538.5, determine fuel economy using the utility factors described in paragraph (c)(1) of this section. Do not use the petroleum-equivalence factors described in 10 CFR 474.3. [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

(ii) For vehicles that qualify as dual fueled automobiles ~~under 49 CFR 538.5~~, determine fuel economy ~~based on the procedure described in paragraph (c)(2)(i) of this section, or based on the~~ following equation, separately for city and highway driving: [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

$$\text{MPGeCAFE} = 1 / (0.5/\text{MPG}_{\text{gas}} + 0.5/\text{MPGelec})$$

Where:

$\text{MPG}_{\text{gas}}$  = The miles per gallon measured while operating on gasoline during charge sustaining operation as determined using the procedures of SAE J1711 (incorporated by reference in § 600.011).

$\text{MPGelec}$  = The miles per gallon equivalent measured while operating on electricity. Calculate this value by dividing the equivalent all-electric range determined from the equation in § 86.1866-12(b)(2)(ii) by the corresponding measured Watt-hours of energy consumed; apply the appropriate petroleum-equivalence factor from 10 CFR 474.3 to convert Watt-hours to gallons equivalent. Note that if vehicles use no gasoline during charge-depleting operation,  $\text{MPGelec}$  is the same as the charge-depleting fuel economy specified in SAE J1711. [EPA-HQ-OAR-2014-0827-1271-A1 p.8]

(iii) Optionally, for 2016 and subsequent model year vehicles that qualify as dual fueled automobiles, determine fuel economy based on the following equation, separately for city and highway driving: [EPA-HQ-OAR-2014-0827-1271-A1 p.9]

$$\text{MPGeCAFE} = 1 / (\text{UF}/\text{MPGelec} + (1-\text{UF})/\text{MPG}_{\text{gas}})$$

Where:

UF = The appropriate utility factor for city or highway driving as described in paragraph (c)(1) of this section. [EPA-HQ-OAR-2014-0827-1271-A1 p.9]

**Response:** EPA agrees that the proposed regulatory text lacked clarity regarding the appropriate calculation method for non-passenger automobiles. EPA also agrees with the commenter regarding utility factors for dual-fueled automobiles. The final rule includes the appropriate changes to the regulatory text.

### **c. Interpretation of driving range in the context of 49 CFR 538.5 and 538.6**

NHTSA proposes to update the authority citation for 49 CFR 538.5. [80 FR 40765] While NHTSA considers changes to 538.5, the Automakers urge NHTSA to consult with EPA on relatively recent developments in test procedures to measure the emissions and fuel economy of alternative fueled vehicles which use electricity. When sections 538.5 and 538.6 were last amended, NHTSA interpreted that the minimum driving range was to be measured operating on electricity alone, generally citing the need for off-board electricity use to meet Congressional intent and the lack of a fuel economy test able to measure a hybrid electric vehicle operating on a combination of electricity and petroleum fuel. [63 Fed. Reg. 66064, December 1, 1998] In the time subsequent to this rulemaking, manufacturers have introduced plug-in hybrid models which make use of stored off-vehicle electricity and petroleum fuel in combination (a.k.a. blended operation). To evaluate vehicles with this type of operation, the California Air Resources Board developed test and calculation methods to determine an “equivalent all electric range,” effectively measuring how far a plug-in hybrid electric vehicle could travel on the stored off-board electricity if only the electric portion of blended operation is considered. [E.g. see California Exhaust Emission Standards and Test Procedures for 2009 through 2017 Model Zero-Emission Vehicles, and Hybrid-Electric Vehicles, in the Passenger Car, Light-Duty Truck and Medium-Duty Vehicle Classes] Given the wide variety of plug-in hybrid technology applications possible and the availability of test procedure and calculation methods capable of determining the off-board electric portion of blended operation, the Automakers recommend that NHTSA clarify its interpretation of the minimum driving range to be based on equivalent all electric range. This could be accomplished within the Preamble of the Final Rule which will be associated with this rulemaking and/or with minor modifications to 49 CFR 438.6. [EPA-HQ-OAR-2014-0827-1271-A1 p.9]

**Response:** EPA agrees with the manufacturers that the equivalent all-electric range is often the most appropriate metric for comparing the electric driving capability – and the commensurate reduction in petroleum fuel use – of plug-in hybrid electric vehicles. In fact, EPA has already set a precedent by using the equivalent all-electric range as qualification criteria for use of the production multipliers applicable to plug-in hybrid electric vehicles in the 2017-2021 model years (see 40 CFR 86.1866-12). We chose to use the equivalent all-electric range in this case to avoid discriminating against vehicles that “blend” use of electricity with gasoline but that still displace petroleum as much as vehicles that have a pure all-electric driving range. However, NHTSA will evaluate the underlying statute and determine whether or not the law will allow the interpretation requested by auto manufacturers.

## **8. Comments on additional issues**

a. EPA should include an amendment to allow additional flexibility for the certification fuel used for fuel economy, CAFE and greenhouse gas emissions testing [EPA-HQ-OAR-2014-0827-1271-A1 p.13]

The Tier 3 Final Rule [79 FR 23414, April 28, 2014] resulted in a change in the certification fuel used for emissions testing but did not provide test procedure adjustments to allow the new certification fuel to



be used for fuel economy-related testing, including the LD CAFE and GHG emission programs. As a result, industry must currently conduct duplicative testing on two separate fuels, which adds additional test burden and unnecessary, additional compliance costs. The Agency included a threshold date of model year (MY) 2019 in part 600.117 when dual testing must cease and which might indirectly result in the elimination of E0 test fuel for CAFE and GHG compliance testing after MY2019. [EPA-HQ-OAR-2014-0827-1271-A1 p.13]

While the Tier 3 rulemaking promised an expeditious follow-up rulemaking to address test procedure adjustment factors and allow the new certification fuel for CAFE and GHG testing, efforts are slow to start, and it is not clear if they will be completed prior to MY 2019. Automakers greatly support EPA efforts to perform the evaluations necessary to arrive at proper corrections to test with the changed fuels. In the undesired scenario of these evaluations not being completed in time, or of the correction being insufficient, it would be prudent for the Agency to consider extending the MY2019 threshold date. Therefore, we recommend that EPA amend section 600.117 to extend the end date and clarify that E0 test fuel will remain the official compliance test fuel for CAFE and GHG testing until changed by a subsequent rulemaking. We do not wish for any extension of the date past the MY 2019 end date to reduce the urgency to complete the necessary test procedure adjustments, but such flexibility is necessary to ensure industry planners that they will not be subject to both a change in CAFE/GHG stringency and/or loss of the double testing flexibilities after MY2019. Automakers look forward to continuing to work with the Agency to speedily evaluate and determine correct adjustment factors for the changes to test fuels. [EPA-HQ-OAR-2014-0827-1271-A1 p.13]

**Response:** Testing in support of amendments to address these fuel effects is ongoing. We intend to continue with the approach described in 40 CFR 600.117, including the specified timeline. We will continue to interact with manufacturers in the effort to resolve these issues.

#### **14.4.6 Testing with Aftertreatment Devices Involving Infrequent Regeneration** **1931**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

#### **5. Comments to proposed changes to Part 1065**

##### **a. Infrequent regeneration procedures should be harmonized**

In the NPRM at 80 FR 40533, the EPA proposes to harmonize the common elements of infrequent regeneration factor (IRAF) procedures in 40 CFR Part 1065 for highway, locomotive, marine and land-based non-road compression ignition engines. Automakers support this change to implement consistent procedures to incorporate the emissions effects of infrequent regeneration for HD vehicles. This would extend the current procedures and requirements used for LD and make them applicable for HD. [EPA-HQ-OAR-2014-0827-1271-A1 p.9-10]

**Organization:** Truck & Engine Manufacturers Association (EMA)

Comments on the Proposed Technical Amendments to Part 86

The proposed revisions to section 86.004-28(i) and (j) (and to section 1065.680) would modify the handling of infrequent regeneration adjustment factors (IRAFs). Subparagraph (i) permits the continued use of the current methodology through the end of model year 2020. Subparagraph (j) specifies the new

methodology for handling IRAFs and points to 1065.680, a common procedural section referenced by several standard-setting Parts. The new methodology would be used beginning in model year 2021. [EPA-HQ-OAR-2014-0827-1269-A1 p.73]

The ability to continue to use the current IRAF calculation process through the end of model year 2020 is critical for lead time and product stability. Having the new requirements become effective in model year 2021 is appropriate, as several other product changes become effective with that model year, and the product changes needed to accommodate the revisions to the IRAF calculation procedures can be made at the same time. [EPA-HQ-OAR-2014-0827-1269-A1 p.73]

Accordingly, EMA supports the proposed changes and recommends that they be finalized as proposed. [EPA-HQ-OAR-2014-0827-1269-A1 p.73]

#### Comments on the Proposed Technical Amendments to Part 1065

The standards for several regulatory categories (on-highway, locomotive, marine, and land-based nonroad engines, etc.) have become more and more stringent, requiring the use of emission control devices that often require infrequent regeneration to maintain their effectiveness and/or prolong their life. As a result, the provisions describing the process to account for the potential emissions from these infrequent regenerations, commonly referred to as infrequent regeneration adjustments factors or “IRAFs” are needed in numerous CFR Parts. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

EPA’s proposal to put the common elements relating to IRAFs in Part 1065 is a good idea and is supported by EMA. Likewise, putting sector or category-specific elements in the sector-specific Parts is appropriate and also supported by EMA. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

EMA has reviewed the proposed language of new section 1065.680 - “Adjusting emission levels to account for infrequently regenerating Aftertreatment devices” - and generally agrees with the proposal. EMA also agrees that it is helpful to have the cited examples in section 1065.680, which illustrate and clarify the various embedded calculations. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

**Organization:** Daimler Trucks North America LLC

**Part 1065** - We agree with all the proposed changes done to Part 1065 except for section 1065.680 - adjusting emission levels to account for infrequently generating aftertreatment devices. On this section we recommend not removing the weighting factor that EPA first published on a 2006 guidance comment. [EPA-HQ-OAR-2014-0827-1164-A1 p.121]

**Organization:** California Air Resources Board (CARB)

#### **Support Comment**

##### **Comment – Adjustment factors for infrequent regeneration events**

CARB staff supports the proposed use of adjustment factors for correction of CO2 emission results and fuel consumption from infrequent regeneration events from heavy-duty engines equipped with exhaust aftertreatment. However, CARB staff has concerns regarding the continued use of the methodology for calculation of infrequent regeneration adjustment factors (IRAFs) as specified in 40 CFR 1065.680. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]

The primary concern stems from the application of the adjustment factors to discount both FTP and heavy-duty SET emissions. Instead, the adjustment factors should be applied in such a way as to apply the discounted FTP regeneration emissions to the SET regeneration emissions. In addition, staff believes that adjustment factors should be developed separately for each engine family. Due to the concerns with manufacturers inappropriately calculating adjustment factors, staff does not recommend allowing carry-across of adjustment factors from one engine family to another. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]

Specifically regarding the application of IRAFs to FTP and SET emissions, staff understands that heavy-duty manufacturers have been calculating adjustment factors based on a U.S. EPA guidance document (REF C1SD-06-22 HD-HWY). The concept in this document is to allow an offset in regeneration emissions from city-type driving to highway-type driving. CARB staff believes the example provided in this guidance document is flawed in that it applies discounted adjustment factors for both the FTP and SET cycles. In this example, the regeneration emissions were not applied to the SET. A true offset would seek to balance the emissions between city and highway driving. That is, if the regeneration emissions were offset from the FTP then the balance would be added to the SET; not subtracted, as done in the guidance document. This becomes more evident in the calculation of the new frequency factors, F, in the RIA's example. [EPA-HQ-OAR-2014-0827-1265-A1 p.103]

The FTP regeneration frequency is decreased from 0.2 to 0.06; however, the SET frequency is also decreased from 0.05 to 0.035. This double discounting in frequency is not reasonable and does not follow our understanding of in-use regeneration frequency. Instead, there should be a composite frequency, F', that resides between the individual cycle frequencies (i.e.,  $0.05 < F' < 0.2$ ). [EPA-HQ-OAR-2014-0827-1265-A1 p.104]

CARB staff suggests that U.S. EPA and NHTSA develop a representative composite frequency that takes into account the SET and FTP frequencies similar to the example equation below. Using the data provided in U.S. EPA guidance document, an equation to offset emissions with in-use driving averaged at 30 percent city (FTP-like driving) and 70 percent highway (SET-like driving) would be as follows: [EPA-HQ-OAR-2014-0827-1265-A1 p.104]

$$F' = F_{ftp} * \text{offset} + F_{set} * (1 - \text{offset})$$

$$F' = 0.20 * 0.3 + 0.05 * (1 - 0.3) = 0.095 \text{ Where offset} = \text{percent city driving}$$

The new frequency, F', would be used for both FTP and SET calculations of upward adjustment factors. [EPA-HQ-OAR-2014-0827-1265-A1 p.104]

[Table 16 can be found on p.104 of docket number EPA-HQ-OAR-2014-0827-1265-A1]

Further, CARB staff recommends utilizing existing standardized data stream parameters or developing new ones that characterize regeneration frequency on in-use engines (e.g., average regeneration frequency as a function of integrated fuel consumed, integrated work, positive kinetic energy) to complement analysis and conclusions made at the time of certification. For example, 2013 and newer MY diesel vehicles support in-use regeneration information through scan tool output. Vehicles using the SAE Standard J1939 protocol must support either SPN 5827 – 'Aftertreatment 1 Average Distance Between Active DPF Regenerations', or SPN 5454 – 'Aftertreatment 1 Diesel Particulate Filter Average Time Between Active Regenerations.' Vehicles using the SAE Standard J1979 protocol must support PID \$8B which includes both 'average time between regens' and 'average distance between regens.' [EPA-HQ-OAR-2014-0827-1265-A1 p.105]

Using these in-use data, a manufacturer can calculate an in-use regeneration frequency. Also, U.S. EPA and NHTSA can use these data for verification and compliance of the manufacturer's reported regeneration adjustment factors. The example below shows how the in-use data might be used to confirm reported adjustment factors: [EPA-HQ-OAR-2014-0827-1265-A1 p.105]

$F = \text{distance to complete Regen} / \text{distance to complete Regen} + \text{avg. dist. between Regens}$

A similar equation can be developed using a time basis:

$F = \text{time to complete Regen} / \text{time to complete Regen} + \text{avg. time between Regens}$

In closing, CARB staff strongly suggests that U.S. EPA and NHTSA revise the IRAF calculation methodology to accurately account for infrequent regeneration emissions on both FTP and SET test cycles. [EPA-HQ-OAR-2014-0827-1265-A1 p.105]

**Response:**

EPA recognizes the engine and vehicle industry associations' affirmation of the proposed regulatory changes. We are finalizing these provisions as proposed.

We specifically amended the regulation to move away from the weighting factors from the 2006 guidance documents. The unified approach to infrequent regeneration adopted in this rule allows for a technically robust method of accounting for upward and downward adjustment factors that applies broadly to the various engine sectors.

The IRAF procedure as outlined in §1065.680, does not contain any discounting as described by ARB in their comments. Specifically ARB references specific discounting of the regeneration frequency, or  $F$ , for both the FTP and SET. §1065.680 does not discount  $F$ , nor does it give any specific information for the FTP. All examples given are for the RMC (or SET). It is possible that ARB has confused their comments on §1065.680 with concerns over what is contained in the EPA IRAF guidance document Cisd-06-22 HD-HWY. §1065.680 is an attempt to move away from Cisd-06-22 HD-HWY and make improvements where applicable. Further, EPA does not believe that it is appropriate to develop a composite regeneration frequency,  $F$ , because emissions from IRAF are accounted for on a duty-cycle specific basis and as such, it is appropriate to utilize an  $F$  developed for each specific duty-cycle.

Use of actual in-use data is allowed, but not required for generating  $F$ .  $F$  can be generated based solely on laboratory data. It is not clear to EPA how the use of OBD monitoring would make  $F$  any more accurate. If you have OBD data for a given engine family from 10 different vehicles and  $F$  is not timer-based, that does not make  $F$  more accurate. After all, the duty cycle of the 10 vehicles from which the data was acquired is not guaranteed to represent the entire fleet of vehicles that the engine family is installed in. Therefore, EPA will continue to allow laboratory-generated values for  $F$ .

#### **14.4.7 Additional Test Procedure Amendments**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

##### **b. Comments on additional test procedure amendments to Part 1065 and Part 1066**

The Automakers do not support the proposed change to 1065.15(a)(2)(ii) – Allowance to report NMOG instead of NMHC -- as written. Rather than making this change for all fuels, we recommend that it not

be applicable to diesel fuels. Applying this change to diesel fuels would necessitate significant and costly changes to test equipment and procedures to test diesel vehicles by requiring off-line chemical lab speciation of exhaust. Such a change is not needed. [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

**Response:** EPA will remove the changes proposed in the NPRM. We have replaced this with an allowance for engine manufacturers to subtract ethane from measured hydrocarbon to demonstrate compliance with standards, as described below.

In the NPRM, at 80 FR 40534, the EPA proposes changes to Part 1065 and Part 1066. Specifically, EPA proposes the following changes:

- § 1066.210: Revise the dynamometer force equation to incorporate grade, consistent with the coastdown procedures being proposed for heavy-duty vehicles. For operation at a level grade, the additional parameters cancel out of the calculation. [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

**Response:** See detailed response below.

- § 1066.605: Adding an equation to the regulations to spell out how to calculate emission rates in grams per mile. This calculation is generally assumed, but we want to include the equation to remove any uncertainty about calculating emission rates from mass emission measurements and driving distance. [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

**Response:** We have added this equation to 40 CFR 1066.605.

- § 1066.815: Create an exception to the maximum value for overall residence time for PM sampling methods that involve PM samples collected for combined bags over a duty cycle. This is needed to accommodate the reduced sample flow rates associated with these procedures. [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

**Response:** EPA has made changes to 40 CFR 1066.110 and 40 CFR 1066.815 that will allow a maximum filter face velocity of 140 cm/s. For single filter per test sampling, flow weighting would be based off of the maximum filter face velocity of 140 cm/s. EPA will note that a maximum of 100 cm/s is recommended, but 140 cm/s is allowed to increase the filter loading to reduce variability. The results of Phase 1 of the CRC E-99 test program, which investigated and compared sampling at up to 150 cm/s to 100 cm/s, were the basis for EPA's decision.

We do not support the proposed change to 1066.210 - New calculation on road grade -- since the change would be confusing and unnecessary for LD: [EPA-HQ-OAR-2014-0827-1271-A1 p.10]

1) The Preamble states this is for HD only (Part 1037), yet this section does not differentiate applicability and appears to apply to LD as well. This needs to be clarified and the previous equation retained. [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

2) In SAE J2263, if the grade is less than 0.5%, there is no grade correction required (Section 7.4). However, if the grade is known, J2263 does provide a grade correction (Section 11.5). Regulations should follow this technique. [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

3) "Gi = instantaneous road grade, in percent (increase in elevation per 100 units horizontal length)" -- This provision requires (implies) some type of on the road measurement of elevation. It is not clear what

type of equipment would be used to provide instantaneous mapping with accuracy, and whether such equipment is widely available. [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

**Response:** Equation 1066.210 describes the forces acting on the vehicle during normal driving. This equation is a general example and the addition of the road grade element does not imply that you need to address road grade forces unless the duty cycles in the standard-setting part include road grade. Part 1066 is applicable to both light-duty and heavy-duty vehicles. Since road grade is an element of heavy-duty testing, it needs to be added to this general equation. EPA has revised the equation to simplify the change and has provided direction in the description to  $G_i$  that directs you to set it equal to zero if your duty cycle does not include road grade. The reference made to J2263 is not germane as 1066.210 does not deal with coastdowns or grade correction.

We support the proposed changes to 1066.605 and 1066.815. [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

We recommend adding a provision in §1066.815(b), to allow a time-weighted average of PM filter face velocity of 100 cm/s, when using single filter measurement technology as described in (b)(4)& (b)(5). Currently, 1065.170(c)(1)(vi) has a maximum filter face velocity of 100 cm/s. However, the weighting factors used in (b)(4) & (b)(5) reduce the loading on the filter. Allowing a time-weighted average filter face velocity of 100 cm/s greatly improves filter loading and is similar loading of 3 or 4 filter PM techniques. [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

Specifically, we recommend that this provision be added at the end of §1066.815(b): “If you collect PM using the procedures specified in paragraphs (b)(4) or (b)(5) of this section, the residence time requirements in 40 CFR 1065.140(e)(3) apply, except that you may exceed an overall residence time of 5.5 s for sample flow rates below the highest expected flow rate.” [EPA-HQ-OAR-2014-0827-1271-A1 p.11]

**Response:** EPA has made changes to 40 CFR 1066.110 and 40 CFR 1066.815 that will allow a maximum filter face velocity of 140 cm/s. For single filter per test sampling, flow weighting would be based off of the maximum filter face velocity of 140 cm/s. EPA will note that a maximum of 100 cm/s is recommended, but 140 cm/s is allowed to increase the filter loading to reduce variability. The results of Phase 1 of the CRC E-99 test program, which investigated and compared sampling at up to 150 cm/s to 100 cm/s, were the basis for EPA's decision.

#### **b. Flexibility for PM blank testing**

We appreciate the agencies' flexibility in the current Part 1066 test procedures in running PM blank tests, and allowing averaging of results. However 1066 implies that a separate PM blank emissions test needs to be performed, which is very burdensome, and unwarranted. This PM blank testing could be combined with another diagnostic: propane injections. Performing these two diagnostics together dramatically reduces the time required, yet achieves similar results. However, Part 1066 has one clause (below) which prevents this if an OEM injects propane in the transfer tube, which checks for leaks throughout the entire sampling system, and is more representative of the real vehicle testing environment. Concerns with allowing this dual diagnostic should be minimal, since these blank test corrections are typically a small fraction of the standard, and the amount of PM correction is capped in 1066.110(b)(2)(i)(D) (“Your PM background correction may not exceed 5  $\mu\text{g}$  or 5% of the net PM mass expected at the standard, whichever is greater.”). [EPA-HQ-OAR-2014-0827-1271-A1 p.13-14]

We therefore recommend the following change:

§1066.110 Equipment specifications for emission sampling systems. (b)(2)(i)(B) You may sample background PM from the dilution tunnel at any time before or after an emission test using the same sampling system used during the emission test. For this background sampling, the dilution tunnel blower must be turned on, the vehicle must be disconnected from the laboratory exhaust tubing, ~~and the laboratory exhaust tubing must be capped.~~ You may run this PM blank test in combination with propane injection diagnostic. [EPA-HQ-OAR-2014-0827-1271-A1 p.14]

**Response:** EPA test data shows that the propane injection has no effect on the PM tunnel blank results when the tailpipe connection point is HEPA filtered. Our data also shows that if the tailpipe connection point is left open to room air unfiltered, the PM background mass can be biased 1 to 1.5 ug high. Based on these results, EPA will make a change to 1066.110 that allows simultaneous PM background measurement and propane injections as long as the tailpipe connection point is HEPA filtered.

c. Comments with regard to requests for additional clarification

1) Comments on clarification of records retention policies: There continues to be confusing and conflicting language in multiple parts and subparts of the regulations. This needs further clarification with regard to emissions test records so that OEMs have a clear understanding of what needs long-term storage. This data is not all electronic today, nor is it in a common electronic format. Retaining large amounts of supporting, primitive data is burdensome and of little value. The Automakers would like to discuss whether requirements could be clarified and focused on critical data. [EPA-HQ-OAR-2014-0827-1271-A1 p.14]

**Response:** The commenter did not raise any specific concerns about confusing or conflicting requirements, so we are unable to address that concern. Moreover, we believe the current records retention policy is clear and adequate. We also continue to expect that paper (primitive) records have become uncommon and will only become less common over time. We therefore believe it is appropriate to adopt the simplified eight-year recordkeeping requirement as proposed. The recent enforcement case regarding Volkswagen reinforces the need to keep certification-related records for several years.

2) §1065.590 PM sampling media (e.g., filters) preconditioning and tare weighing. “(j) Substitution weighing involves measurement of a reference weight before and after each weighing of PM sampling media (e.g., filters).” Comment: The regulatory language appears to allow multiple filter mass measurements between pre & post reference filter mass measurements. The sentence in (j) could be clearer by deleting “each” or modifying to “each or multiple.” Doing this substitution weighing before and after “each” filter is very burdensome and unwarranted; manufacturers should be allowed to run a reasonable amount of multiple filters bookended by substitution mass measurements. [EPA-HQ-OAR-2014-0827-1271-A1 p.14]

**Response:** The substitution weighing procedure in 1065.590(j) is optional. 1065.590(f)(2) clearly states that you may use the procedure in (j) or develop your own procedure. EPA has no intentions to revise the procedure in paragraph (j) as a whole. If manufacturers desire to make changes to the procedure in (j), they are allowed to as described in (f)(2).

EPA notes that the procedure in paragraph (j) reads as though it covers a single filter medium, with the exception of the mention of media in the introductory paragraph to (j). To avoid

confusion, EPA will make the mention of media singular by changing it to medium. Manufacturers are still free to modify the procedure in (j) via (f)(2) to allow its use over groupings of sample media at their own discretion.

3) 1065.341(c)(3) “Select a C3H8 injection port in the CVS. Select the port location to be as close as practical to the location where you introduce engine exhaust into the CVS. Connect the C3H8 cylinder to the injection system.” Comment: The regulatory language should be clarified that this section also allows the option for propane injection in the transfer tube as well. This allows (1) leak checking the entire sampling system from the point where exhaust gas is injected into the transfer tube; (2) supporting The Automakers request to simultaneously run PM blank tests / propane injection diagnostics; and (3) allowing propane leak checking of partial dilution systems like PM or gaseous emissions. [EPA-HQ-OAR-2014-0827-1271-A1 p.14-15]

**Response:** EPA has addressed the comment by revising 1065.341(c)(3) to read as follows:

(3) Select a C3H8 injection port in the CVS. Select the port location to be as close as practical to the location where you introduce engine exhaust into the CVS, *however you may include part of the laboratory exhaust tubing and locate the injection port in this tubing*. Connect the C3H8 cylinder to the injection system.

**Organization:** Daimler Trucks North America LLC

**Additional Test Procedure Amendments** – The agencies propose to allow NMOG measurements to demonstrate compliance with NMHC standards, and the agencies request comment on whether other forms of hydrocarbon standards (such as VOC) should be allowed for alternative fuels. This seems reasonable. 80 FR 40534. [EPA-HQ-OAR-2014-0827-1164-A1 p.30]

EPA subsequently prepared revised draft regulations to address manufacturers’ concern that ethane emissions from natural gas engines was making it hard to meet standards, even though ethane is generally nonreactive in the atmosphere. This non-reactivity also makes it hard to reduce ethane emissions with conventional aftertreatment technology.

California ARB objected to the suggestion that we should redefine NMHC standards to exclude ethane without accounting for the change in the standard, arguing that this would allow manufacturers to dial in a higher level of toxic hydrocarbon emissions while continuing to comply with the standard.

**Response:**

EPA’s stationary program has long excluded ethane from hydrocarbon (VOC) emission standards. California ARB’s emission standards for highway and nonroad engines applies reactivity adjustments to reduce the ethane emissions by 72 percent. In line with these programs and policies, we believe it is appropriate to allow manufacturers to subtract ethane emissions from their measured hydrocarbon results. This is especially the case for engines fueled by natural gas and LPG, where fuel ethane can be substantial. Gasoline and diesel fuel contain no ethane, so there is no comparable concern for ethane to make it through the combustion process unoxidized and be emitted into the atmosphere.

We are applying this conclusion to heavy-duty highway engines and all sectors of nonroad compression-ignition engines that are fueled with natural gas and LPG. The one exception is for Category 3 marine compression-ignition engines, which are subject to a hydrocarbon standard of 2 g/kW-hr. The ethane provision is only needed where the emission standard is at a very low level. A standard of 0.19 g/kW-hr is typical for the other types of compression-ignition engines.



We believe manufacturers have no incentive to dial in a higher hydrocarbon emission level to account for the subtracted ethane. Even if they do, the resulting increase of perhaps 0.03 g/kW-hr from the small number of natural gas and LPG engines would be miniscule.

#### **14.4.8 Amendments Related to Nonroad Diesel Engines in 40 CFR Part 1039 1939**

**Organization:** Truck & Engine Manufacturers Association (EMA)

Comments on the Proposed Technical Amendments to Part 1039

The current provisions of section 1039.135(d)(1) state as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

(d) You may add information to the emission control information label to identify other emission standards that the engine meets or does not meet (such as European standards). You may also add other information to ensure that the engine will be properly maintained and used. [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

EPA is proposing to amend that regulatory language in the following manner: [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

(d) You may add information to the emission control information label as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

(1) If your emission control information label includes all the information described in paragraphs (c)(5) through (10) of this section, you may identify other emission standards that the engine meets or does not meet (such as international standards). You may include this information by adding it to the statement we specify or by including a separate statement. [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

(2) You may add other information to ensure that the engine will be properly maintained and used. [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

(3) You may add appropriate features to prevent counterfeit labels. For example, you may include the engine's unique identification number on the label. [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

EMA believes that finding space for the items required to be on the emission control information label has always been challenging. In that regard, adding information about which other emission standards the engine meets, such as ".and California" or ".and European Union Stage XX" can be very important to those who read the emission control information label, including Customs Inspectors. [EPA-HQ-OAR-2014-0827-1269-A1 p.78]

The information required in 1039.135 (c)(5) through (10) requires a significant amount of space on the emission control information label and is considered to be of lesser importance. In addition, much of that information can easily be found elsewhere, as the regulatory language quoted below indicates. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(5) State the engine's displacement (in liters); however, you may omit this from the label if all the engines in the engine family have the same per-cylinder displacement and total displacement. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(6) State the date of manufacture [DAY (optional), MONTH, and YEAR]; however, you may omit this from the label if you stamp, engrave, or otherwise permanently identify it elsewhere on the engine, in which case you must also describe in your application for certification where you will identify the date on the engine. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(7) State the FELs to which the engines are certified if certification depends on the ABT provisions of subpart H of this part. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(8) Identify the emission-control system. Use terms and abbreviations as described in 40 CFR 1068.45. You may omit this information from the label if there is not enough room for it and you put it in the owners manual instead. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(9) For diesel-fueled engines, unless otherwise specified in §1039.104(e)(2), state: "ULTRA LOW SULFUR FUEL ONLY". [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(10) Identify any additional requirements for fuel and lubricants that do not involve fuel-sulfur levels. You may omit this information from the label if there is not enough room for it and you put it in the owners manual instead. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

The information required by paragraph (c)(8) can take up an especially large amount of space on the emission control information label, and provides little value. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

In light of the foregoing, EMA recommends deleting the opening clause of paragraph (d)(1) so that it reads as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

(1) You may identify other emission standards that the engine meets or does not meet (such as international standards). You may include this information by adding it to the statement we specify or by including a separate statement. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

If the Agency feels strongly that information about other standards that the engine meets cannot be added unless information that was omitted based on limited availability of space on the emission control information label is added back, then EMA recommends that only the information required in subparagraphs (c)(5) through (c)(7) and (c)(9) through (c)(10) be required to be added back. As mentioned above, the information required by subparagraph (c)(8) consumes a significant amount of space and is of very limited value. [EPA-HQ-OAR-2014-0827-1269-A1 p.79]

The other change to this section is the addition of a provision which would allow a manufacturer to add features to the label to prevent counterfeit labels (paragraph (d)(3) of the proposed language). EMA agrees with that proposed change. [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

**Response:** We agree with the concern and have revised the regulation to allow manufacturers to omit the specified information "as long as this does not cause you to omit" the other information.

EPA also proposes to add a provision to 40 CFR 1039.205 that would require manufacturers to describe their “normal practice” for importing engines. By way of example, EPA states that this description may include identifying the names and addresses of any agents that a manufacturer authorized to import its engines. [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

This proposed provision is problematic. The vast majority of manufacturers of engines and equipment used in construction, agricultural and industrial markets are multi-national. For a wide variety of reasons, the nonroad engines and equipment they produce are often manufactured in only a few locations around the world, and then shipped to end-user customers in nearly every country and region of the world. As a consequence, a large percentage of manufacturers’ nonroad engines and equipment is shipped around the world, and many are “imported” into the United States. Describing the “normal practice” for importing all of those engines (both loose engines and those installed in equipment) would result in a tremendous burden. [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

In the Preamble to the NPRM, the Agency states that “where a manufacturer’s engines are imported through a wide variety of means, EPA would not require this description to be comprehensive.” EPA goes on to state that “in such cases, a short description of the predominant practices would generally be sufficient.” This additional explanation of what is required of manufacturers provides much needed relief. Accordingly, EMA recommends that EPA include those explanatory statements in the Preamble to the final Phase 2 Rule. [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

**Response:** As noted, in cases where an engine manufacturer ships loose engines to equipment manufacturers for eventual importation into the United States, we would understand that manufacturers would not need to account for all the different ways that their engines might be imported. The regulation requires that engine manufacturers describe their “normal practice for importing engines,” with the clarification that this may involve naming agents for importation. For engine manufacturers that sell loose engines to a wide range of equipment manufacturers, the manufacturer could fulfill the requirement by describing its business model and perhaps identifying the equipment manufacturers that are expected to import the highest volume of equipment with that engine manufacturer’s engines.

EPA is proposing to make the same revisions to the opening paragraph of §1039.225 as the Agency is proposing to make to the opening paragraph of §1033.225, as discussed above. EMA’s comments and recommendation regarding these proposed changes are largely the same. The specific wording of the proposed revision is as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

§1039.225 How do I amend my application for certification? [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

Before we issue you a certificate of conformity, you may amend your application to include new or modified engine configurations, subject to the provisions of this section. After we have issued your certificate of conformity, but before the end of the model year, you may send us an amended application requesting that we include new or modified engine configurations within the scope of the certificate, subject to the provisions of this section. Before the end of the model year, you must amend your application if any changes occur with respect to any information that is included or should be included in your application. After the end of the model year, you may amend your application only to update maintenance instructions as described in § 1039.220 or to modify an FEL as described in paragraph (f) of this section. [EPA-HQ-OAR-2014-0827-1269-A1 p.80]

As with the proposed revisions to section 1033.225, the proposed changes to section 1039.225 are unacceptable. In the Preamble explanation for these changes, the Agency again states that the changes at issue are simply 'clarifications' of the existing language. The proposed changes, however, go well beyond being 'clarifications' and represent significant modifications. [EPA-HQ-OAR-2014-0827-1269-A1 p.80-81]

As noted above, the ability to add a new engine configuration and/or amend an existing engine configuration is critical to engine manufacturers and the customers they serve, both during the model year and afterwards. In some cases a change may be needed to make product improvements and/or correct unanticipated product issues. In other cases, new ratings may be required to meet customer needs to enable pieces of equipment powered by the subject engines to perform their intended functions. As some of those changes may be needed to maintain emissions compliance, or to correct emissions-related issues discovered during the course of business, it is in the Agency's best interest to continue to allow manufacturers the opportunity to request to make such changes. [EPA-HQ-OAR-2014-0827-1269-A1 p.81]

In that regard, it is important to note that such application changes must be submitted to the Agency, and are subject to Agency approval. Consequently, if EPA has an issue with a requested new engine configuration or with a requested amendment to an existing engine configuration, the Agency can address that issue during their review process, and so does not need the proposed revision at issue. [EPA-HQ-OAR-2014-0827-1269-A1 p.81]

Accordingly, and as with respect to the proposed revisions to section 1033.225, EMA recommends that EPA retain the current language of the opening paragraph of section 1039.225, and not finalize the proposed changes to this paragraph. [EPA-HQ-OAR-2014-0827-1269-A1 p.81]

**Response:** We agree that the proposed change to the regulation would conflict with EPA's longstanding policy on field fixes. We are removing this proposed change and replacing it with a new paragraph that translates the field-fix guidance into regulation. The expectation is that this regulation codifies the field-fix guidance without changing current policy. The new regulation language reads as follows:

“You may produce engines as described in your amended application for certification and consider those engines to be in a certified configuration if we approve a new or modified engine configuration during the model year under paragraph (d) of this section. Similarly, you may modify in-use engines as described in your amended application for certification and consider those engines to be in a certified configuration if we approve a new or modified engine configuration at any time under paragraph (d) of this section. Modifying a new or in-use engine to be in a certified configuration does not violate the tampering prohibition of 40 CFR 1068.101(b)(1).”

We are adopting this change for all heavy-duty highway engines and vehicles and for all nonroad compression-ignition engines. We also expect to add this same paragraph for nonroad spark-ignition engines and vehicles in due course.

**Organization:** Daimler Trucks North America LLC

**Part 1039** - We accept all changes proposed by the agencies on Part 1039. [EPA-HQ-OAR-2014-0827-1164-A1 p.121]

**Amendments Related to Non-road Diesel Engines in 40 CFR Part 1039** – The EPA requested comment on adding SCR diagnostic requirements to nonroad diesel engines. 80 FR 40534. DTNA’s Tier IV engines already comply, so we agree with the EPA’s proposal. 40 CFR Part 1039. [EPA-HQ-OAR-2014-0827-1164-A1 p.132]

**Amendments Related to Non-road Diesel Engines in 40 CFR Part 1039** – The EPA requested comment on removing regulatory provisions for Independent Commercial Importers in 40 CFR Part 1039. We think that these rules are obsolete, so we agree with removing them. [EPA-HQ-OAR-2014-0827-1164-A1 p.132]

**Response:**

We are adopting the provisions as proposed and as supported by the commenter.

**Organization:** Volvo Group

**REVISIONS TO NONROAD EMISSIONS CONTROL PROVISIONS**

Currently, an imported engine manufacturer is permitted to run Selective Enforcement Audit testing at or near their manufacturing location, typically using their engine certification facility. Foreign manufacturers should not be required to provide an additional SEA test site in the United States. The phrase, “in the United States,” should be removed from the proposed change to §1039.205 since it unfairly burdens foreign engine manufacturers with maintaining expensive §1065 compliant test cell capacity in addition to their existing Certification Test Cell capacity. [EPA-HQ-OAR-2014-0827-1290-A1 p.81]

**Response:**

It has been EPA’s longstanding policy that manufacturers must perform testing at the facility identified by EPA. This may be the manufacturer’s own facility, but it may be any other test facility. The provision requiring the manufacturer to identify a test lab in the United States is simply arranging for an easier path to identify a mutually agreeable test facility if we would want to require testing in the United States. The manufacturer can choose to name a reputable third-party test lab instead of developing complete testing capability in the United States.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Recording reductant use and other diagnostic functions**

CARB staff conceptually supports U.S. EPA and NHTSA’s proposal requiring non-road compression ignition engine manufacturers to incorporate OBD that monitor selective catalytic reduction (SCR) reductant levels and quality, and alert the equipment operator when those levels and quality are out of specification. Advanced notification of compromised or low levels of reductant will help to ensure proper SCR operation in-use, and should help minimize occurrences of the engine entering a derated mode of operation per existing SCR inducement strategies. [EPA-HQ-OAR-2014-0827-1265-A1 p.125]

CARB staff understands that this proposal is not meant to replace SCR inducement policies, but rather to complement them with additional detection capability in an uncomplicated manner. While we generally prefer simple and straightforward approaches as well, diagnostics need the proper balance between simplicity and utility. As such, CARB staff recommends that extra rigor be introduced in 40 CFR 1039.110 to enhance monitoring effectiveness and compatibility. CARB's "On-Board Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines" in Title 13 of the California Code of Regulations (CCR), Section 1971.1, contain reductant level/quality monitoring provisions that could serve as guidelines for a more robust federal mechanism. [EPA-HQ-OAR-2014-0827-1265-A1 p.125]

At a minimum, CARB staff recommends that U.S. EPA and NHTSA adopt standardized fault codes (e.g., SAE Standard J1939 or controller area network (CAN) based), monitoring conditions, malfunction criteria, and fault processing protocols to ensure reasonable and reliable diagnostic system monitoring frequency and malfunction detection performance. Precautions such as these will help ensure that issues related to reductant quality and replenishment are detected and addressed in a timely manner, and will undoubtedly prove useful should matters of in-use compliance and enforcement come into question. For example, there are no timeframes for detection specified in the proposed language; therefore, a manufacturer could theoretically only monitor once per month (or even less frequently) rendering the diagnostic virtually useless. Therefore, we recommend U.S. EPA and NHTSA to clearly define a minimum performance metric such that the monitoring strategy provides detection capability several times per tank fill of reductant, or continuously for the parts of the diagnostic that rely on electrical continuity or out of range type checking. Standardization may also create opportunities for innovative control approaches by third party developers who might otherwise not have access to proprietary diagnostics. [EPA-HQ-OAR-2014-0827-1265-A1 p.125-126]

Additionally, CARB staff recommends that U.S. EPA and NHTSA revise the reductant quality monitoring exemption in 40 CFR 1039.110(a) for vehicles that already possess a diagnostic NOx sensor. The problem with the provision is that it requires a NOx sensor to be present with the capability to monitor reductant quality, but does not necessarily require the sensor to monitor reductant quality in any meaningful way. We recommend that a qualifying statement be appended to the language to address this limitation (see underscored text in paragraph (a) of CARB staff's revised regulatory text below). [EPA-HQ-OAR-2014-0827-1265-A1 p.126]

CARB staff also recommends the same degree of standardization and robustness mentioned above for any emission-related diagnostic strategy employed per the provisions of 40 CFR 1039.110(b). Taking the time to standardize diagnostic practices now will save valuable resources in the future when more comprehensive OBD requirements are adopted for the non-road compression ignition category. For reference, 40 CFR 1039.110(b) contains the following language: [EPA-HQ-OAR-2014-0827-1265-A1 p.126]

**“§1039.110 Recording reductant use and other diagnostic functions.**

(a) Engines equipped with SCR systems using a reductant other than the engine's fuel must have a diagnostic system that monitors reductant quality and tank levels and alert operators to the need to refill the reductant tank before it is empty, or to replace the reductant if it does not meet your concentration specifications. Unless we approve other alerts, use a warning lamp or an audible alarm. You do not need to separately monitor reductant quality if you include an exhaust NOx sensor (or other sensor) that allows you to determine inadequate reductant quality and alert operators when the condition that is indicative of inadequate reductant quality is

present. However, tank level must be monitored in all cases. [EPA-HQ-OAR-2014-0827-1265-A1 p.126]

(b) You may equip your engine with other diagnostic features. If you do, they must be designed to allow us to read and interpret the codes. Note that § 1039.205 requires you to provide us any information needed to read, record, and interpret all the information broadcast by an engine's onboard computers and electronic control units.” [EPA-HQ-OAR-2014-0827-1265-A1 p.127]

**Response:** EPA’s objective for nonroad OBD systems in this rule is to adopt requirements that can be adopted with minimal lead time. The most effective way to do this is to copy the OBD provisions that already apply for marine diesel engines under 40 CFR part 1042. We intend to revisit issues related to CARB’s suggested enhancements to the proposed OBD protocol in a future rulemaking. This will allow us to take a broader view of the requirements to make sure we capture the range of concerns for designing OBD systems that are robust and effective, without creating an unreasonable burden or failing to account for possible technical limitations. We would expect to include marine diesel engines in that program review.

We have revised the regulatory text related to NOx sensors as an alternative to DEF concentration monitoring since that clarification is clearly understood to be part of this alternative compliance path. We have made the change for both land-based engines in 40 CFR 1039.110 and marine diesel engines in 1042.110.

#### **Neutral/Provide Additional Information Comment**

##### **Comment – Allowing optional content on the emission control label for non-road compression ignition engines**

Although CARB staff recognizes that this particular provision merely allows manufacturers to incorporate features on the label that can be used to identify counterfeit labels (which CARB staff supports in principle), CARB staff recommends that U.S. EPA and NHTSA include a provision requiring the case-by-case approval of all manufacturer specific content on the label or any content not specifically identified in the regulations, prior to issuing a Certificate of Conformity. U.S. EPA and NHTSA should retain the right to reject any content that could have unintended consequences regardless of whether or not that content meets the general criteria for the optional label content. In particular, staff is concerned that too much information on the label could be a source of confusion to the end user or to enforcement inspectors in the field. For example, a manufacturer might want to use the labelling provisions of 40 CFR 1039.135(d)(1) to identify an ABT engine, that was originally certified to a family emission limit (FEL) consistent with Tier 3 emission levels, as being compliant with the more stringent Tier 4 emission levels. While this identification may not be inaccurate, it could create a situation for California’s in-use programs in which fleet owners mistakenly purchase these ABT engines believing that they fulfill the owners’ requirements for upgrading the “emissions average” of their fleets. Such a situation could negatively impact both the effectiveness of CARB’s in-use programs and the fleet owners’ costs should penalties be assessed. Other situations could be problematic, such as the inclusion of bar codes or Quick Response® (QR) type matrix codes on the emission control label that would redirect to a manufacturer supported webpage over which U.S. EPA and NHTSA have no control, or which a manufacturer may decide to no longer support at a future date. CARB staff does not have a comparable allowance for optional label content for off-road compression ignition engines, as the CAA prohibits California from regulating farm and construction equipment under 175 hp; therefore, we must rely on U.S. EPA and NHTSA to protect California’s interests in this matter. [EPA-HQ-OAR-2014-0827-1265-A1 p.127-128]

**Response:** EPA considers manufacturer's proposed label content as part of the review of an application for certification. We intend to be mindful of the concern expressed by California ARB as part of that review process.

#### **14.4.9 Amendments Related to Marine Diesel Engines in 40 CFR part 1042 and 1043 1946**

**Organization:** GE Transportation

As a general matter, GE supports the proposed technical changes and clarifications to 40 CFR part 1042. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

Second, as discussed below, GE believes that it is critical for EPA to also apply these technical changes and clarifications to the marine testing requirements in 40 CFR part 1042. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

### **II. APPLICATION OF TESTING CLARIFICATIONS TO MARINE AND STATIONARY ENGINES IN 40 C.F.R. PART 1042**

The same reasons that support the clarification of the proportionality verification for locomotives apply equally to marine and stationary engines. Accordingly, EPA should apply these same clarifications and regulatory language changes (subject to the requested changes noted above) to the testing requirements for marine and stationary engines defined in 40 C.F.R Part 1042. The steady state discrete mode testing procedure for marine and stationary engines contains the same technical issues relating to the verification of proportional sampling when utilizing batch fuel rate measurements that are resolved for locomotive testing by the proposed § 1033.501(a)(4) and (a)(5). These issues will be resolved for testing of marine and stationary engines if provisions similar to the proposed § 1033.501(a)(4) and (a)(5) are incorporated into Part 1042. [EPA-HQ-OAR-2014-0827-1297-A1 p.3]

A. Clarifications in 40 CFR part 1042 Consistent with 40 CFR 1033.501(a)(4) [EPA-HQ-OAR-2014-0827-1297-A1 p.3]

The proposed Technical Amendment contains no provisions in 40 CFR part 1042, subpart F to accommodate proportional sampling verification when using a batch fuel rate, similar to the amendment of § 1033.501(a)(4) for steady state discrete mode testing. Use of a gravimetric measurement to determine a batch fuel rate for steady state discrete mode testing is the standard by which EPA verifies all other fuel flow meters as provided in § 1065.307(d)(4). It is requested that 40 CFR part 1042 incorporate similar language to § 1033.501(a)(4). [EPA-HQ-OAR-2014-0827-1297-A1 p.3]

B. Inclusion in 40 CFR part 1042 consistent with 40 CFR 1033.501(a)(5) [EPA-HQ-OAR-2014-0827-1297-A1 p.3]

GE requests a similar allowance in 40 CFR part 1042 for verification of proportional sampling over grouped test intervals instead of each discrete interval for testing of marine and stationary engines. This ensures consistent test equipment, processes and verification practices between test facilities regardless of the equipment under test (i.e., locomotives, marine engines, or stationary engines). Moreover, it ensures the same metric and degree of proportional sampling in all engine programs irrespective of engine application. [EPA-HQ-OAR-2014-0827-1297-A1 p.3]



**Response:** EPA will make the requested changes to 40 CFR part 1042 that are similar to those made in 40 CFR part 1033 and has modified 40 CFR 1042.501(a) by adding four additional subparagraphs to address the concerns over proportional sampling verification for steady-state discrete mode testing.

**Organization:** Navy

Our enclosed comments request that EPA consider a revision to the National Security Exemption (NSE) language in its diesel engine regulations to add an exemption for engines used in tactical equipment, vehicles, and vessels required to operate on high sulfur fuels to meet performance requirements in a worldwide deployable environment. [EPA-HQ-OAR-2014-0827-1137-A1 p.1]

### **Request for Modification to National Security Exemption Language in EPA Engine Regulations**

**Comment** - The Department of Defense (DoD) must deploy and operate weapon systems around the world. The sulfur content in fuel supplies varies greatly at different deployment sites. Accordingly, DoD weapon systems must be able to operate with a wide range of sulfur contents. Current and future Environmental Protection Agency (EPA) compression ignition engine emission standards employ pollution prevention technologies that are intolerant to high levels of sulfur. If operated using high sulfur fuels, these engines suffer power degradation and engine failure. In an operational or tactical environment, engine degradation and failure jeopardizes warfighters' lives and national security. CAA Section 203(b) provides EPA the authority to exempt these engines for reasons of national security. Accordingly, DoD requests that EPA grant system-specific National Security Exemptions (NSEs) and Blanket NSEs for DoD tactical equipment required to operate on high sulfur fuels. [EPA-HQ-OAR-2014-0827-1137-A1 p.3]

**Discussion** - EPA has approved all of the DoD's NSE requests, including Blanket NSEs, exempting all tactical equipment from current non-road EPA emissions standards and tactical vehicles from current motor vehicle EPA emissions standards. EPA has stated that they thoroughly understand this rationale and plan to continue to approve all of the DoD's NSE requests for DoD tactical equipment and vehicles to operate on high sulfur fuel. Continuing to require submittal of NSE requests to the EPA for approval with this rationale as justification will result in additional time and expense to the taxpayer with no benefit. [EPA-HQ-OAR-2014-0827-1137-A1 p.3]

**Recommendation** – DoD requests EPA revise the following sections of the Code of Federal Regulations (CFR) to add the requirement to operate on high sulfur fuels as a basis for an exemption from these regulations for purposes of national security. Therefore, no exemption request or approval will be necessary. This change will save considerable time and expense to both the EPA and DoD by eliminating unnecessary paperwork and management of these NSEs. [EPA-HQ-OAR-2014-0827-1137-A1 p.3]

#### **§1042.635 National security exemption.**

The standards and requirements of this part and prohibitions in §1068.101(a)(1) do not apply to engines exempted under this section.

(a) An engine is exempt without a request if it will be used or owned by an agency of the Federal government responsible for national defense, where the vessel in which it is installed has armor, permanently attached weaponry, specialized electronic warfare systems, unique stealth performance requirements, or unique combat maneuverability requirements, and/or installed in an auxiliary vessel that has the requirement to operate on high-sulfur fuels (greater than 15 parts per million) to meet performance requirements in a worldwide deployable environment. This applies to both remanufactured and freshly manufactured marine engines. Gas turbine engines are also exempt without a request if they

will be owned by an agency of the Federal government responsible for national defense. [EPA-HQ-OAR-2014-0827-1137-A1 p.3-4]

**Response:** We agree with Navy that an automatic exemption is appropriate in cases where a defense agency would be operating (noncombat) compression-ignition engines in areas where ULSD may not be available. We believe the suggested language could be understood to broadly apply to all engines operated by defense agencies. We have adopted a provision tailored to the concern, as follows: “An engine/equipment is automatically exempt if it would need sulfur-sensitive technology to comply with emission standards, and it is intended to be used in areas outside the United States where ultra-low-sulfur fuel is unavailable.” This would not apply for compression-ignition engines that don’t have sulfur-sensitive technologies, and it would not apply for engines that can be expected to have access to ULSD.

In addressing the Navy comment, it became clear that we should draft a single, comprehensive national security exemption in §1068.225 rather than keeping a separate national security exemption for marine engines. The expanded version of §1068.225 includes minor changes. First, we more carefully identify how combat features apply in the context of equipment-based standards. Second, we are making explicit the allowance for engine manufacturers to produce and ship engines that qualify for the exemption.

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Comments on the Proposed Technical Amendments to Part 1042

As discussed above in connection with section 1039.135(c) and (d), the information required in 1042.135 (c)(5) through (9) requires a significant amount of space on the emission control information label and is considered to be of lesser importance. In addition, much of that information can easily be found elsewhere, as the language below indicates. [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

(5) State the date of manufacture [DAY (optional), MONTH, and YEAR]; however, you may omit this from the label if you stamp, engrave, or otherwise permanently identify it elsewhere on the engine, in which case you must also describe in your application for certification where you will identify the date on the engine. [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

(6) Identify the application(s) for which the engine family is certified (such as constant-speed auxiliary, variable-speed propulsion engines used with fixed-pitch propellers, etc.). If the engine is certified as a recreational engine, state: “INSTALLING THIS RECREATIONAL ENGINE IN A COMMERCIAL VESSEL OR USING THE VESSEL FOR COMMERCIAL PURPOSES MAY VIOLATE FEDERAL LAW SUBJECT TO CIVIL PENALTY (40 CFR 1042.601).” [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

(7) For engines using sulfur-sensitive technologies, state: “ULTRA LOW SULFUR DIESEL FUEL ONLY.” [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

(8) State the useful life for your engine family if the applicable useful life is based on the provisions of § 1042.101(e)(2) or (3), or § 1042.104(d)(2). [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

(9) Identify the emission control system. Use terms and abbreviations as described in 40 CFR 1068.45. You may omit this information from the label if there is not enough room for it and you put it in the owners manual instead. [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

The information required by paragraph (c)(9) can claim an especially large amount of space on the emission control information label, and provides little value. [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

In light of the foregoing, EMA requests that EPA not change the current language of paragraph 1042.135(d)(1). [EPA-HQ-OAR-2014-0827-1269-A1 p.82]

If the Agency feels strongly that information about the other standards that the engine meets cannot be added unless the information that was omitted based on the limited availability of space on the emission control information label is added back, then EMA recommends that only the information required in subparagraphs (c)(5) through (c)(8) be required to be added back. As mentioned above, the information required by subparagraph (c)(9) consumes a great deal of space and is of very limited value. [EPA-HQ-OAR-2014-0827-1269-A1 p.83]

The other proposed change to this section is the addition of a provision which would allow a manufacturer to add features to the label to prevent counterfeit labels (paragraph (d)(3) of the proposed language). As noted above, EMA agrees with this change. [EPA-HQ-OAR-2014-0827-1269-A1 p.83]

**Response:** We agree with the comment and have revised the regulation as described in Section 14.4.8.

EPA is proposing to make the same changes to the opening paragraph of §1042.225 as the Agency is proposing to make to the opening paragraphs of §1033.225 and §1039.225. EMA's comments and recommendation regarding these proposed changes are essentially identical to EMA's comments discussed above. Accordingly, for the same reasons as set forth above, EMA recommends that EPA retain the current language of the opening paragraph of §1042.225, and not finalize the proposed changes to that paragraph. [EPA-HQ-OAR-2014-0827-1269-A1 p.83]

**Response:** We agree with the comment and have revised the regulation as described in Section 14.4.8.

EPA also is proposing an amendment to section 1042.515(f)(4)(iii). EPA's proposed technical amendment to this provision would read, as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.83]

(4) You may exclude emission data based on catalytic Aftertreatment temperatures as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.83]

(i) For an engine equipped with a catalytic NO<sub>x</sub> aftertreatment system, exclude NO<sub>x</sub> emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(ii) For an engine equipped with an oxidizing catalytic Aftertreatment system, exclude HC and CO emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C. Also exclude PM emission data if the applicable PM standard (or family emission limit) is above 0.06 g/kW-hr. Where there are parallel paths, measure the temperature 30 cm downstream of the last oxidizing aftertreatment device in the path with the greatest exhaust flow. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(iii) Measure exhaust temperature within 30 cm downstream of the last applicable catalytic Aftertreatment device. Where there are parallel paths, use good engineering judgment to

measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

EMA has concerns regarding this amendment. EPA has inexplicably dropped the current language of paragraph 1042.515(f)(4)(iii) which reads “Other parameters. You may request our approval for other minimum or maximum ambient or engine parameter limit values at the time of certification.” That language provides important and needed potential relief and should not be deleted, especially since that relief is only available upon request, and requires EPA approval. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

Another proposed change to this section is to move the specification of the temperature measurement point as well as the instructions pertaining to how to deal with the situation of parallel exhaust streams to a separate paragraph. However, it appears that EPA inadvertently left a portion of those instructions in revised paragraph (4)(ii). It is redundant and unnecessary to have that instruction in both places. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

Accordingly, EMA recommends that EPA modify section 1042.515(f)(4) to read as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(4) You may exclude emission data based on catalytic Aftertreatment temperatures as follows: [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(i) For an engine equipped with a catalytic NOX aftertreatment system, exclude NOX emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(ii) For an engine equipped with an oxidizing catalytic Aftertreatment system, exclude HC and CO emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C. Also exclude PM emission data if the applicable PM standard (or family emission limit) is above 0.06 g/kW-hr. [EPA-HQ-OAR-2014-0827-1269-A1 p.84]

(iii) Measure exhaust temperature within 30 cm downstream of the last applicable catalytic Aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow. [EPA-HQ-OAR-2014-0827-1269-A1 p.84-85]

(iv) *Other parameters.* You may request our approval for other minimum or maximum ambient or engine parameter limit values at the time of certification. [EPA-HQ-OAR-2014-0827-1269-A1 p.85]

**Response:** EPA has removed the redundant text in 1042.515(f)(4). EPA will not add the EMA proposed paragraph (iv) as this section deals with aftertreatment exclusions and not exclusions related to engine temperature. More broadly, we believe there has been enough development and learning for current aftertreatment technologies to allow us to identify certain exclusions without leaving an allowance for creating exclusions for additional items or types of operation that have not yet been identified

#### **14.4.10 Amendments Related to Locomotives in 40 CFR Part 1033**

**Organization:** Truck & Engine Manufacturers Association (EMA)

Comments on the Proposed Technical Amendments to Part 1033

EPA is proposing to make the following amendments to the opening paragraph of section 1033.225:

**§1033.225 Amending applications for certification.**

Before we issue you a certificate of conformity, you may amend your application to include new or modified locomotive configurations, subject to the provisions of this section. After we have issued your certificate of conformity, but before the end of the model year, you may send us an amended application requesting that we include new or modified locomotive configurations within the scope of the certificate, subject to the provisions of this section. Before the end of the model year, you must also amend your application if any changes occur with respect to any information that is included or should be included in your application. For example, you must amend your application if you determine that your actual production variation for an adjustable parameter exceeds the tolerances specified in your application. After the end of the model year, you may amend your application only to update maintenance instructions as described in § 1033.220 or to modify an FEL as described in paragraph (f) of this section. [EPA-HQ-OAR-2014-0827-1269-A1 p.73-74]

As shown in the “track changes” version of the proposed amendment quoted above, EPA is seeking to modify the existing regulatory language to differentiate the items that a manufacturer can request be amended within the model year, on the one hand, and those items that a manufacturer can request be amended only after the end of the model year, on the other hand. In that regard, EPA would continue to allow manufacturers to request new or modified engine configurations (as long as they are within the scope of the certificate and subject to the other provisions of section 1033.225) before the end of the model year. But, after the end of the model year, EPA is proposing to limit amendments that can be requested by a manufacturer to updated maintenance instructions as described in section 1033.220, or FEL modifications as described in section 1033.225(f), thereby disallowing requests for amendments that would add to or modify existing engine configurations, even those that otherwise would be within the scope of the certificate and consistent with the other provisions of section 1033.225. [EPA-HQ-OAR-2014-0827-1269-A1 p.74]

Simply stated, these proposed amendments are unacceptable. In the Preamble explanation for these changes, the Agency states that the changes are merely “clarifications” of the existing language. That is not correct. The proposed revisions go well beyond being “clarifications” and represent significant modifications. [EPA-HQ-OAR-2014-0827-1269-A1 p.74]

The ability to add a new engine configuration and/or amend an existing engine configuration is critical to engine manufacturers and the customers they serve, both during the model year and afterwards. In some cases a change may be needed to make product improvements and/or correct unanticipated product issues. In other situations, new ratings may be needed to meet customer requirements to enable pieces of equipment powered by the subject engines to perform their intended functions. As some of those changes may be needed to maintain emissions compliance, or correct emissions-related issues found in the course of business, it is in the Agency’s best interest to continue to allow manufacturers the opportunity to request such changes. [EPA-HQ-OAR-2014-0827-1269-A1 p.74]

It is important to note that all of the application changes at issue must be submitted to the Agency, and are subject to approval by the Agency. Consequently, if EPA has an issue with a requested new engine configuration or with a requested amendment to an existing engine configuration, the Agency can address that issue during the review process. There is, therefore, no need for this unacceptable amendment. [EPA-HQ-OAR-2014-0827-1269-A1 p.74]

Accordingly, EMA recommends that EPA retain the current language of the opening paragraph of section 1033.225, and not finalize the proposed changes to this paragraph. [EPA-HQ-OAR-2014-0827-1269-A1 p.74]

**Response:** We agree with the comment and have revised the regulation as described in Section 14.4.8.

In addition to the proposed technical amendments to Part 1033, EPA has requested comments on several other provisions in Part 1033. Specifically, 40 CFR 1033.101(g)(3) provides an allowance for shorter useful lives for non-locomotive-specific engines—that is, engines not specifically designed for use in locomotives. For normal locomotive engines, the minimum useful life is specified in terms of MW-hrs as the product of the rated horsepower multiplied by 7.50. However, the regulations allow manufacturers/remanufacturers of locomotives with non-locomotive specific engines to request a shorter useful life if the locomotives will rarely operate longer than the shorter useful life. EPA has asked for comment regarding the need for additional guidance on applying this provision. [EPA-HQ-OAR-2014-0827-1269-A1 p.74-75]

EMA believes that this is an important regulatory provision, allowing a shorter useful life for certain engines used in locomotive applications. Now that the provision has been in place for several years, and has been utilized by several EMA member companies, EMA recommends keeping the provision as it is and not making any changes. The example default alternative minimum life, which defines a set multiplier less than the standard 7.5 would be especially problematic, as it would remove a key aspect of the current provision which allows engine (and duty cycle) characteristics (characteristics which vary from engine to engine) to define the reduced useful life. [EPA-HQ-OAR-2014-0827-1269-A1 p.75]

**Response:** As recommended in the comment, we are not adopting a change to useful life provisions of 40 CFR part 1033.

EPA is also seeking comment on whether the Agency should consider notch-specific engine/alternator efficiencies to be confidential business information. Under the current “*Class Determination 1-13, Confidentiality of Business Information Submitted in Certification Applications for 2013 and subsequent model year Vehicles, Engines and Equipment*,” there are three possible ways such information could be treated: 1) as information not entitled to confidential treatment; 2) as information entitled to confidential treatment until introduction into commerce; or 3) information entitled to confidential treatment. The “Class Determination” document, authored by EPA’s Office of General, provides guidance as to how to determine which of these three treatment options is appropriate for various types of information. [EPA-HQ-OAR-2014-0827-1269-A1 p.75][This section can also be found in section 1.4.6 of this comment summary]

The following table, taken from the Class Determination document, lists the information that can be entitled to confidential treatment. [EPA-HQ-OAR-2014-0827-1269-A1 p.75][This section can also be found in section 1.4.6 of this comment summary]

[Table 3, 'Manufacturer Information Entitled to Confidential Treatment', can be found on p.76 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

In accordance with EPA regulations at 40 C.F.R. sections 2.204 and 2.205, information will be entitled to confidential treatment if the manufacturer (1) asserts that the information is entitled to confidential treatment, and (2) has not waived or withdrawn that assertion. Inherent in assertion (1) are the following representations by the manufacturer: (a) they have maintained the information in confidence, (b) the information cannot be readily obtained by other legitimate means, and (c) disclosure of the information to the public both before and after model introduction would be likely to cause substantial harm to the manufacturer’s competitive position. [EPA-HQ-OAR-2014-0827-1269-A1 p.76][This section can also be found in section 1.4.6 of this comment summary]

EPA provides two alternative methods to certify engines used in locomotive applications. Such engines can be certified on an engine dynamometer or alternatively in the locomotive. In the latter case, it is necessary to know the notch-specific engine/alternator efficiencies to ensure that the engine is tested at the appropriate speed and load conditions. [EPA-HQ-OAR-2014-0827-1269-A1 p.76][This section can also be found in section 1.4.6 of this comment summary]

EMA believes that notch-specific engine/alternator efficiency clearly fits within the category “Technical Description Information” on Table 3 above. Accordingly, EMA believes that notch-specific engine/alternator efficiencies readily meets the criteria set forth in 40 CFR 2.204 and 2.205 and should be treated as confidential business information. [EPA-HQ-OAR-2014-0827-1269-A1 p.77][This section can also be found in section 1.4.6 of this comment summary]

**Response:** We have been unable to prepare a comprehensive policy regarding CBI determinations, so we will continue to respond to any requests for information on a case-by-case basis.

EPA has also requested comment on extending the provisions of 40 CFR 1033.101(i) to Tier 4 locomotives. That provision generally involves a less stringent CO standard coupled with over-complying with the PM standard. Specifically, this option, which currently applies for Tier 2 and earlier locomotives, requires PM emissions be at least 50 percent below the normally applicable PM standard. The existing provisions were developed to provide a compliance path for natural gas locomotives that reflected both the technological capabilities of natural gas locomotives and the relative environmental benefits of their CO and PM emissions. The provision was not applied to Tier 4 locomotives, because the applicable Tier 4 PM standard is already very low (0.03 g/hp-hr). If EPA were to apply a similar provision corresponding to Tier 4 standards, EPA would need to select PM and CO levels that are properly paired to manage this tradeoff. Thus, EPA has requested comment on whether it is appropriate to pursue such alternate standards, and on the specific numerical standards for PM and CO that would represent an equivalent level of stringency relative to the published standards. [EPA-HQ-OAR-2014-0827-1269-A1 p.77]

Alternate CO standards are currently provided for Tier 0, Tier 1 and Tier 2 Locomotives. The pertinent regulatory language is found in 40 CFR Part 1033.101(i), as set forth below: [EPA-HQ-OAR-2014-0827-1269-A1 p.77]

(i) *Alternate CO standards.* Manufacturers/remanufacturers may certify Tier 0, Tier 1, or Tier 2 locomotives to an alternate CO emission standard of 10.0 g/bhp-hr instead of the otherwise applicable CO standard if they also certify those locomotives to alternate PM standards less than or equal to one-half of the otherwise applicable PM standard. For example, a manufacturer certifying Tier 1 locomotives to a 0.11 g/bhp-hr PM standard may certify those locomotives to the alternate CO standard of 10.0 g/bhp-hr. [EPA-HQ-OAR-2014-0827-1269-A1 p.77]

EMA believes that alternative CO standards for Tier 4 locomotives would allow a compliance path for manufacturers/remanufacturers of locomotives fueled by natural gas and other non-conventional fuels, and EMA recommends that such alternative CO standards be provided. Further, EMA recommends that alternative CO standards also be provided for Tier 3 remanufactured locomotives as well. [EPA-HQ-OAR-2014-0827-1269-A1 p.77]

More specifically, EMA recommends the following alternative sets of standards for Tier 3 and Tier 4 locomotives. On the two tables below - one for Tier 3 remanufactured locomotive, the other for Tier 4

locomotives - the current required set of standards is highlighted in bold and the recommended alternative sets of standards are shown in italics. [EPA-HQ-OAR-2014-0827-1269-A1 p.77]

[Table of Tier 3 and 4 Locomotives can be found on p.78 of docket number EPA-HQ-OAR-2014-0827-1269-A1]

**Response:**

We are adopting alternate standards for Tier 3 and Tier 4 locomotives, consistent with the alternate standards adopted for earlier tiers of standards. Rather than adopting the graduated approach recommended by EMA, we believe it is appropriate to continue with the policy of establishing an alternate CO standard of 10.0 g/hp-hr, with an increased level of PM control required for the Tier 3 and Tier 4 standards to qualify for the CO relief. Since the technologies in question generally correspond with substantial step changes in emissions, we don't want to create graduated standards suggesting that manufacturers need to dial in a certain level of PM control to earn a corresponding level of relief for CO emissions. These alternate standards are most likely to be relevant for natural gas engines. We believe manufacturers of natural engines can achieve a level of 0.01 g/hp-hr and have set that as the alternate PM standard corresponding to the 10.0 g/hp-hr CO standard for Tier 3 and Tier 4 engines.

**Organization:** Association of American Railroads

The Association of American Railroads ("AAR") appreciates the opportunity to comment on the proposed rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles- Phase 2. 1 AAR generally supports the changes made in the proposal that impact railroad operation directly; however, AAR seeks clarification with regard to §1033.601, General compliance provisions. [EPA-HQ-OAR-2014-0827-1273-A2 p.1]

(f) Multi-fuel locomotives. Subpart C of this part describes how to test and certify dual-fuel and flexible-fuel locomotives. Some multi-fuel locomotives may not fit either of those defined terms. For such locomotives, we will determine whether it is most appropriate to treat them as single-fuel locomotives, dual-fuel locomotives, or flexible-fuel locomotives based on the range of possible and expected fuel mixtures. For example, a locomotive might burn natural gas but initiate combustion with a pilot injection of diesel fuel. If the locomotive is designed to operate with a single fueling algorithm (i.e., fueling rates are fixed at a given engine speed and load condition), we would generally treat it as a single-fuel locomotive. In this context, the combination of diesel fuel and natural gas would be its own fuel type. If the locomotive is designed to also operate on diesel fuel alone, we would generally treat it as a dual-fueled locomotive. If the locomotive is designed to operate on varying mixtures of the two fuels, we would generally treat it as a flexible-fueled locomotive. To the extent that requirements vary for the different fuels or fuel mixtures, we may apply the more stringent requirements. [EPA-HQ-OAR-2014-0827-1273-A2 p.2]

In this section, it is unclear what EPA means by "flexible-fuel" and "dual-fuel" and what technology EPA is referencing with regard to those terms. AAR requests that EPA provide a full definition of "flexible-fuel" and "dual-fuel," as well as corresponding examples of technology for both engines. In addition, low pressure, dynamic gas blending, and high pressure direct injection are undefined and require explanation. There are many other combinations that need to be addressed and defined. Also, it is unclear whether there are other fuel types besides natural gas and diesel that EPA is including in the definition of flexible-fuel. [EPA-HQ-OAR-2014-0827-1273-A2 p.2]



Also, please explain what EPA means by, “[t]o the extent that requirements vary for the different fuels or fuel mixtures, we may apply the more stringent requirements” and the reason for more stringent requirements. [EPA-HQ-OAR-2014-0827-1273-A2 p.2]

**Response:**

The proposed rule included new definitions for flexible-fuel and dual-fuel and the draft text in §1033.601(c) included examples of the corresponding technologies, consistent with the AAR comment. The proposed rule did not include any of the terms AAR suggested would need more explanation. The combination of natural gas and diesel fuel is listed as an example of an engine using two fuels, but there is nothing to suggest that the provisions apply any differently for other fuel combinations.

Most regulatory provisions apply uniformly for different fuels, but there are some places where the regulation describes or prescribes something different for different fuels. If an engine has two fuels, it is subject to requirements that apply for both fuels. As such, it is not enough for the engine to meet the requirements that apply for one fuel, but not for the other. A different way to say this is that the engine must meet the more stringent requirements if they are different.

**Organization:** GE Transportation

As a general matter, GE supports the proposed technical changes and clarifications to 40 CFR part 1033. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

[T]he proposed technical changes and clarifications help resolve issues related to locomotive testing. These comments provide a few practical enhancements to the testing procedures for locomotives that are important to effectuate the purposes of the proposed amendments. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

GE supports the revision to 40 CFR 1033.101, which clarifies that compliance with the numerical hydrocarbon (HC) emission standard is based on non-methane hydrocarbon (NMHC) for dual-fuel and flexible-fuel locomotives. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

**I. CLARIFICATIONS OF LOCOMOTIVE TESTING REQUIREMENTS IN 40 CFR 1033.501**

A. Proportionality Verification for Certain Discrete Mode Tests (40 C.F.R. § 1033.501(a)(4)) [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

Section 1033.501(a)(4) of the proposed Technical Amendment states that locomotive manufacturers should verify proportional sampling by “.using the mean raw exhaust molar flow rate paired with each recorded sample flow rate.” This language limits the proportionality verification options in 40 CFR 1065.545 to only § 1065.545(b). In the final rule, EPA should slightly alter the proposal such that if a batch fuel measurement is used to determine raw exhaust flow rate, the batch modal fuel rate would be paired with each recorded modal 1 hertz (Hz) data set. Chemical balance calculations then would be performed at a frequency of 1Hz for the purpose of determining exhaust molar flow rate at 1Hz. These 1Hz raw exhaust flows would already be paired with each recorded sample flow rate and only be used for proportional sampling verification purposes. This approach would include some variation in the determination of modal raw exhaust flow associated with all other recorded data except fuel rate. Thus, both § 1065.545(a) and § 1065.545(b) become viable means to verify proportional sampling. [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

No changes in determining mass emissions, including drift verification, are being suggested. Those would still be performed utilizing the steady state discrete mode method provided in § 1065.650(e). [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

**Response:** The change that EPA proposed to 1033.501(a)(4) in the NRPM (below) is written generically enough to allow the use of either 1065.545(a) or (b) to verify proportionality, including the scenario proposed by GE. Therefore no change is necessary.

B. Consistent Use of “Phase” and “Interval” (40 CFR 1033.501(a)(5)) [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

The proposed Technical Amendment replaces “phase” with “interval” throughout 40 CFR part 1033. However, “phase” is still used in § 1033.501(a)(5). The word “phase” should be replaced with “group” in § 1033.501(a)(5) to be consistent with respect to terminology used elsewhere in the proposed Technical Amendment. [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

**Response:** We agree with the comment and have revised the regulation accordingly.

C. Clarification on Smoke Test Invalidation (40 CFR 1033.501(j)(2)) [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

Section 1033.501(j)(2) of the proposed Technical Amendment states that manufacturers must “invalidate a smoke test if active regeneration starts to occur during the test.” [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

Currently, sections 1033.515(c)(4) and 1033.520(e)(4) require measurement of smoke and emissions concurrently, with no allowance for measuring smoke separately from other emissions. [EPA-HQ-OAR-2014-0827-1297-A1 p.2]

We recommend that EPA amend Part 1033 to provide an option to perform smoke measurements and other regulated emissions measurements in separate test sequences, similar to the existing provision in 40 CFR 92.124(f). Section 1033.501(j)(2) of the Technical Amendment should explain the means with which to treat smoke and emissions measurements if active regeneration of aftertreatment occurs during either portion of the test. [EPA-HQ-OAR-2014-0827-1297-A1 p.2-3]

**Response:** EPA will make the following changes regarding smoke measurement to address the concern expressed in the comment:

1033.515(c)(4) If applicable, begin the smoke test at the start of the test mode A. Continue collecting smoke data until the completion of test mode 8. You may perform smoke measurements independent of criteria pollutant measurements by rerunning the test over the duty-cycle. If you choose this option, the minimum time-in-notch is 3.0 minutes for duty-cycles in which only smoke is measured. Refer to §1033.101 to determine applicability of smoke testing and §1033.525 for details on how to conduct a smoke test.

1033.520(e)(4) If applicable, begin the smoke test at the start of the first test interval of the applicable ramped modal cycle. Continue collecting smoke data until the completion of final test interval. You may perform smoke measurements independent of criteria pollutant measurements by rerunning the test over the duty-cycle. If you choose this option, the minimum time-in-notch is 3.0 minutes for duty-cycles in which only smoke is measured.

### III. NMHC MEASUREMENTS FOR DUAL-FUEL AND FLEXIBLE-FUEL LOCOMOTIVES

The proposed revisions to §1033.101(f)(1)(i) would clarify that the numerical emission standard for hydrocarbon (HC) is based on non-methane hydrocarbon (NMHC) for dual-fuel and flexible-fuel locomotives. GE supports this clarification. [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

Regulations governing emissions from locomotives have always stated that the numerical standard for HC shall be based on NMHC for gaseous-fueled locomotives (§92.8(a)(1) and §1033.101(f)(1)(ii)). This is appropriate because a large portion of natural gas is methane, but EPA has previously excluded methane from the definition of Volatile Organic Compounds (VOC) under 40 CFR 51.100(s), given methane's negligible photochemical reactivity. [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

Dual-fuel and flexible-fuel locomotives that use a combination of diesel fuel and natural gas are likely to be configured such that during a majority of the locomotive's operating time, they will use a mixture of diesel and natural gas simultaneously injected into the cylinders. On average, the locomotive will burn more natural gas than diesel; thus, it is appropriate to regulate such a locomotive on measurements of NMHC. [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

**Response:** In the final rule, we specify that the hydrocarbon standard for gaseous-fueled locomotives excludes ethane, much like we have established for methane, as describe in Section 14.4.7.

### IV. AMENDMENTS TO CERTIFICATE APPLICATIONS AND EPA DECISIONS

#### A. Amendments to Certificate [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

In proposed §1033.225, the Technical Amendment would clarify that after the end of the model year for a given certificate of conformity, manufacturers "may amend [their] application only to update maintenance instructions ... or to modify an FEL." [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

In the past, EPA has utilized the mechanism of a "field fix" in order to apply changes to prior year certificates, as described in Field Fixes Related to Emission Control-Related Components, Advisory Circular 2B, (Mar. 17, 1975) ("Field Fix Circular"). The Field Fix Circular defines a field fix as follows: [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

In the context of this Advisory Circular, a field fix is defined as: A modification, removal or replacement of an emission-control related component by a manufacturer or dealer, or revision by a manufacturer for implementation by dealers to specifications or maintenance practices for emission-control related components on vehicles that have left the assembly line. [EPA-HQ-OAR-2014-0827-1297-A1 p.4]

It is common practice in the locomotive industry for manufacturers to develop improved emission-control related components for incorporation into current model year locomotives, with the intent to also incorporate such components into prior model year locomotives of similar design. For example, a manufacturer could develop a modification to a locomotive's originally-certified fuel injector that improves the reliability of the injector. In this example, under current practice, a field fix is used to notify EPA of the manufacturer's intent to incorporate the improved injector into prior model year locomotives. The proposed rule revision creates uncertainty as to whether EPA is planning a new approach of amending prior years' certification applications or whether EPA intends to continue using

the field fix approach. It is important for EPA to make clear how it intends manufacturers to proceed. In addition, if applications are to be amended, it is unclear whether EPA would subsequently “act” on those applications and how the certificate would be amended (or if amendment would occur automatically). In short, to the extent EPA intends to eliminate the field fix mechanism, what will be the mechanism for manufacturers to use in order to update prior model year applications for updates to emission-control related components (including AECDs)? [EPA-HQ-OAR-2014-0827-1297-A1 p.5]

**Response:** We agree with the comment and have revised the regulation as described in Section 14.4.8.

#### B. EPA Decisions [EPA-HQ-OAR-2014-0827-1297-A1 p.5]

In proposed §1033.255(c)(2), EPA states that it “may deny [an] application or suspend or revoke [a] certificate if [a manufacturer does] any of the following ... Submit false or incomplete information ... This includes doing anything after submission of [an] application to render any of the submitted information false or incomplete.” [EPA-HQ-OAR-2014-0827-1297-A1 p.5]

GE is concerned that use of the phrase “doing anything” is overly broad and does not clearly indicate to manufacturers the specific actions that EPA is trying to address with this provision. Using the example in above paragraph IV.B, if a manufacturer develops an improved fuel injector for incorporation into prior model year locomotives, but the revised provisions in §1033.225 preclude amending the application to include this improved fuel injector, would that manufacturer be in violation of this provision? The language EPA has drafted appears to be overbroad, and it needs to be clarified so that EPA can provide adequate notice to regulated entities of the actions that could call their certificates of conformity into question. [EPA-HQ-OAR-2014-0827-1297-A1 p.5]

EPA should clarify and narrow this provision in the final rule and should explain clearly the actions that would implicate the provision. Otherwise, the provision is impermissibly broad and vague. [EPA-HQ-OAR-2014-0827-1297-A1 p.5]

**Organization:** GE Transportation

GE requests clarification on language in the Technical Amendment concerning amendments to certificate applications (40 CFR 1033.225) and certain EPA decisions (40 CFR 1033.255). The proposed regulatory language should be revised to address the specific situation that is of concern to ensure that the provision gives adequate notice to regulated entities of the types of activities that could jeopardize their certificates of conformity. [EPA-HQ-OAR-2014-0827-1297-A1 p.1]

**Response:**

As noted in the previous section, we are not adopting the proposed change to §1033.225. Some examples of making applications incorrect would include (1) Naming an agent for service in the application, then deciding later to no longer rely on that agent for managing communications with EPA, (2) changing engine designs for production engines in a way that is not covered by the application (adjustable parameters, emission control features, etc.), and (3) Recommending a revised time to remanufacture that is longer than the locomotive’s useful life. We address the question regarding §1033.225 in Section 14.4.8.



## Appendix A to Section 14 - Sensitivity Analysis of Glider Impacts

EPA is restricting the number of gliders that may be produced using engines not meeting current standards. Current standards for NO<sub>x</sub> and PM (which began in 2007 and took full effect in 2010) are at least 90 percent lower than the most stringent previously applicable standards, so the NO<sub>x</sub> and PM emissions of any glider vehicles using pre-2007 engines are at least ten times higher than emissions from equivalent vehicles being produced with brand new engines.<sup>248</sup> However, most gliders being produced today use engines originally manufactured before 2002. Since these pre-2002 engines lack both EGR and exhaust aftertreatment, they would have NO<sub>x</sub> and PM emissions 20-40 times higher than current engines. If miscalibrated, emissions could be even higher. Thus, each glider vehicle using an older engine that is purchased instead of a new vehicle with a current MY engine results in significantly higher in-use emissions of air pollutants associated with a host of adverse human health effects, including premature mortality (see Section VIII of the FRM Preamble).

These emission impacts have been compounded by the increasing sales of these vehicles. Estimates provided to EPA indicate that production of glider vehicles has increased by an order of magnitude from what it was in the 2004-2006 time frame – from a few hundred each year to thousands.<sup>249</sup> Glider vehicle production is not currently being reported to EPA, but we estimate that current production is close to 10,000 each year. Some commenters to the proposed rule indicated that the volume may be higher still. Volvo provided evidence that current sales have grown to 10,000 or more per year. Even some commenters who produce glider vehicles and opposed EPA's proposal acknowledged that glider sales are now over 10,000 units annually. See Section XIII.B.(3) of the Preamble and Section 14.2 of this RTC.

For the final rule, EPA has updated our analysis of the environmental impacts of gliders.<sup>250</sup> The updated analysis used the MOVES model, which is the same emissions modeling tool used to estimate the emissions impacts of the rule, described in Sections VII and VIII of the FRM. EPA performed two analyses which are described below. The first projected future fleetwide emissions for a control scenario based on the proposal (which is similar to the final rule). The second projected per-vehicle emissions for MY 2017 gliders. Both analyses focused on NO<sub>x</sub> and PM emissions and assumed that these gliders emit at the level equivalent to the engines meeting the MY 1998-2001 standards, since most glider vehicles currently being produced use remanufactured engines of this vintage. See Section XIII.B.(3) of the Preamble and Section 14.2 of this RTC. We did not attempt to account for any miscalibration of these engines or other factors that would cause emissions to be higher than 1998 engines. Finally, the analyses made the simplifying assumption that all gliders are tractors. Although not entirely correct, the vast majority of glider vehicles currently being produced are tractors, so this assumption still allows impacts to be reasonably approximated.

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<sup>248</sup> The NO<sub>x</sub> and PM standards for MY 2007 and later engines are 0.20 g/hp-hr and 0.01 g/hp-hr, respectively. The standards for MY 2004 through 2006 engines were ten times these levels, and earlier standards were even higher.

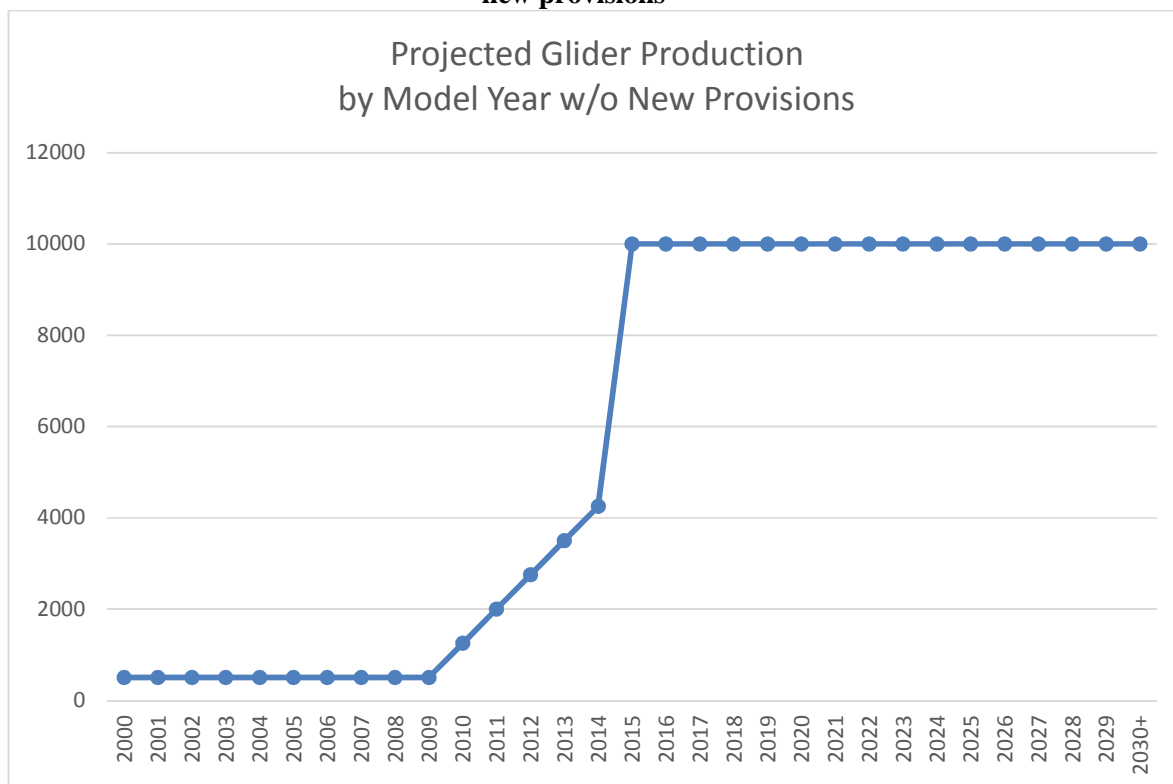
<sup>249</sup> "Industry Characterization of Heavy Duty Glider Kits," MacKay & Company, September 30, 2013.

<sup>250</sup> Memorandum to the Docket "Emissions Modeling Files for Glider Analysis" Docket No. EPA-HQ-OAR-2016. July, 2016.

### Fleetwide Emission Projections

Based on public comments, EPA is estimating that approximately 10,000 gliders will be produced in 2016. Consistent with this, the modeling of gliders discussed here assumed annual glider sales of 10,000 for 2015 and later. As noted above, the modeling assumed that these gliders emit at the level equivalent to the engines meeting the MY 1998-2001 standards without miscalibration.

**Figure A- 1: Glider vehicle production projected for fleetwide analysis without new provisions**



We modeled impacts on NO<sub>x</sub> and PM inventories with and without restrictions for two calendar years: 2025 and 2040. The restrictions were modeled as limiting sales in 2018 and later to 1,000 new gliders each year. This control case roughly approximates the restrictions being adopted for 2018 and later, and is consistent with the proposed requirements. The total number of vehicles was held constant by increasing the number of fully compliant vehicles (i.e., vehicles with engines meeting 2017 and later standards for NO<sub>x</sub> and PM) by 9,000 for each model year after 2017. However, we recognize that the actual number of gliders produced annually under the control case may vary by year and/or be higher or lower than 1,000. The results are shown below. This control scenario does not reflect the restrictions being adopted for 2017. See the model year analysis below for the impacts of model year 2017 glider vehicles.

**Table A-1: Fleetwide NOx and PM Emissions (tons) from  
Glider Vehicles for Calendar Year 2025**

|                   | Without Controls<br>(US Tons per Year) | With Controls<br>(US Tons per Year) | Reductions<br>(US Tons per Year) |
|-------------------|--|-------------------------------------|----------------------------------|
| 2025              |  |                                     |                                  |
| NO <sub>x</sub>   | 295,000                                | 104,769                             | 190,231                          |
| PM <sub>2.5</sub> | 7,817                                  | 2,753                               | 5,064                            |

**Table A-2: Fleetwide NOx and PM Emissions (tons) from  
Glider Vehicles for Calendar Year 2040**

|                   | Without Controls<br>(US Tons per Year) | With Controls<br>(US Tons per Year) | Reductions<br>(US Tons per Year) |
|-------------------|--|-------------------------------------|----------------------------------|
|                   |  |                                     |                                  |
| NO <sub>x</sub>   | 371,091                                | 52,476                              | 318,615                          |
| PM <sub>2.5</sub> | 9,955                                  | 1,409                               | 8,546                            |

The model projects that if glider vehicle production remains at 10,000 per year, there would be 128,750 glider vehicles on the road in 2025 and that they would emit 295,000 tons/year of NO<sub>x</sub> in 2025 and 7,817 tons/year of PM<sub>2.5</sub>. This means the average glider on the road in 2025 would emit 4,583 pounds of NO<sub>x</sub> and 121 pounds of PM<sub>2.5</sub> for that single year.<sup>251</sup>

*Model Year Analysis*

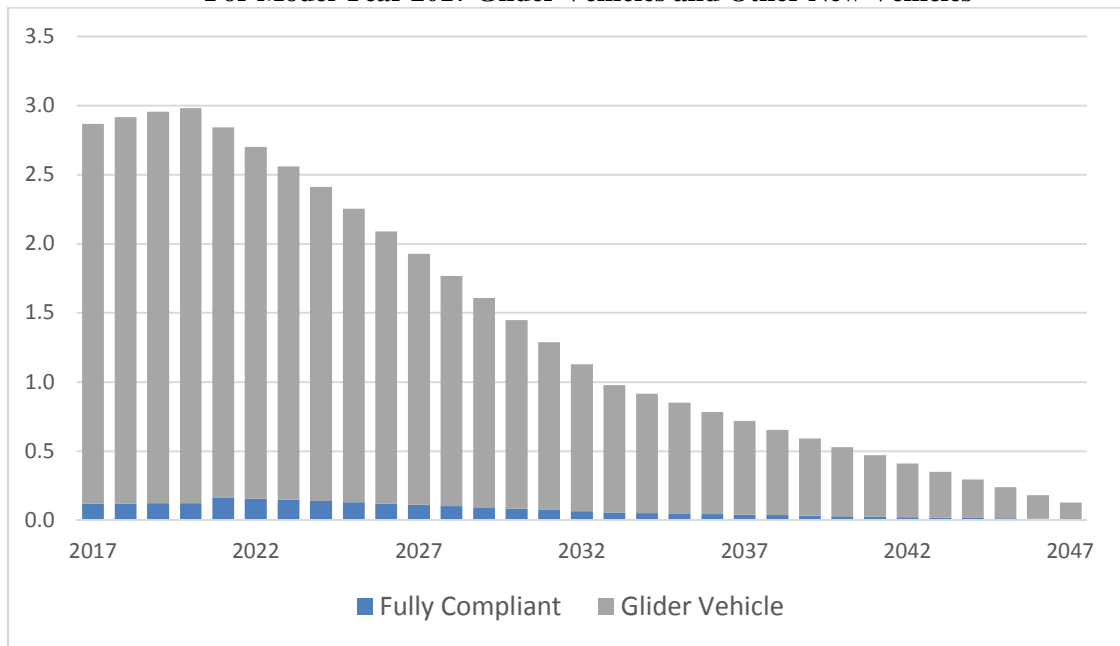
EPA also modeled the lifetime emissions of a single model year. The analysis estimated per-vehicle emissions, as well as the emission reductions associated with restricting the number of glider vehicles that could be produced in 2017 using older engines not meeting the current criteria pollutant standards. As with the fleetwide analysis, the model year analysis assumed that these gliders emit at the level equivalent to the engines meeting the MY 1998-2001 standards without miscalibration. Although presented for model year 2017, similar results would be expected for later years as well. The per-vehicle results are shown in the figures below (gray bars for glider vehicles). These figures also show the corresponding emissions projected for conventional model year 2017 vehicles with fully compliant engines (small blue bars).

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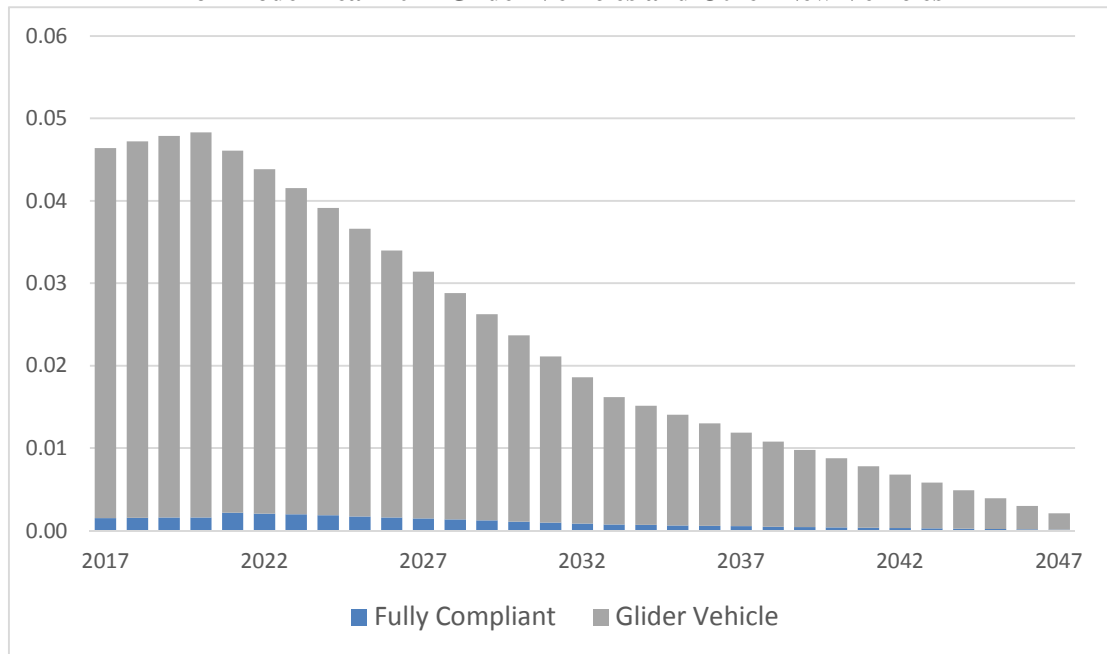
<sup>251</sup> This estimate is for the projected number of vehicles on the road, and does not include vehicles projected to have been scrapped from the population.



**Figure A-2: Annual Per-Vehicle NO<sub>x</sub> Emissions (tons/year)  
For Model Year 2017 Glider Vehicles and Other New Vehicles**



**Figure A-3: Annual Per-Vehicle PM Emissions (tons/year)  
For Model Year 2017 Glider Vehicles and Other New Vehicles**



Emissions are shown normalized to the initial number of model year 2017 vehicles.<sup>252</sup> The trends shown in these figures largely reflect three phenomena: deterioration, scrappage, and declining use. Emissions initially increase due to deterioration of the engines (and deterioration of aftertreatment controls for the fully compliant engines). Then the average per-vehicle emissions decline as the projected annual mileage accumulation rates decline and some fraction of the vehicles are removed from service. Model year lifetime emissions are shown below per thousand glider vehicles.<sup>253</sup>

**Table A-3: Lifetime NOx and PM Emissions (tons)  
For Model Year 2017 Glider Vehicles and Other New Vehicles**

|  | NOx<br>Lifetime Tons per<br>1,000 Vehicles | PM <sub>2.5</sub><br>Lifetime Tons per<br>1,000 Vehicles |
|--|--|--|
| Model Year 2017 Glider Vehicles          | 43,800                                     | 710  |
| Model Year 2017 Fully Compliant Vehicles | 2,300                                      | 30   |
| Difference                               | 41,500                                     | 680  |

As shown in this table, even a small number of glider vehicles has a very large emission impact. Even without any projections of miscalibration, glider vehicles are projected to emit about 20 times as much NOx and PM as the same number of fully compliant vehicles.<sup>254</sup> Moreover every 1,000 glider vehicles that are produced instead of fully compliant vehicles results in 41,500 tons of additional NOx and 680 tons additional PM emitted into the atmosphere. Although we do not have precise historical production rates for glider vehicles, we are confident that they were less than 5,000 per year prior to 2015. Without controls, it is reasonable to assume that glider vehicle production for 2017 would be 10,000 to 15,000.<sup>255</sup> Thus, the restriction on 2017 production that is being adopted is projected to prevent the use of high polluting engines in 5,000 to 10,000 glider vehicles. This would prevent the emission of 207,500-415,000 tons of NOx and 3,400-6,800 tons of PM.

<sup>252</sup> These numbers differ from per-vehicle estimates from the fleetwide analysis because they are normalized to the total number of model year 2017 vehicles produced rather than those still in the fleet for a given calendar year.

<sup>253</sup> The maximum lifetime assumed for these vehicles is 30 years; however, MOVES models most vehicles as being removed from service after much less than 30 years. MOVES projects that nearly 80 percent of lifetime emissions will occur within the first 15 years of a vehicle's life.

<sup>254</sup> EPA has separately estimated that glider emissions could be as much more than twice as high as this (or producing more than 40 times as much NOx and PM as current engines) if the engines are miscalibrated, incompletely/improperly rebuilt, and/or were originally manufactured before 1998.

<sup>255</sup> 2016 production is projected to be approximately 10,000 glider vehicles. Given the trend of ever-increasing sales over the last several years, combined with the likelihood of some pre-buying occurring based on the proposed restrictions for 2018, we believe that 2017 production could have been 15,000 or more without the production limit for 2017.

### *Benefits of Controlling Emissions from Glider Vehicles*

Reducing the number of glider vehicles produced using older engines will yield substantial improvements in public health. For example, using incidence-per-ton estimates, the number of PM<sub>2.5</sub>-related premature mortalities caused by glider vehicles can be estimated from the lifetime reductions in both NO<sub>x</sub> (which forms nitrate PM in secondary reactions) and directly emitted PM<sub>2.5</sub>. Using benefit-per-ton values (described in Section IX.H of the FRM Preamble), the present value of total monetized PM<sub>2.5</sub>-related benefits associated with these lifetime emission reductions can also be calculated. These health-related benefits are presented in the table below. Cases of premature mortality avoided are presented as a range based on results derived from two studies (the American Cancer Society cohort study - Krewski et al., 2009, and the Harvard Six-cities study - Lepeule et al., 2012). Monetized benefits are presented as net present values in 2013\$, assuming a 30-year vehicle lifetime and a 3% and 7% discount rate. Both premature mortalities and benefits are shown for model year 2017 glider vehicles based on the increase in lifetime emissions over a fully compliant model year 2017 vehicle. Note, as discussed below, there would be additional benefits that have not been quantified.

**Table A-4: Lifetime NO<sub>x</sub> and PM Emissions Increases (tons)  
For Model Year 2017 Glider Vehicles and Associated Benefits**

|  |                   |
|--|-------------------|
| Increased Lifetime NO <sub>x</sub> Emissions per 1,000 Glider Vehicles                                     | 41,500 Tons       |
| Increased Lifetime PM <sub>2.5</sub> Emissions per 1,000 Glider Vehicles                                   | 680 Tons          |
| Premature Mortalities per 1,000 Glider Vehicles  | 70-160 Persons    |
| Monetized PM <sub>2.5</sub> -related Benefits Associated with Reducing Glider Production by 1,000 Vehicles | \$0.3-1.1 Billion |

As noted above, the restriction on 2017 production that is being adopted is projected to prevent the use of high polluting pre 2002-engines in 5,000 to 10,000 glider vehicles, and would prevent the emission of 207,500-415,000 tons of NO<sub>x</sub> and 3,400-6,800 tons of PM over the lifetime of those vehicles and engines. This is estimated to prevent 350 to 1,600 premature mortalities (and achieve \$1.5 to 11.0 billion in monetized PM<sub>2.5</sub>-related benefits).

Several commenters argued that EPA is precluded from adopting any controls on installation of high polluting engines in glider vehicles until MY 2021. This could mean the production of 30,000 to 40,000 additional glider vehicles using the older high polluting engines. Using the same assumptions as above, these three additional model years of production are estimated to result in an additional 2,100 to 6,400 premature mortalities, incremental to the premature mortalities.

As described above, this sensitivity analysis uses estimates of the benefits from reducing the incidence of PM<sub>2.5</sub>-related health impacts. These estimates, which are expressed per ton of PM<sub>2.5</sub>-related emissions eliminated by adopting glider vehicle controls, represent the total monetized value of quantified human health benefits (including reduction in both premature mortality and premature morbidity) from reducing each ton of directly emitted PM<sub>2.5</sub>, or its precursors (e.g., NO<sub>x</sub>), from on-road mobile sources. Ideally, the human health benefits would be estimated based on changes in ambient PM<sub>2.5</sub> as determined by full-scale air quality modeling. However, the length of time needed to prepare the necessary emissions inventories, in addition to the processing time associated with the modeling itself, has precluded us from performing air quality modeling for this analysis.

The benefit per-ton technique has been used in previous analyses, including EPA’s 2017-2025 Light-Duty Vehicle Greenhouse Gas Rule,<sup>256</sup> the Reciprocating Internal Combustion Engine rules,<sup>257,258</sup> and the Residential Wood Heaters NSPS.<sup>259</sup> The table below shows the quantified PM<sub>2.5</sub>-related benefits captured in the per-ton estimates, as well as unquantified PM<sub>2.5</sub> effects the per-ton estimates are unable to capture.

**Table A-5: Human Health and Welfare Effects of PM<sub>2.5</sub>**

| POLLUTANT         | QUANTIFIED AND MONETIZED IN PRIMARY ESTIMATES  | UNQUANTIFIED EFFECTS CHANGES IN:  |
|-------------------|--|---|
| PM <sub>2.5</sub> | Adult premature mortality<br>Acute bronchitis<br>Hospital admissions: respiratory and cardiovascular<br>Emergency room visits for asthma<br>Nonfatal heart attacks (myocardial infarction)<br>Lower and upper respiratory illness<br>Minor restricted-activity days<br>Work loss days<br>Asthma exacerbations (asthmatic population)<br>Infant mortality | Cancer, mutagenicity, and genotoxicity effects<br>Chronic and subchronic bronchitis cases<br>Strokes and cerebrovascular disease<br>Low birth weight<br>Pulmonary function<br>Chronic respiratory diseases other than chronic bronchitis<br>Non-asthma respiratory emergency room visits<br>Visibility<br>Household soiling |

This sensitivity analysis uses per ton benefits estimates taken from the "Technical Support Document Estimating the Benefit per Ton of Reducing PM<sub>2.5</sub> Precursors from 17 Sectors," U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle.<sup>260</sup> The procedure for calculating benefit per ton coefficients follows three steps, shown graphically in Figure A-4 below:

<sup>256</sup> U.S. Environmental Protection Agency (U.S. EPA). (2012). *Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*, Assessment and Standards Division, Office of Transportation and Air Quality, EPA-420-R-12-016, August 2012. Available on the Internet at: <http://www.epa.gov/otaq/climate/documents/420r12016.pdf>.

<sup>257</sup> U.S. Environmental Protection Agency (U.S. EPA). (2013). *Regulatory Impact Analysis for the Reconsideration of the Existing Stationary Compression Ignition (CI) Engines NESHAP*, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January. EPA-452/R-13-001. Available at [http://www.epa.gov/ttnecas1/regdata/RIAs/RICE\\_NESHAPreconsideration\\_Compression\\_Ignition\\_Engines\\_RIA\\_final2013\\_EPA.pdf](http://www.epa.gov/ttnecas1/regdata/RIAs/RICE_NESHAPreconsideration_Compression_Ignition_Engines_RIA_final2013_EPA.pdf).

<sup>258</sup> U.S. Environmental Protection Agency (U.S. EPA). (2013). *Regulatory Impact Analysis for Reconsideration of Existing Stationary Spark Ignition (SI) RICE NESHAP*, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January. EPA-452/R-13-002. Available at [http://www.epa.gov/ttnecas1/regdata/RIAs/NESHAP\\_RICE\\_Spark\\_Ignition\\_RIA\\_finalreconsideration2013\\_EPA.pdf](http://www.epa.gov/ttnecas1/regdata/RIAs/NESHAP_RICE_Spark_Ignition_RIA_finalreconsideration2013_EPA.pdf).

<sup>259</sup> U.S. Environmental Protection Agency (U.S. EPA). (2015). *Regulatory Impact Analysis for Residential Wood Heaters NSPS Revision*. Office of Air Quality Planning and Standards, Research Triangle Park, NC. February. EPA-452/R-15-001. Available at <http://www2.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf>.

<sup>260</sup> <https://www.epa.gov/sites/production/files/2014-10/documents/sourceapportionmentbpttsd.pdf>.

1. Use source apportionment photochemical modeling to predict ambient concentrations of primary PM<sub>2.5</sub>, nitrate and sulfate attributable to each of 17 emission sectors across the Continental U.S., including on-road mobile sources. The on-road mobile source sector contribution to PM<sub>2.5</sub> concentrations was estimated using the peer-reviewed model CAMx version 5.30, which includes numerous science modules that simulate the emission, production, decay, deposition and transport of organic and inorganic gas-phase and particle-phase pollutants in the atmosphere (Baker and Scheff, 2007; ENVIRON, 2010; Nobel et al., 2001; Russell, 2008).<sup>261,262,263,264</sup> Particulate matter source apportionment technology (PSAT) implemented in CAMx estimated the contribution from on-road mobile sources to primarily emitted PM<sub>2.5</sub> and to secondarily formed PM<sub>2.5</sub> (e.g., nitrate) using reactive tracers to capture nonlinear formation and removal processes (Baker and Foley, 2011; ENVIRON, 2010; Wagstrom et al., 2008).<sup>265,266,267</sup> Mobile source contributions were estimated in CAMx for domains covering the eastern and western United States with 12 km square sized grid cells. The emissions data used in the air quality modeling were based on EPA's 2005 v4 platform.<sup>268</sup>
2. For each sector, estimate the health impacts, and the economic value of these impacts, associated with the attributable ambient concentrations of primary PM<sub>2.5</sub>, sulfate and nitrate PM<sub>2.5</sub> using the environmental Benefits Mapping and Analysis Program (BenMAP v4.0.66).<sup>269,270</sup> BenMAP is a peer-reviewed Geographic Information System (GIS)-based tool that takes air quality input data (i.e., the CAMx data described in step 1), overlays that with population to estimate exposure, and uses that information to estimate changes in health effects using "health impact functions" derived from the published epidemiology literature.
3. For each sector, divide the PM<sub>2.5</sub>-related health impacts attributable to each type of PM<sub>2.5</sub>, and the monetary value of these impacts, by the level of associated precursor emissions. That is, primary PM<sub>2.5</sub> benefits are divided by direct PM<sub>2.5</sub> emissions, and nitrate benefits are divided by NO<sub>x</sub> emissions.

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<sup>261</sup> Baker K, Scheff P. Photochemical model performance for PM<sub>2.5</sub> sulfate, nitrate, ammonium, and precursor species SO<sub>2</sub>, HNO<sub>3</sub>, and NH<sub>3</sub> at background monitor locations in the central and eastern United States. *Atmos Environ* 2007;41:6185–95. <http://dx.doi.org/10.1016/j.atmosenv.2007.04.006>.

<sup>262</sup> ENVIRON. User's guide comprehensive air quality model with extensions version 5.30. [www.camx.com](http://www.camx.com). 2010.

<sup>263</sup> Nobel CE, McDonald-Buller EC, Kimura Y, Allen DT. Accounting for spatial variation of ozone productivity in NO<sub>x</sub> emission trading. *Environ Sci Technol* 2001;35:4397–407.

<sup>264</sup> Russell AG. EPA supersites program-related emissions-based particulate matter modeling: initial applications and advances. *J Air Waste Manage Assoc* 2008;58:289–302. <http://dx.doi.org/10.3155/1047-3289.58.2.289>.

<sup>265</sup> Baker KR, Foley KM. A nonlinear regression model estimating single source concentrations of primary and secondarily formed PM<sub>2.5</sub>. *Atmos Environ* 2011;45:3758–67. <http://dx.doi.org/10.1016/j.atmosenv.2011.03.074>.

<sup>266</sup> ENVIRON. User's guide comprehensive air quality model with extensions version 5.30. [www.camx.com](http://www.camx.com). 2010.

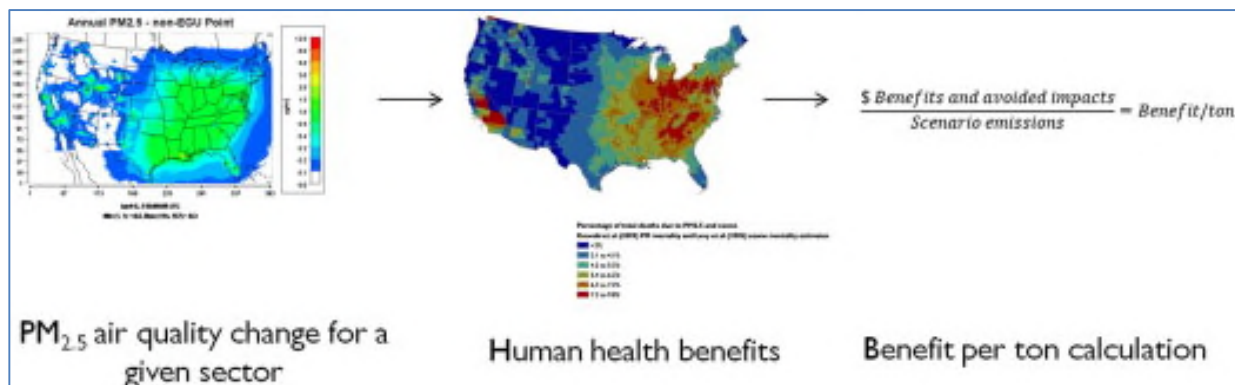
<sup>267</sup> Wagstrom KM, Pandis SN, Yarwood G, Wilson GM, Morris RE. Development and application of a computationally efficient particulate matter apportionment algorithm in a three-dimensional chemical transport model. *Atmos Environ* 2008;42:5650–9. <http://dx.doi.org/10.1016/j.atmosenv.2008.03.012>.

<sup>268</sup> United States Environmental Protection Agency (US EPA). 2005 National Emissions Inventory Data & Documentation. Available at: <http://www.epa.gov/ttnchie1/net/2005inventory.html#2011>.

<sup>269</sup> <https://www.epa.gov/benmap>.

<sup>270</sup> In this stage we estimate the PM<sub>2.5</sub>-related impacts associated with changes in directly emitted PM<sub>2.5</sub> and nitrate separately, so that we may ultimately calculate the benefit per ton reduced of the corresponding PM<sub>2.5</sub> precursor, or directly emitted PM<sub>2.5</sub>, in step 3. When estimating these impacts we apply effect coefficients that relate changes in total PM<sub>2.5</sub> mass to the risk of adverse health outcomes; we do not apply effect coefficients that are differentiated by PM<sub>2.5</sub> specie.

**Figure A-4: Conceptual Diagram Of The Analytical Process For Calculating Impact And Benefit Per Ton Estimates.**



The process described above yields per-ton estimates that relate emission changes to health impacts and monetized benefits. We recommend readers refer to pp. 142-144 of Fann et al. (2012)<sup>271</sup> for a detailed description of the benefit-per-ton methodology.

In this sensitivity analysis, using benefit-per-ton values, EPA only estimates the economic value of the human health benefits associated with the resulting reductions in PM<sub>2.5</sub> exposure. For example, we do not estimate the change in health risk associated with reductions in diesel PM based on current limitations in methods and available data. Thus, the per-ton estimates do not reflect cancers attributable to exposure to diesel PM exhaust, a likely human carcinogen. See Preamble Section VIII.A.6. However, we capture other benefits related to reductions in diesel PM (chiefly, benefits related to cardiovascular health endpoints) to the extent that diesel PM is included in measured PM<sub>2.5</sub>. Furthermore, due to analytical limitations with the benefit per ton method, this analysis does not estimate reductions in premature mortality and other benefits resulting from reductions in population exposure to other criteria pollutants such as ozone. The air quality modeling that underlies the PM-related benefit per ton values also produced estimates of ozone levels attributable to each sector. However, the complex non-linear chemistry governing ozone formation prevented EPA from developing a complementary array of ozone benefit per ton values. This limitation notwithstanding, we anticipate that the ozone-related benefits associated with reducing emissions of NO<sub>x</sub> and VOC emitted by glider vehicles using high polluting engines are substantial. Refer to RIA Appendix 8.A for the ozone benefits results from the supplemental CY benefits analysis. Finally, the benefits per-ton method does not monetize all of the potential health and welfare effects associated with reduced concentrations of PM<sub>2.5</sub>.

<sup>271</sup> Fann, N., Baker, K.R., and Fulcher, C.M. (2012). *Characterizing the PM<sub>2.5</sub>-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S.*, Environment International, 49, 241-151, Published online September 28, 2012. <http://www.sciencedirect.com/science/article/pii/S0160412012001985>.

## 15 Other Comments

### 15.1 General Other Comments

**Organization:** California Air Resources Board (CARB)

#### Comment on Topic Where NPRM Requests Comment

#### **Comment – Modification of the minimum and maximum allowable test vehicle accumulated mileage for BEVs and plug-in hybrid electric vehicles (PHEV)**

CARB staff agrees that it would be appropriate to increase the maximum allowable test vehicle accumulated mileage for BEVs and PHEVs. *Note that this proposed modification does not appear to be included in the NPRM or redlined regulatory language, only in the RIA.* [EPA-HQ-OAR-2014-0827-1265-A1 p.96]

#### **Response:**

The agencies appreciate the response to our request for comment on increasing the maximum allowable test vehicle accumulated mileage for EVs and PHEVs. We do not plan to increase the mileage at this time, as it is not clear what the mileage level should increase to as we were given no supporting data or suggestions from commenters.

**Organization:** National Zephyr Research, NZR Conversions and Equipment Sales, Inc.

We respectfully offer our contribution to the above EPA initiative and are pleased to introduce EPA, NHTSA to a new iteration for Semi-trailers which may assist with emission standards. The NEW 'ACCORD-Semi-trailer' with '5th Wheel Compound Hitch' tractor package. This universal design will advance the existing 53' or long configuration with improved aerodynamic characteristics and includes the following model designations for your consideration. [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

- Silver-Diamond 53' ACCORD Semi-trailer (Conversions) [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Blue-Diamond 63' ACCORD Semi-trailer (OAL < 75') [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Black-Diamond 73' ACCORD Semi-trailer (OAL > 82') [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

These 'Accordion' or 'Stinger' Semi-trailers have one thing in common; they are rigidly coupled to the tractor and do not articulate at the tractor 5th wheel. A patented 5th wheel compound hitch system is designed to restrict 5th wheel rotation and force the trailer to articulate at the stinger position approx. 20' behind the kingpin. A patented design the ACCORD semi-trailer when used in conjunction with the patented d-TRAIN 5th wheel compound hitch tractor package offers a new and advance on existing semi-trailers with many advantages that may be of interest to EPA some of which are as follows: [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

- Tractor will not articulate and will never be involved is a full jackknife [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

- Zero 'GAP' from BOC to the trailer (approx. 6') aerodynamics saving fuel [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Length of Semi-trailer is increased min. 18% to increase productivity [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Forward lengths dimensions are reduced [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Maneuverability is improved by 50% [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Aerodynamics substantially improved without fairings [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Most existing Semi-trailers and tractor may be converted [EPA-HQ-OAR-2014-0827-0947-A1 p.1]
- Tractors remain universal even when converted to d-TRAiN hitch system [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

We are suggesting that these trailers be tested and evaluated and are confident the results will prove significant. And new design option for OEMs willing to become a licensed. This technology is offered to OEM and Service Shops across the nation. [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

However, this project needs funding to build concept OEM or conversion trailers. With EPA, DOE and NHTSA assistance we would willingly co-operate with licensees throughout the US to confirm these findings. Incidentally, There is ample proof of concept provided by Auto-hauler transporters presently operating on US and Canadian roads and which have been successfully shipping cars and trucks throughout the US and Canada for at least thirty years. To view animation of this concept and view drawings Goto: [www.nationalzephyrresearch.wordpress.com](http://www.nationalzephyrresearch.wordpress.com) [EPA-HQ-OAR-2014-0827-0947-A1 p.1]

**Response:**

Thank you for the information provided on these technology packages. We appreciate your innovation; however, the agencies are not funding the development of technologies in the Phase 2 program.

**Organization:** Daimler Trucks North America LLC

**Paperwork Reduction Act** - The agencies request comments on the collection of information for the Phase 2 regulations, including the accuracy of the agencies' burden estimates and any suggested methods for minimizing respondent burden. 80 FR 40541. We understand that the agencies need to collect information under the Phase 2 regulations for certification and end of year reporting purposes. But we think that, rather than simply tally the amount of burden imposed on manufacturers, the agencies could work with manufacturers to reduce some of the burden. In particular, the agencies require dozens of redundant applications for certification; this redundancy could be eliminated. The agencies require unnecessary estimates of ten vehicles' GEM scores per regulatory sub-category as a means of characterizing the Certificates of Conformity as test-based; the agencies could use the last year's or previous year's end-of-year report (which contains much more detailed and accurate information) as meeting that requirement, thus eliminating some burden on manufacturers. The agencies require extensive paperwork for off-cycle technology certifications, as we learned in Phase 1 when we had to submit documents for upwards of a year for a technology that has proven extremely fuel-saving on the road and on our Super Truck vehicle; this burden could be reduced. In short, we would like to work with the EPA and NHTSA to get the agencies what they need while minimizing burden on us--as there is a long way to go. [EPA-HQ-OAR-2014-0827-1164-A1 p. 132-133]

**Response:**



The agencies have had extensive outreach with the manufacturers to understand their concerns and will continue to work to minimize burden while maintaining a robust compliance program. The agencies have also tailored aspects of the program to facilitate easier compliance demonstrations (e.g., use of GEM equation for trailer compliance; design standards for non-box and non-aero trailers; modification of proposed provisions related to delegated assembly). Concerns about the burden associated with specific aspects of the compliance program are addressed in earlier sections of this RTC.

**Organization:** Driversgripe.com

Hello, I currently run www.driversgripe.com and I understand that you are mandating trucking monitor devices in 2017 of January and want you to know this is an invasion of our privacy under the constitution and would like to say there is no proven facts of these devices working. Look at FedEx and other trucks that have the device and have a high rate of accidents There is nothing wrong with these devices being installed if a driver has multiple violations and allowed to remove them once there is no further violations but to force one to do so is not right according to the constitution and to all the good truck drivers that have no violations or have minor fractions Remember one thing without trucks you would not have your car, house, supply's to build highways, etc. It is not fair to publish all truck drivers to an negligence of a few [EPA-HQ-OAR-2014-0827-1758 p.1]

**Response:**

This rulemaking does not mandate the use of specific technologies (with the exception of design standards for certain limited types of trailers). Rather, the standards are performance based and allow manufacturers to choose the technology mix that most fits their customers' needs. With respect to "trucking monitoring devices" in particular, the agencies have included no such requirement in this rulemaking.

## 15.2 Comments on International Harmonization

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**Organization:** Daimler Trucks North America LLC

### 14. Alignment with Canada

**Alignment with Canada** - We applaud the agencies on working with the Environment Canada for a unified program. 80 FR 40150. The continuation of this strategy will continue the shared set of procedures and common model for demonstrating compliance and shared target for any vehicle category. Our concern from GHG Phase 1 still resonates in the fact that there is a different sales mix in the different countries, and with compliance based upon a manufacturer's sales mix, common numerical CO2 or fuel consumption targets would result in different levels of stringency in the two countries. As stated in Phase 1, the US agencies should work with Environment Canada to define achievable target penetrations of the various technologies that are appropriate for Canada and calculate the numerical targets based on these penetration rates. [EPA-HQ-OAR-2014-0827-1164-A1 p.133]As noted in the April 2015 white paper from the International Council on Clean Transportation, "Heavy-Duty Vehicle Fuel Efficiency Simulation: A Comparison of U.S. and EU Tools," a key area for harmonization is the alignment of test procedures to quantify a technology's performance or efficiency benefit. For example, it would be ideal to conduct a single axle-efficiency test to create an input map for both the U.S. and EU regulatory models. [EPA-HQ-OAR-2014-0827-1254-A1 p.2]

**Organization:** Meritor, Inc.

## Maintain Broad Regulatory Framework - Nationally and Internationally

Meritor supports the proposed nationwide regulatory framework as demonstrated in Phase 1 and proposed for Phase 2. We encourage the agencies to resolve any open issues with state regulatory bodies to ensure a unified, national regulation. As a global company, we also encourage the agencies to take a leadership role and collaborate internationally so that the final regulation may harmonize with global actions that are proposed or already completed. Addressing the global issue of reducing greenhouse gas on a state-by-state or a country-by-country level will contribute to proliferation which increases cost and requires that limited resources be dedicated to compliance rather than the pursuit of technologies that will further drive greenhouse gas reduction. Although we recognize the feasibility limitations of global regulatory standards, we encourage the agencies to continue efforts to commonize global regulation where possible. [EPA-HQ-OAR-2014-0827-1254-A1 p.2]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

Harmonization should be the driving goal of regulations like this – whether it is between the federal and state entities or between the U.S. and European Union – particularly for greenhouse gas (CO<sub>2</sub>) emissions, which are a global. While global harmonization is outside the scope of this particular proposed rule, MEMA reminds the agencies about the significant consequences resulting from multiple compliance regimes, testing protocols, conflicting and overlapping or competing regulations. For example, it is desirable that emerging European regulations be compatible with the testing procedures outlined in the proposal. Given that the developing state of EU regulatory processes may benefit from regulatory models and structure being promoted by the EPA and NHTSA, we urge the agencies to continue outreach to their EU counterparts about the U.S. procedures development and, to the extent possible, for the U.S. procedures to be mirrored in the European context. This would be especially important in areas like engine fuel maps, transmission representation and axle efficiencies. [EPA-HQ-OAR-2014-0827-1274-A1 p.3]

**Organization:** International Council on Clean Transportation (ICCT)

### International context

Finally, this rulemaking is key in establishing the U.S. as a global leader on freight truck efficiency. The governments of Canada, China, Europe, India, Japan, Mexico, and others are also considering their next policy actions to similarly ensure greater efficiency technology deployment for heavy-duty vehicles (Sharpe, 2015b; Kodjak, 2015). Assessment of technology potential across markets, as well as alignment opportunities for regulatory testing, modeling, and compliance and protocols are all important areas for international collaboration (see, e.g., Langer and Khan, 2013). We recommend that the agencies make a commitment within the rulemaking to collaborate with their counterparts around the world to ensure that the experiences are shared and leveraged, and the potential climate and energy benefits increased, from their respective heavy-duty vehicle rulemakings. [EPA-HQ-OAR-2014-0827-1180-A4 p.18]

### Response:

The agencies believe that the Phase 1 program, this Phase 2 rulemaking, and the many other actions called for in the President's 2013 Climate Action Plan are critical for supporting United States leadership to encourage other countries to also achieve meaningful GHG reductions and fuel conservation. In the development of the Phase 2 program, EPA and NHTSA staff also met with regulatory counterparts from several other nations who either have already or are considering establishing fuel consumption or GHG

requirements, including outreach with representatives from the governments of Canada, the European Commission, Japan, and China.

As noted in the Preamble (Section I), on March 13, 2013, Environment and Climate Change Canada (ECCC), which is EPA's Canadian counterpart, published its own regulations to control GHG emissions from heavy-duty vehicles and engines, beginning with MY 2014. These regulations are closely aligned with EPA's Phase 1 program to achieve a common set of North American standards. ECCC has expressed its intention to amend these regulations to further limit emissions of greenhouse gases from new on-road heavy-duty vehicles and their engines for post-2018 MYs. As with the development of the current regulations, ECCC is committed to continuing to work closely with EPA to maintain a common Canada–United States approach to regulating GHG emissions for post-2018 MY vehicles and engines. This approach will build on the long history of regulatory alignment between the two countries on vehicle emissions pursuant to the Canada–United States Air Quality Agreement.<sup>1</sup> In furtherance of this coordination, EPA participated in a workshop hosted by ECCC on March 3, 2016 to discuss Canada's Phase 2 program.<sup>2</sup> The Government of Canada, including ECCC and Transport Canada, has also been of great assistance during the development of this Phase 2 rule. In particular, the Government of Canada supported aerodynamic testing, and conducted chassis dynamometer emissions testing.

In a joint statement from the U.S. and Canada on March 10, 2016,<sup>3</sup> both nations committed to “work together and with other countries to encourage robust leader-level G-20 commitments to improve the environmental performance of heavy-duty vehicles, including through the implementation of stringent domestic regulations on fuel efficiency and/or greenhouse gas emissions, air pollutant emissions and low-sulfur fuels and green freight programs.”

<sup>1</sup> [http://www.ijc.org/en\\_/Air\\_Quality\\_\\_Agreement](http://www.ijc.org/en_/Air_Quality__Agreement)

<sup>2</sup> “Phase 2 of the Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations; Pre-Consultation Session,” March 3, 2016.

<sup>3</sup> U.S.-Canada Joint Statement on Climate, Energy, and Arctic Leadership. March 10, 2016.

<https://www.whitehouse.gov/the-press-office/2016/03/10/us-canada-joint-statement-climate-energy-and-arctic-leadership>

### **15.3 NAS Recommendations 1973**

**Organization:** American Iron and Steel Institute

In this regard, it should also be noted that the National Academy of Sciences Committee recommended that EPA and NHTSA develop a separate standard for natural gas vehicles and that the agencies assemble a best estimate of 'well-to-tank GHG emissions to be used for developing future rulemakings.' The Preamble indicates that the agencies are not developing such a standard primarily because the low market share of such vehicles means that imposing standards will have little impact on the overall GHG reductions from the program. The agencies take a similar position with respect to assessing the life cycle impact of electric vehicles.<sup>41</sup> While the agencies also cited uncertainty in methane estimates and leakage, they did not consider this uncertainty to be of such a degree as to prevent them from moving forward.<sup>42</sup> [EPA-HQ-OAR-2014-0827-1275-A1 p.13-14]

Since materials affect the construction of all vehicles, EPA and NHTSA cannot use the same rationale for its 'wait and see' approach to natural gas and electric vehicles. Utilizing a life cycle analysis of materials in this rulemaking would not suffer from most of the constraints that the agencies have identified for natural gas or zero-emission vehicles. Changes to materials would much more likely be made across

many different vehicles at the same time versus through the sale of individual alternatively fueled vehicles. [EPA-HQ-OAR-2014-0827-1275-A1 p.14]

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41 EPA also is proposing to maintain a zero emissions rate for electrically charged vehicles, even though upstream emissions will vary depending on electricity source. Id. at 40,331, 40,389. Again, however, a main part of the rationale for not imposing lifecycle standards in this rulemaking is not methodological but rather based on the agencies assessment of the very small market and emissions impact of these vehicles.

42 Instead, the agencies expressed a desire to take a holistic approach for incorporating well-to-tank emissions into future rulemakings. 80 Fed. Reg. at 40,516.

**Organization:** California Air Resources Board (CARB)

**Comment on Topic Where NPRM Requests Comment**

**Comment – Tire testing and the need for a reference machine for calibration of truck tire characterization equipment**

The NPRM proposes to carry over tire testing provisions adopted in International Organization for Standardization (ISO) 28580 for the Phase 1 program into Phase 2. CARB staff supports this proposal. [EPA-HQ-OAR-2014-0827-1265-A1 p.134]

The NPRM also requests comment on the need to develop a reference machine for calibration of truck tire characterization equipment, and on whether tire test facilities are interested in and willing to commit to developing a reference machine. CARB staff supports this effort to consider the need for a reference machine to ensure accurate correlations of coefficient of rolling resistance (Crr) measurements within the tire industry. CARB staff believes this effort is critical to ensuring reliable comparisons between tire models and manufacturers, and is pertinent to providing rolling resistance data to assist consumers in purchasing replacement tires with Crr levels equivalent to original equipment manufacturer (OEM) tires. [EPA-HQ-OAR-2014-0827-1265-A1 p.134-135]

One of the findings in the National Academy of Sciences (NAS) Committee on Technologies and Approaches for Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, Phase Two, interim report was that tire Crr measurements need to be precise, given the relatively modest fuel savings achieved with LRR tires. Further, while the ISO 28580 test procedure has received high grades from the tire industry, there is not yet a robust cross-correlation for machines used in commercial tire testing. Based on this finding, the NAS Committee recommended that NHTSA, supported by U.S. EPA, implement a mechanism for obtaining accurate tire rolling resistance data, including establishing a tire alignment laboratory and mandating the use of that laboratory.<sup>49</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.135]

Based on public comment during Phase 1 development and to address the NAS Committee's specific recommendation to establish a tire alignment laboratory, U.S. EPA and NHTSA evaluated test data from U.S. EPA's Phase 1 tire test program conducted at two independent tire test labs, Standards Testing Lab (STL) and Smithers-Rapra (Smithers), and concluded that any lab-to-lab variation between STL and Smithers has little effect on measured rolling resistance values.<sup>50</sup> As such, U.S. EPA and NHTSA consider STL or Smithers as acceptable for use as the reference test laboratory in correlating results of tire testing performed by vehicle manufacturers intended for use as GEM inputs. The Phase 2 proposal,

however, does not go so far as to require vehicle manufacturers to use a reference laboratory, and instead carries over the provisions from Phase 1 that allow vehicle manufacturers to also perform their own testing or obtain test results from the tire manufacturer or another third party. [EPA-HQ-OAR-2014-0827-1265-A1 p.135]

Given the proposal's lack of a provision mandating the use of a reference laboratory, CARB staff believes it is important that NHTSA and U.S. EPA work with the tire test industry in developing a reference machine. [EPA-HQ-OAR-2014-0827-1265-A1 p.135]

### **Oppose/Requested Change Comment**

#### **Comment – Develop rolling resistance performance standard for replacement tires**

The Phase 2 proposal continues the Phase 1 requirement for GEM inputs for steer tire and drive tire rolling resistance. As with the Phase 1 program, the Phase 2 proposal contains no mechanism to ensure that rolling resistance of replacement tires is the same as the OEM tires simulated during GEM vehicle certification, even though vehicle tires will likely be replaced at the discretion of the vehicle owner at multiple points over the actual lifetime mileage of the vehicle. For example, U.S. EPA and NHTSA estimate a tire replacement interval of about 200,000 miles for tractors (page 7-36 of the RIA). For a class 8 tractor, the regulatory useful life in regards to GHG emissions is 10 years/435,000 miles (page 40215 of the NPRM) but this mileage value is considerably less than the actual lifetime mileage for a class 8 truck. Without a mechanism to ensure replacement tires have Crr values equivalent to OEM tires, there is no assurance a vehicle will maintain its allowable GHG vehicle emission levels demonstrated through GEM. [EPA-HQ-OAR-2014-0827-1265-A1 p.136]

As such, CARB staff strongly supports the NAS Committee recommendation<sup>51</sup> for NHTSA, in coordination with U.S. EPA, to quantify the rolling resistance of new tires, especially those sold as replacements, and to adopt a regulation establishing a LRR performance standard for all new tires designed for tractors and trailers (if additional cost-effective fuel savings can be achieved), and encourages NHTSA to act as expeditiously as possible. [EPA-HQ-OAR-2014-0827-1265-A1 p.136]

### **Oppose/Requested Change Comment**

#### **Comment – Publication of tire Crr levels and development of tire Crr database**

The NPRM states that U.S. EPA and NHTSA are considering publishing Crr levels from GHG and fuel efficiency program compliance data (which is submitted by vehicle manufacturers, not by tire manufacturers), although the data could vary for a given tire model among vehicle manufacturer submissions or lag when tires are redesigned. CARB staff supports this as a first step in providing buyers information on Crr levels for the universe of tires utilized under the Phase 2 program in order to facilitate tire replacements with equivalent Crr levels. [EPA-HQ-OAR-2014-0827-1265-A1 p.137]

Nonetheless, U.S. EPA and NHTSA cite the data limitations described above as the rationale for not proposing to establish a public database containing heavy-duty vehicle tire LRR information at this time. While CARB staff acknowledges this concern, the NAS Committee recommends,<sup>52</sup> and CARB staff strongly encourages, that U.S. EPA and NHTSA develop a mechanism to maintain accurate information on LRR levels in a public database (or other web-based medium). Commercial tires are not sidewall labeled with Crr values, or another standardized metric, to assist truck owners in purchasing replacement tires with Crr values equivalent to the OEM tires, or to assist vehicle builders with tire selection based on their fuel savings benefits. The NPRM itself acknowledges the inability of vehicle buyers to obtain

reliable information on the fuel savings, reliability, and maintenance costs of technologies that improve fuel efficiency (page 40436 of the NPRM). For the near-term, CARB staff believes that a public database is necessary to provide truck owners and vehicle builders with access to accurate information on tire LRR and fuel savings benefits associated with Crr values. [EPA-HQ-OAR-2014-0827-1265-A1 p.137]

For the longer-term, CARB staff recommends that NHTSA coordinate with the tire industry to develop standardized sidewall labeling parameters that include Crr values, or other standardized accepted metrics for determining Crr values, and undertake a rulemaking to require such sidewall labeling. [EPA-HQ-OAR-2014-0827-1265-A1 p.137-138]

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<sup>49</sup> (NAS, 2014) The National Academies of Sciences, “Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase 2, First Report,” Washington, D.C. National Research Council, The National Academies Press, 2014.

<sup>50</sup> Summary of test results is described in U.S. EPA Heavy-Duty Tire Evaluation Memorandum by L. Joseph Bachman, July 18, 2011.

<sup>51</sup> (NAS, 2014) The National Academies of Sciences, “Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase 2, First Report,” Washington, D.C. National Research Council, The National Academies Press, 2014.

<sup>52</sup> (NAS, 2014) The National Academies of Sciences, “Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase 2, First Report,” Washington, D.C. National Research Council, The National Academies Press, 2014.

**Organization:** National Automobile Dealers Association (NADA)

## SECTION 102 OF EISA

NADA/ATD actively supported the 2007 enactment of Section 102 of EISA, which detailed a Congressionally-mandated national program for the first-time-ever regulation of commercial vehicle fuel efficiency.<sup>3</sup> As required by EISA, the National Academy of Sciences (NAS) completed its first study on this topic in March 2010.<sup>4</sup> The following year, a joint NHTSA/EPA Phase 1 rule was published, some 5 months before the statute’s 24 month deadline. The Phase 1 rule required manufacturers to begin compliance with EPA’s GHG mandates effective with model year (MY) 2014, but made NHTSA’s mandates “voluntary” until MY 2016. The Phase 1 mandates take full effect with MY 2018. [EPA-HQ-OAR-2014-0827-1309-A1 p.2]

NADA/ATD is fully supportive of continuous improvements in commercial truck FE/GHG performance. [EPA-HQ-OAR-2014-0827-1309-A1 p.2-3]

Consistent with that support is the fact that no variable cost is more critical to truck dealership customers than fuel, leading the overwhelming majority of customers to focus on fuel efficiency performance when ordering new commercial vehicles. NADA/ATD questions the need for a Phase 2 rule, except perhaps as a backstop to the mandates set out in the Phase 1 rule.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1309-A1 p.2-3] [[This comment can also be found in EPA-HQ-OAR-2014-0827-1372, p.70.]]

NADA/ATD believes that improvements in commercial truck, tractor and trailer FE/GHG should be market-based, not mandated by regulation. [EPA-HQ-OAR-2014-0827-1309-A1 p.2-3]

However, in February of 2014, the President called upon NHTSA and EPA to move forward with a Phase II rule. In April 2014, the NAS issued a second (interim) report outlining several recommendations addressing technical and policy matters to be considered in the context of a Phase 2 FE/GHG rule for commercial vehicles.<sup>7</sup> The Phase 2 proposal appears to reflect the consideration of many of those recommendations. What is less clear is the degree to which the Phase 2 proposal fully takes into account the key constraints identified by the NAS<sup>8</sup> and the statutory mandate that any FE/GHG rules be “appropriate, cost-effective and technologically feasible.” These critical constraints inherently reflect the reality that federal FE/GHG mandates only apply to the manufacture of new motor vehicles and engines and not to their purchase. Consequently, unless FE/GHG rules are “appropriate, cost-effective and technologically feasible,” prospective customers will avoid purchasing the new vehicles and engines they govern, electing instead to hold onto the used vehicles they own or lease, or turn to the used vehicle market. Either way, commercial truck dealerships lose potential new vehicle sales, with no benefit to the environment or to energy security. [EPA-HQ-OAR-2014-0827-1309-A1 p.3]

With its passage of EISA, Congress amended the Energy Policy and Conservation Act, which contains a clear-cut prohibition against the adoption or enforcement of state laws related to fuel economy.<sup>9</sup> Avoiding a patchwork of state laws in this area is critical to the for-hire carriers, private companies, public fleets, and individuals who operate trucks and tractors in every state in the nation. The final Phase 2 rule must acknowledge the critical importance of avoiding duplicative and non-identical state rules that could impose untenable burdens on dealerships, on new truck and engine manufacturers, and on prospective purchasers. Above all, the Phase 2 rule should constitute a single federal commercial vehicle FE/GHG program. [EPA-HQ-OAR-2014-0827-1309-A1 p.3]

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3 EISA requires that:

1. The National Academy of Sciences (NAS) conduct and publish a study of potential commercial vehicle fuel efficiency improvement strategies, and

2. NHTSA, in consultation with the Secretary of Energy (DOE) and EPA, examine the fuel efficiency of commercial medium- and heavy-duty on-highway vehicles and work trucks and determine:

(A) the appropriate test procedures and methodologies for measuring the fuel efficiency of such vehicles;

(B) the appropriate metric for measuring and expressing fuel efficiency performance, taking into consideration, among other things, the work performed by such vehicles and the types of operations in which they are used;

(C) the range of factors, including, without limitation, design, functionality, use, duty cycle, infrastructure, and total overall energy consumption and operating costs that affect the fuel efficiency of such vehicles; and

(D) such other factors and conditions that could have an impact on a program to improve the fuel efficiency of such vehicles.

3. Not later than 24 months after completion of the NAS study, NHTSA consult with DOE and EPA and determine by rulemaking how to implement a commercial medium- and heavy-duty on-highway vehicle and work truck fuel efficiency improvement program designed to achieve the maximum feasible improvement, and adopt and implement appropriate test methods, measurement metrics, fuel economy

standards, and compliance and enforcement protocols appropriate, cost-effective, and technologically feasible for such vehicles, prescribing as appropriate separate standards for different classes of vehicles. Such rules were to provide for not less than 4 full model years of regulatory lead-time and 3 full model years of regulatory stability.

49 USC '32902(k).

4 Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicle, (NAS, 2010).

6 Neither EISA nor the CAA mandates a Phase 2 rule (or any commercial truck GHG/FE program beyond Phase 1).

7 Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium and Heavy-Duty Vehicles, Phase Two, First Report, (NAS, 2014).

8 The NAS recognized the following constraints on commercial truck fuel efficiency and GHG reduction improvements: (a) holding life-cycle cost of technology change or technology addition to an acceptable level; (b) holding capital cost of acquiring required new technology to an acceptable level; (c) acknowledging the importance of employing a balance of energy resources that offers national security; (d) avoiding near-term, precipitous regulatory changes that are disruptive to commercial planning; (e) ensuring that the vehicles offered for sale remain suited to their intended purposes and meet user requirements; (f) ensuring that the process used to demonstrate compliance is accurate, efficient, and not excessively burdensome; and (g) not eroding control of criteria pollutants or unregulated species that may have health effects. Report at p. ix.

9 49 USC '32919.

**Organization:** National Waste & Recycle Association

The trucks used by our industry are in the “vocational vehicle” category in both the Phase 1 rule and the Phase 2 proposal. As they did with the Phase 1 proposal, EPA and NHTSA continue to ignore the advice of the National Academies of Science (NAS). In its study, “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-duty Vehicles” (2010), NAS highlighted the wide differences between different types of vocational vehicles. In the press release accompanying the release of the study, NAS pointed out that “NHTSA will need to establish standards tied to the task associated with a particular type of vehicle; garbage trucks might be held to a different standard than transit buses, for example.” The failure of the agencies to heed that advice and to instead lump all vocational vehicles together with only minimal differences in regulatory approach, results in a proposal that fails to recognize their differences and that will accomplish far less than an approach tailored to each different kind of vocational vehicle. [NHTSA-2014-0132-0071-A1 p.6][This comment can also be found in section 6.1 of this comment summary]

**Response:**

The NAS HD Phase 2 First Report contains more than 40 recommendations to the agencies. The agencies have carefully considered all of the Committee’s recommendations, and incorporated many of them in the Phase 2 standards. In some instances, the agencies have chosen a different course (with explanation) from the one charted by the NAS Committee’s recommendations. See Section XII of the NPRM for a detailed



discussion of these recommendations and the agencies' response to those recommendations (80 FR 40512).

#### *Life Cycle Emissions for Natural Gas Vehicles*

While AISI cited the NAS recommendation to estimate life cycle emissions from natural gas vehicles, AISI did not comment as to whether or not the agencies should follow that recommendation. Rather, its comments addressed life cycle emissions for material substitution. These were addressed in RTC Section 1.8 and also in section I.F of the Preamble to the final rule.

#### *Reference Test Lab for Tire Rolling Resistance*

CARB supported the NAS recommendation to establish a reference laboratory for tire rolling resistance. We largely share this goal, and expect to continue working toward it with industry and other interested stakeholders.

CARB also commented that Phase 2 “contains no mechanism to ensure that rolling resistance of replacement tires is the same as the OEM tires” and should adopt a performance standards for replacement tires. However, we did not propose such standards and consider them to be outside the scope of this current rulemaking. Additionally, we believe CARB overstates this concern. The regulations do include a regulatory prohibition against disabling emission controls including tire-related improvements.

Similarly CARB commented in support of standardized sidewall labeling for rolling resistance. However, that is also outside the scope of this rulemaking.

#### *Vocational Vehicle Segmentation*

NWRA commented that the agencies should have more closely followed the NAS recommendations related to vocational vehicle segmentation. They argued that the proposal “fails to recognize their differences and that will accomplish far less than an approach tailored to each different kind of vocational vehicle.” However, this position ignores the burden it would place on manufacturers to separately track vehicles by final application. The approach being finalized balances these competing interests by allowing manufacturers to select from a limited range of duty-cycles. This will allow vehicles to be evaluated similarly (although not identical) to how they are likely to be used.

## **15.4 Small Business Impacts 1979**

**Organization:** American Reliance Industries, Co. (ARI)

### **ARI's Procedures under Phase 1**

ARI has worked directly with EPA's designated compliance officer to ensure compliance with the procedural requirements relevant to ARI under Phase 1. ARI qualified for the small business exemption under 40 C.F.R. § 1037.150(c). ARI notified the designated compliance officer each model year prior to introducing any heavy duty vehicles for that model year into commerce that included cab sleeper modifications made by ARI. ARI places a permanent label on each heavy duty vehicle improved by ARI that states: “THIS VEHICLE IS EXCLUDED UNDER 40 CFR § 1037.150(c).” [EPA-HQ-OAR-2014-0827-1300-A1 p.2]

When qualifying for the small business exemption, ARI had to ensure that it qualified as a small business under 13 C.F.R. § 121.201. ARI operates in a unique niche market that is not properly reflected in NAICS Code system. There is not a NAICS Code that directly identifies ARI's line of business. ARI has been using NAICS Code 336120, Heavy Duty Truck Manufacturing, when qualifying for the small business exemption because this is the type of vehicle that it primarily improves. ARI has always fallen far below the threshold for qualifying as a small business under 13 C.F.R. § 121.201. ARI is also a very low volume producer in comparison to others who are more suitably designated under NAICS Code 336120, Heavy Duty Truck Manufacturing. [EPA-HQ-OAR-2014-0827-1300-A1 p.2]

### **Evaluation of the Phase 1 Small Business Exemption Impact by EPA and NHTSA**

The following statement was made by the agencies when assessing whether to include the small business exemption in Phase 1: "The proposed exemption from the standards established under this proposal would have a negligible impact on the GHG emissions and fuel consumption reductions otherwise due to the standards." Draft Reg. Impact Statement, EPA NHTSA (October 2010). [EPA-HQ-OAR-2014-0827-1300-A1 p.2]

#### *Alternative Options*

ARI believes that two simpler alternative methods exist for providing an exemption to small businesses that are second stage manufacturers performing cab sleeper modifications. EPA and NHTSA could select to carry over the small business exemption from Phase 1 and finalize it as a permanent flexibility. Alternatively, EPA and NHTSA could add a section comparable to the current 40 C.F.R. § 1037.150(c), but limited to small businesses that are second stage manufacturers performing cab sleeper modifications. Under either approach, ARI recognizes that EPA and NHTSA may want to have a notification requirement and a labeling requirement. ARI encourages the agencies to make any labeling requirement be added in addition to the original certification label. ARI also encourages the agencies to make any required label identify that "AFTER THE ORIGINAL CERTIFICATION OF THIS VEHICLE, A SMALL BUSINESS MADE CAB SLEEPER MODIFICATIONS WHICH ARE EXCLUDED UNDER 40 C.F.R. \_\_\_\_\_." ARI recognizes that under any approach, the term "cab sleeper modifications" may need to be defined in order to ensure that it includes the possibility of adding aerodynamic technologies as described above. ARI is interested in working with EPA and NHTSA to help develop a definition that is acceptable to the agencies and applicable to the industry. [EPA-HQ-OAR-2014-0827-1300-A1 p.5]

ARI requests that the agencies either carry over the small business exemption from Phase 1 or make a specific small business exemption for second stage manufacturers performing cab sleeper modifications. [EPA-HQ-OAR-2014-0827-1300-A1 p.7]

#### **Response:**

The agencies proposed and are finalizing provisions to include small business manufacturers in our Phase 2 program. It is not clear from the comment if ARI exclusively produces new custom sleeper tractors as a secondary manufacturer, or if they also provide glider kits or glider vehicles for customers that wish to use older engines in a new custom sleeper body. In either case, the agencies are adopting flexibilities for both glider manufacturers (40 CFR 1037.150(t) and 1037.635) and custom sleeper manufacturers (40 CFR 1037.150(r) and 1037.622).

Under our interim provision in 40 CFR 1037.150(t), glider manufacturers may produce up to 300 exempt vehicles per calendar year. Any production beyond 300 units would meet the requirements outlined in 40

CFR 1037.635, including use of an engine that meets GHG and criteria pollutant standards for the engine model year corresponding to the vehicle's date of manufacture.

We are adopting an interim provision in 40 CFR 1037.150(r) to allow small business secondary manufacturers to convert low- and mid-roof tractors to mid or high-roof configurations without recertification for the purpose of building a custom sleeper tractor. Also noted in 40 CFR 1037.622, small business custom sleeper manufacturers may modify complete or incomplete vehicles certified as tractors, as long as they do not modify the vehicle body in front of the b-pillar or increase the effective frontal area of the certified configuration, including consideration of the frontal area of the standard trailer. For high-roof tractors, this would generally mean the added sleeper compartment may not be more than 102 inches wide or 162 inches high (measured from the ground), which are the dimensions of the appropriate standard trailer under this part.

**Organization:** California Air Resources Board (CARB)

### **Comment on Topic Where NPRM Requests Comment**

#### **Comment – Small business impacts**

The NPRM requests comment on additional provisions for small businesses. In California, small businesses play an important role in the economic vitality of the state, representing 3.5 million businesses and 50 percent of the private-sector labor force. CARB staff supports additional research on the impact of the proposed rulemaking on small businesses, specifically in regards to potential impacts on employment. [EPA-HQ-OAR-2014-0827-1265-A1 p.187]

#### **Response:**

The agencies evaluated the potential economic impact of this rulemaking and do not believe it will have a significant economic impact on small businesses. We estimated the number of hours these rules will require from the individual sectors and the heavy-duty industry as a whole, but cannot distinguish if these additional hours would necessitate additional hiring, since it is possible that companies will assign current staff to fulfill their needs.

### **Requested Clarification**

#### **Comment – Small Manufacturer Provisions**

Small manufacturers were exempt from Phase 1 GHG rules, but must comply with Phase 2, under a delayed schedule. The small manufacturer delays apply to engine manufacturers (page 40161 of the NPRM), trailer manufacturers (page 40285 of the NPRM), and small engine converters (page 40545 of the NPRM). Alternate fuel engines, defined as those fueled with any fuel other than gasoline, E85, or diesel, have an additional year to comply with each new standard. CARB staff supports the inclusion of small manufacturers into Phase 2 of the GHG regulations. CARB staff recommends clarification on whether this alternate fuel delay noted in 40 CFR 1036.150 (d) and 86.1819 – 14 (j) (5) is in addition to the small manufacturer delay (resulting in a delay of up to 2 years for an alternative fuel engine manufactured by a small manufacturer), and whether the alternative fuel delay is available to manufacturers who are not small manufacturers. [EPA-HQ-OAR-2014-0827-1265-A1 p.191]

#### **Response:**

We have revised the regulation to clarify that the one-year delay applies only for small manufacturers, and that it is not a two-year delay for the initial round of Phase 2 standards.

**Organization:** CALSTART

Regulatory Flexibility for Small Manufacturers

Much of the innovation in idle reduction, electric drive, hybridization and even new novel engine and waste heat recovery systems is occurring among the supplier industry and small, innovative manufacturers. To encourage this innovation, it is very important to both find ways to include these innovators in the rule and to minimize the regulatory burden of involvement in the regulation. California has been grappling with this conundrum which it recognizes is creating a barrier to innovation at the time it most needs to encourage it. Indeed, the HD-OBD requirements, while understandable, did not provide any flexibility for low volume, low risk technologies to proceed – they faced the same burden as fully mature, high-volume approaches. It is certainly a key factor, among several, that stalled early hybrid technology. [EPA-HQ-OAR-2014-0827-1190-A1 p.8]

The California Air Resources Board (CARB) currently is redesigning a structure to try and better encourage the deployment of these advanced technologies under its Innovative Technology Regulation. The concurrent timing of the Phase 2 rules can provide an opportunity to work with CARB to harmonize the federal and California policy approaches around new concepts to minimize the regulatory burden on small manufacturers and provide clarity for future deployment. The California draft rule is envisioning a phased or stair-stepped, staged approach to regulatory compliance that is tied to production volume. In other words, it would possibly allow low volume, early stage technology to face a reduced regulatory and compliance burden than higher volume, mature technology. As the technology ramps up in market volume and penetration it would face increasing tiers of regulatory compliance, ending in full compliance. We can envision a productive use of this approach for advanced technologies and some off cycle technologies in Phase 2. [EPA-HQ-OAR-2014-0827-1190-A1 p.8]

Because the Phase 2 proposed regulations are forward-looking and provide significant lead-time, the rule should be designed in a way that captures all of the potential fuel consumption reduction technologies, including those of innovative secondary manufacturers. The Phase 1 standards allowed small, final stage or aftermarket technology providers to participate in the regulations only as certifying manufacturers. For many reasons, including the stringency and structure of the regulation as well as the disproportionate burden it would place on small-volume manufacturers, this has limited participation in the current regulations, meaning that the fuel consumption reductions currently achieved by end users of these systems are not reflected in the Phase 1 certified fleet. It is worth noting that the stringency levels of Phase 1 did not drive OEMs to seek such approaches or the reductions (or credits) they could provide. Phase 2 provides an opportunity to rectify this and encourage innovation across the certified vehicle fleet. [EPA-HQ-OAR-2014-0827-1190-A1 p.8]

**Response:**

The agencies provide a means to evaluate innovative technologies in our off-cycle provisions for Phase 2. See responses to comments on innovative and off-cycle technologies at Section 1.4.2. We also discuss some possible roles of secondary manufacturers in Section 1.4.4. A certificate holder should be an entity willing and able to be responsible for compliance for all aspects of the vehicle covered by the certificate. This is generally an engine or chassis manufacturer. Suppliers and other unregulated manufacturers are encouraged to work with OEMs to integrate their technologies.

**Organization:** Competitive Enterprise Institute et al.

The rule threatens the economic viability of small trucking firms, hundreds of which have gone out of business due to increasing regulatory costs. The proposal says not one word about the plight of small truckers or the greater relative burdens it will place on them. [EPA-HQ-OAR-2014-0827-1251-A2 p.1]

The rule threatens the economic viability of small trucking firms.

In scores of places, the rule acknowledges that regulations impose a greater relative burden on small firms than on large. Accordingly, pursuant to the Small Business Regulatory Enforcement Fairness Act (SBREFA), EPA convened a Small Business Advocacy Review (SBAR) Panel to consider “flexibility provisions . . . specific to small businesses.” However, in every instance, the entities in question are small manufacturers, not vehicle owners and operators. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

Specifically, the agencies propose regulatory flexibilities for manufacturers of box trailers, non-box trailers, non-highway trailers, alternative fuel converters, emergency vehicle chassis, custom chassis, off road vocational vehicle chassis, and gliders. Not once does the 627-page proposal mention small trucking firms. [EPA-HQ-OAR-2014-0827-1251-A2 p.2]

[Table XV-2, 'Primary Small Business Categories Potentially Affected by the Regulation', can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

We recognize that the rule’s requirements apply to manufacturers, not customers. Nonetheless, small business truckers are an important category of stakeholders. As a recent Wall Street Journal article observes, small operators “make up the vast majority of the roughly 470,000 for-hire fleets on the road today.” Indeed, companies “operating six or fewer trucks . . . make up 89% of all fleets.” Although large firms are increasing wages and hiring drivers, new regulations, “including rules capping emissions and limiting drivers’ hours on the road,” are making it harder for small firms to hire workers, raise wages, or even survive: [EPA-HQ-OAR-2014-0827-1251-A2 p.3]

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4 Loretta Chao, “Trucking Makes a Comeback, but Small Operators Miss Out: Their costs are rising, and new U.S. regulations add to their expense,” Wall Street Journal, September 23, 2015, <http://www.wsj.com/articles/truckingmakes-a-comeback-but-small-operators-miss-out-1443050680>

**Response:**

Our official analysis of small business impacts through our Small Business Regulatory Enforcement Fairness Act (SBREFA) obligations is limited to small entities that would be regulated under the proposed rulemaking (i.e., engine and vehicle manufacturers). We did not calculate the economic impact that other related small industries, including small trucking firms, may experience and are not required to do so. *Coalition for Responsible Regulation v. EPA*, 684 F. 3d 102, 129 (D.C. Cir. 2012). However, unlike many other regulations promulgated by the agencies, the technologies that provide the basis for these regulations will pay for themselves with use. Payback for the initial cost of technologies for these rules are an average of four years or less. These technologies are expected to increase the up-front cost of these regulated vehicles, which we recognize can be difficult to justify for small firms or individual owner-operators, but these customers are also likely to own their vehicles longer than larger firms.

OOIDA's example refers to owning a truck for 10 and 7 years, which would suggest that these technologies would conservatively provide three years of direct savings to the owner.

**Organization:** Autocar, LLC

Autocar submits this letter and comments to the Proposed Regulations (the "**Comments**") and respectfully requests that the Company not be subject to the Proposed Regulations for two reasons: [EPA-HQ-OAR-2014-0827-1233-A1 p.2]

First, Autocar's products are of a particular vehicle type (low-speed, frequent-stop, stationary-application trucks) that will not produce the environmental benefits intended by the proposed technologies, beyond the use of an emissions-compliant engine.[EPA-HQ-OAR-2014-0827-1233-A1 p.2]

Second, Autocar is a small business that should be exempt from Phase 2. In 2011, the agencies determined that its small size justified a deferral from compliance from the **Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 1** regulations ("**Phase 1**") for Autocar. The relevant facts remain the same, and Autocar's size, volume and product lines continue to justify an exemption or different standards for its vehicles.[EPA-HQ-OAR-2014-0827-1233-A1 p.2]

1.1 Autocar is a small business that has demonstrated leadership in the alternative fuel vocational truck market. Autocar has 293 employees<sup>1</sup> located in east central Indiana in Wayne County, at one plant in Hagerstown, Indiana (population 1,787), an area that historically has struggled during economic downturns. Autocar annually produces approximately 2,000 refuse truck chassis and 500 other trucks and chassis, marketed and sold under three product lines: (A) heavy heavy-duty class 8 vocational truck cab and chassis, primarily for use as refuse trucks; (B) heavy heavy-duty class 8 terminal tractors (yard hostlers); and (C) medium heavy-duty class 7 vocational truck chassis, primarily for use as street sweepers and refuse trucks. Unlike most other chassis makers, who design, stamp and fabricate many of their trucks' components, Autocar purchases parts, modules and components from its suppliers, and assembles its cabs and chassis. Autocar does not manufacture engines nor is it affiliated with any engine manufacturer. [EPA-HQ-OAR-2014-0827-1233-A1 p.6]

1.2 Autocar exemplifies the Federal Government's desire to safeguard competition in the specialty vehicle markets. Autocar not only supports sound GHG emissions and fuel efficiency standards policy, but is also aligned with the Federal Government's efforts to promote competition in the specialty vehicle markets. As the longest-standing continuous truck brand in the United States, Autocar was at risk of being eliminated when its then-owner, AB Volvo, acquired another heavy-duty Class 8 low cab over engine ("LCOE") chassis manufacturer, Mack Trucks, Inc., in 2000. The United States Department of Justice ("DOJ") (under Presidents Clinton and Bush), concerned with the potential effects of reduced competition in the refuse market, and finding there was no reasonable substitute for a heavy LCOE chassis, ordered Volvo to divest itself of one of its LCOE lines (U.S. v. AKTIEBOLAGET VOLVO, et al., Competitive Impact Statement, February 7, 2001, and Final Judgment, entered April 30, 2001). [EPA-HQ-OAR-2014-0827-1233-A1 p.7]

As a result, Volvo sold the assets of the Autocar division to Autocar's current owner, and Autocar built a factory, hired employees, secured suppliers and began production in Hagerstown in 2003. Autocar would not exist as an independent small business had the Federal Government not taken steps to preserve it, and Autocar's existence has, in fact, generated the pro-competitive effects the Department of Justice sought. The agencies should not now undermine the DOJ's efforts at promoting competition by implementing requirements that would threaten Autocar's continued viability. [EPA-HQ-OAR-2014-0827-1233-A1 p.7]

## **As a Small Business, Autocar Should be Exempt from the Phase 2 Regulations.**

3.1 Autocar was exempt from Phase 1 as a small business, and compliance with Phase 2 would be unsustainable. As noted above, Autocar is a small, privately owned assembler. Autocar already has a high concentration of its employees working in product development and dedicated to continuous product improvement in the areas of safe operation, cost and fuel economy. Allocation of resources is a delicate balance when the Company has only 293 workers, and Autocar cannot reasonably locate, recruit, retain and pay for additional personnel and other resources to work toward achieving the standards required under the Proposed Regulations (Appendix A addresses development work that Autocar would need to complete if it is not exempt). [EPA-HQ-OAR-2014-0827-1233-A1 p.9]

Autocar does not build or install its own engines, but works closely with powertrain makers to find ways to achieve fuel efficiencies and lower emissions on Autocar's vehicles. The Company's success depends on delivering these improvements year after year. [EPA-HQ-OAR-2014-0827-1233-A1 p.9-10]

The agencies recognized these facts when they exempted Autocar from the Phase 1. Autocar did not use its exemption to shirk environmental responsibility, but instead continued to drive improved emissions through increased penetration of CNG and hybrid-powered trucks in its industry segments.<sup>6</sup> Through delegated assembly, all Autocar vehicles are compliant with the latest emission standards. [EPA-HQ-OAR-2014-0827-1233-A1 p.10]

Autocar assembles trucks that move through the air slowly and perform significant functions while stopped. If Autocar is required to apply the technologies suggested in the Proposed Regulations, the agencies' desired environmental benefits would not be achieved on these mostly low-speed trucks, and Autocar resources would be diverted from work on accepted, proven-effective alternative fuel vehicles useful for Autocar's trucks' applications. [EPA-HQ-OAR-2014-0827-1233-A1 p.10]

3.2 Autocar's vehicles are highly customized and are sold in a fixed-size market, making additional regulatory compliance unduly burdensome on this small business. Autocar's customers require customized products. Because each neighborhood in America demands a differently-configured truck to collect its trash and sweep its streets, Autocar's business model is to assemble high-quality chassis with customized specifications and components specifically suited to each truck ordered by its customers. Autocar's customers include municipalities such as the City of Charlotte and the City of San Antonio, private and public waste haulers, airports and construction companies, and Autocar's small size enables it to work very closely within this narrow set of vocations. [EPA-HQ-OAR-2014-0827-1233-A1 p.10]

For the last 10 years, the American annual market segment size for refuse trucks and street sweepers has consistently remained less than 6,000 units, requiring Autocar to operate leanly and efficiently. The Company minimizes research and development costs by sourcing adaptable, off-the-shelf components whenever possible. We integrate, rather than manufacture in the typical fashion. For these reasons, the burden of compliance with the Proposed Regulations poses a unique threat to Autocar's ability to continue its business. [EPA-HQ-OAR-2014-0827-1233-A1 p.10]

3.3 Unlike a large, diverse, vertically-integrated manufacturer, a small business such as Autocar cannot reasonably absorb new regulatory development and compliance cost. Without continuing the small business deferral that EPA and NHTSA provided in Phase 1, manufacturers meeting Small Business Administration size criteria (see Note 1 above) would be forced to raise prices of their products. Small businesses cannot adequately realize the advantages of averaging and spreading costs afforded large manufacturers; without an exemption, the compliance burden would be disproportionately high. In fact, even with the compliance deferral granted in Phase 1, a number of the small businesses the agencies

exempted were sold, bankrupt or dissolved in the four years since. [EPA-HQ-OAR-2014-0827-1233-A1 p.11]

Moreover, small businesses exempted from Phase 1 have not, and cannot, reasonably marshal the resources necessary for compliance, including engineers experienced with GEM testing and personnel dedicated to maintaining records and executing the processes necessary to obtain EPA and NHTSA certification (see the chart below presented by EPA in 2012 to summarize the substantial work needed to certify).<sup>7</sup> Notwithstanding the burden, Autocar would be at a distinct disadvantage in attracting and affording such talent now. Even if a small business could build such a compliance organization, it could not reasonably match such costs with benefits, because as the agencies themselves noted, “[A]veraging is not of practical value as a compliance flexibility” for manufacturers offering a narrow range of products, and such manufacturers do not have “large sales volumes over which to distribute technology development costs.” 80 Fed. Reg. at 40,294. Exempting small businesses would be consistent with the Small Business Advocacy Review Panel’s recommendations. [EPA-HQ-OAR-2014-0827-1233-A1 p.11]

[Graphic, Steps in EPA/NHTSA Certification Process, can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1233-A1]

3.4 Exempting small manufacturers would support other small businesses and preserve competition that benefits customers. In support of the agencies’ examination of the effect of their regulations on small businesses, Autocar notes that, should it be forced to comply with the Proposed Regulations, other small businesses, including the small governmental entities the agencies specifically identified as being potentially impacted (80 Fed. Reg. at 40,542-40,543), would similarly suffer negative downstream effects. [EPA-HQ-OAR-2014-0827-1233-A1 p.12]

Without the benefit of compliance flexibilities and without an exemption, Autocar and other small manufacturers—and their customers—would face potential disruption to their businesses due to production delays, lost sales, upfront cost increases and increased maintenance costs. Increased costs of ownership would negatively impact customers’ payback analysis, causing them to use existing vehicles longer, and delay the purchase of new equipment, due to higher acquisition and maintenance costs. Many of these customers are other small businesses (for example, municipalities and independent “mom-and-pop” waste management companies) that would be negatively impacted by such additional costs and market disruptions. And if Autocar was forced from the marketplace, customers would have fewer companies competing for their business, which would otherwise support lower prices and improved product features, in contravention of the DOJ’s objectives. [EPA-HQ-OAR-2014-0827-1233-A1 p.12]

Additionally, many body builders that install important vocational equipment onto Autocar’s cabs and chassis are small businesses (as the agencies specifically noted at 80 Fed. Reg. 40,286) and these firms are able to sell more of their products when they have several viable chassis makers participating in their market. [EPA-HQ-OAR-2014-0827-1233-A1 p.12]

Autocar is a small company with small volumes in niche markets. The unsustainable and disproportionate efforts that would be required for Autocar to achieve compliance with the Proposed Regulations would yield only minimal impact on the reduction of GHG emissions. If given the ability to continue to pursue other proven and accepted environmentally-friendly technologies such as CNG and hybrid drive, Autocar, and likely other small players, have a chance to generate more than a small impact on GHG emissions. [EPA-HQ-OAR-2014-0827-1233-A1 p.16-17]

Autocar requests that the final rules reflect an exemption for small business manufacturers or an exemption for low-speed and stationary or high-frequency-stop vocational vehicles. Alternatively, but



with caution, Autocar supports modified standards and simplified compliance for small custom chassis manufacturers of low-speed and stationary or high-frequency-stop vocational vehicles. [EPA-HQ-OAR-2014-0827-1233-A1 p.17]

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6 In its comments on the Phase 1 proposed regulations, Volvo argued that a small business exemption would incentivize big companies to divest themselves of small truck making divisions with the hope of creating exempt entities, and would discourage body builders from doing business with non-exempt entities such as Volvo. See Comments of the Volvo Group on the proposed rule, Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 74 FR 74152 (November 30, 2010) dated January 31, 2010. To Autocar's knowledge, none of Volvo's concerns materialized as a result of the Phase 1 small business deferral – market shares were not directly affected; body builders did not change their product mix or their business relationships with chassis manufacturers; large manufacturers did not restructure their business units to get around the regulations (nor could they effectively, under the SBA criteria).

7 Source: Greenhouse Gas (GHG) Emission Requirements For Vocational Vehicles: Materials For Heavy-Duty Chassis Manufacturers, United States Environmental Protection Agency, August 2012, <http://www3.epa.gov/otaq/climate/documents/vocational-only-presentation.pdf>.

**Organization:** Autocar, LLC

### **3. Autocar is Small and will be Adversely Affected by the Compliance Scheme Proposed in the EPA's Vocational Custom Chassis Memorandum.**

3.1 Autocar was Exempt from Phase 1 Compliance. When the agencies exempted Autocar from compliance with Phase 1,<sup>12</sup> they recognized its small size and production volume compared to its competitors.<sup>13</sup> As a result, Autocar was exempt from a compliance structure that would otherwise have involved the use of full GEM and whole-vehicle certification and compliance (with LRR tires being the only required technology). What is being considered now for Phase 2 compliance would thrust Autocar into the realm not only of GEM, but of two levels of GEM. Compliance would require Autocar to rely on third parties to invent and supply technologies, some of which do not currently exist, and some which will not be effective for the industry segments in which Autocar participates. The negative impact of the regulations on Autocar will be enormous, and the positive impact on GHG emissions, through the regulation of Autocar's 2,500 trucks per year, will be miniscule. If the agencies adopt the compliance scheme suggested in the Memorandum, Autocar will have approximately 18 months to source, integrate, market and certify new technologies, through full GEM for some of its chassis applications and Simplified GEM for its refuse chassis. To proceed as suggested by the Memorandum would force an unanticipated, costly and unnecessary compliance pathway on Autocar. [EPA-HQ-OAR-2014-0827-1885-A1 p.9]

3.2 Small Manufacturers Face Multiple Threats to Survival. Small manufacturers in the United States face daunting challenges to stay in business and are declining in number.<sup>14</sup> In fact, many of the small businesses exempted in Phase 1 no longer operate independently, having either filed for bankruptcy or been absorbed by larger companies (see Figure 2 on the following page). While capitalizing on the benefits of being small, such as agility and staying close to customers, when compared to their giant competitors with deep resources, small businesses in the motor vehicle industries struggle more, with employee turnover, recruiting, financing, leverage with suppliers and access to new technology. The threat that these challenges post to the survival of small businesses is the reason the agencies are required

to make accommodations for small businesses in rulemaking under the Regulatory Flexibility Act.<sup>15</sup> The agencies have failed under SBREFA to provide adequate consideration to small business concerns, specifically by failing to subcategorize for custom chassis makers, especially for refuse and other specialty applications. [EPA-HQ-OAR-2014-0827-1885-A1 p.9-10]

[Figure 2 can be found on p.10 of docket number EPA-HQ-OAR-2014-0827-1885-A1]

3.3 The Small Business Advocacy Review Panel Specifically Recognized the Potential Impact on Manufacturers like Autocar and Recommended an Exemption, but the agencies are Taking a Different Approach. In its Final Report on the Proposed Regulations' impact on small businesses, the Small Business Advocacy Review Panel (the 'Panel') recommended 'proposing a low volume exemption based on the volume of sales' for vocational custom chassis manufacturers like Autocar.<sup>16</sup> Although the agencies followed the Panel's recommendation in requesting comment on this topic in the Proposed Regulations, the next official communications from the agencies were the Memorandum, which made no mention of a small volume exemption, and the NODA, which stated that Phase 2 would build on Phase 1 by 'including vehicles produced by small business manufacturers.'<sup>17</sup> The agencies have neglected their obligation to minimize the regulations' impact on small businesses. And if the agencies are not inclined to use the size of a vehicle manufacturer's business as grounds for exemption, then a more appropriate factor in determining the exemption is low volume, as recommended by the Panel.<sup>18</sup> [EPA-HQ-OAR-2014-0827-1885-A1 p.10-11]

3.4 The Impact of the Regulations Will Be Disproportionate. The compliance requirements proposed in the Memorandum will impose burdens disproportionately high for a company such as Autocar that assembles small volumes of customized chassis and no other product lines, limiting both the ability to benefit from averaging, as well as the ability to spread development and compliance costs across many vehicles. Autocar's development and compliance costs will be concentrated across its current volume of 2,500 vehicles annually, while Autocar's competitors will spread those costs across tens of thousands of vehicles.<sup>19</sup> Autocar's competitors have had the opportunity to build internal GEM compliance teams, while Autocar is just now getting its first exposure to the model.<sup>20</sup> And with vertical integration and massive purchasing power, the competition will gain additional advantage over their Indiana rivals, as illustrated in Figure 3. [EPA-HQ-OAR-2014-0827-1885-A1 p.11]

[Figure 3 can be found on p.12 of docket number EPA-HQ-OAR-2014-0827-1885-A1]

3.5 Some Small Businesses Received Greater Flexibilities. In the Memorandum, EPA exempted manufacturers of emergency vehicles and cement mixers from compliance with Phase 2, requiring only that they install LRR tires on their vehicles. Manufacturers of recreational vehicles also have a lesser compliance burden than other vocational vehicle types. Neither the Memorandum nor the documents included in the NODA explain why emergency vehicles, cement mixers and recreational vehicles should be exempt, but not refuse vehicles. Moreover, Autocar and other small volume manufacturers assemble custom chassis in other heavy-duty vocational applications that are not addressed in the Memorandum, such as conventional (non-cab-over-engine) refuse trucks, concrete pumpers, street sweepers, tank trunks and sewer cleaners. Without explanation, these similar applications have been excluded from the proposed Simplified compliance scheme, and presumably require full GEM certification. This bifurcated approach will further unnecessarily burden small businesses. [EPA-HQ-OAR-2014-0827-1885-A1 p.12][This comment can also be found in section 6.2 of this comment summary]

3.7 Phase 2 May Put Autocar Out of Business or Cause it to Exit Certain Product Lines. Autocar is not equipped to handle the design, implementation, procurement, sales and marketing obligations that will be necessary for compliance with Phase 2, and it cannot bear the increased cost of these obligations and still

continue to operate its business as it does today. If certain product lines are subject to full GEM, those product lines may have to be discontinued, stressing Autocar further. The agencies must not restrain trade by eliminating competition through regulation. Autocar already competes with some of the largest manufacturers in the world. Regulatory actions that favor large competitors by allowing them to average, bank and trade credits - advantages of which Autocar cannot avail itself - and favor large competitors by distressing their small competitors, are inappropriate and unfair. As discussed in detail in Autocar's October 1, 2015 Comments, Autocar would not exist as an independent small business had the Federal Government not taken steps to preserve it, and Autocar's existence has, in fact, generated the pro-competitive effects the Department of Justice sought. The agencies should not now undermine the Department of Justice's efforts at promoting competition by implementing requirements that would threaten Autocar's continued viability. [EPA-HQ-OAR-2014-0827-1885-A1 p.13]

## 5. Conclusion

Fifteen years ago, at the request of the Department of Justice, the management and owners of Autocar chose to hire 200 people and start a small business in Hagerstown, Indiana, in an industry where its competitors employ hundreds of thousands of people all over the world. Frankly, we wouldn't have it any other way. But after all the hard work put into Autocar to make it competitive, the agencies must not inject Autocar into a regulatory scheme designed for companies that can 'average, bank and trade' and 'spread compliance cost over multiple vehicle types.' These are concepts that exclude small business by their very nature. The agencies are required to provide flexibilities to accommodate small business, and the only flexibility that will be effective for Phase 2, like Phase 1, is a small business or low volume exemption. Autocar outlined the suggested parameters of these exemptions in its October 1, 2015 comments, and reiterates its request that such an exemption be included in the final Phase 2 rule. [EPA-HQ-OAR-2014-0827-1885-A1 p.13]

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12 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase I, 76 Fed. Reg. 51788 (Sept. 15, 2011).

13 See Figure 3 for details.

14 Bureau of Labor Statistics, Business Employment Dynamics, Business Establishment Age and Survival Data, Manufacturing, March 2015, <http://www.bls.gov/bdm/bdimage.htm#MANUFACTURING>.

15 5 U.S.C. 601-612, as strengthened by the Small Business Regulatory Enforcement Fairness Act of 1996 ('SBREFA'), Pub. L. N. 114-121, Title II, 110 Stat. 847, 857-74.

16 Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule, Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles: Phase 2, at 42 (Jan. 15, 2015).

17 81 Fed. Reg. at 10825

18 Any number of methods could be used to determine which manufacturers should be exempt per the SBREFA Panel's recommendation. Autocar previously proposed and continues to support a 5,000-vehicle limitation on the number of vehicles that a small chassis manufacturer may produce under an exemption annually, consistent with the small-volume vehicle manufacturer exemption for NHTSA's TREAD reporting.

19 Autocar is interested in pursuing ways to offset these development costs, such as taking advantage of any incentives or development funding that the agencies could offer, or perhaps purchasing environmental credits from outside of the medium- and heavy-duty engine and vehicle industries if the agencies would allow.

20 After learning of EPA's proposed approach in the Memorandum, Autocar contacted several consulting firms as well as other vehicle manufacturers to attempt to retain a GEM consultant, to assist in understanding and potentially implementing the GEM compliance model. Most manufacturers have had in-house GEM experts since Phase 1 and could not provide GEM simulation services. One outside consultant Autocar located charges \$145 per hour for Phase 1 services and has yet to work with Phase 2 GEM.

**Response:**

Small businesses producing heavy-duty vehicles are not subject to Phase 1 heavy-duty GHG and fuel consumption standards because of a deferral, not a permanent exemption. Before proposing regulations that would apply to small businesses in Phase 2, we conducted an official analysis of small business impacts under the Small Business Regulatory Enforcement Fairness Act (SBREFA). In response to the recommendations of the SBREFA panel as well as public comments, the agencies are adopting provisions that will reduce the compliance burden for small businesses. Primarily, we are including a one-year delay in implementation for all small businesses that will allow them additional time to become familiar with the compliance process, address staffing concerns, and evaluate technologies.

In the vocational vehicle sector, the agencies have identified nearly 40 chassis manufacturers likely to be subject to the Phase 2 standards, where nearly half of them are small businesses based on number of employees. In consideration of current market dynamics where many of these small businesses compete directly with large diversified manufacturers, as well as comments stating it would be unfair to make less stringent standards available solely on the basis of sales volume, the agencies are not finalizing a broad sales volume threshold below which a vocational chassis manufacturer would have a different set of requirements. See discussion in Section 6.4 of this RTC.

We are adopting a custom chassis program where eligibility is not limited to small entities. Manufacturers will have the option to designate the following applications as custom chassis: coach (intercity) bus, motor home, school bus, transit bus, refuse truck, cement mixer and emergency vehicle. See Section 6.2.3 for responses to other comments on the custom chassis program. Chassis so designated may be certified with a default engine map and other default parameters so that manufacturers choosing this option will have fewer technologies to evaluate, and will have unique standards for each vehicle type that reflect use of appropriate technologies. Further, the agencies are adopting a non-GEM design standard option for motor home, cement mixer, and emergency vehicle chassis, because we have determined these vehicles to have the least number of feasible technologies that can be applied in Phase 2. As discussed in Section 6.4.1, we were unable to identify other custom chassis technology packages that we believed could be applied at a 100% adoption rate; thus, averaging (and use of GEM) was deemed necessary for other vehicles. Cement mixers have been determined by the agencies to essentially need only apply low rolling resistance tires, certified engines, and low leakage air conditioning systems (i.e. the final optional standard is predicated on performance of only these technologies). Where a manufacturer of these vehicles is able to apply the same technology on all of its production without averaging, we offer the non-GEM option as a compliance flexibility to avoid the certification burden associated with running GEM.

In response to comments, we are also revising some of the low-speed and off-road vehicle exemptions that are carrying forward from Phase 1. See Section 6.4.2 for responses to these comments, including some revisions in Phase 2 that may provide a pathway for a reduced certification burden for some of commenter's other products.

In part to address the commenter's concern about large companies having a business advantage over small, non-diversified businesses, the agencies are adopting a more restricted approach to averaging, banking and trading (ABT) for custom chassis, allowing averaging within each subcategory, but no banking or trading for vehicles certified to the optional standards, except that small businesses may use traded credits to comply with the optional custom chassis standards. This recognizes that small businesses may have fewer opportunities than large companies to over-comply with the final standards. If a manufacturer wishes to generate tradeable credits from sales of these vehicles, one or more families may be certified to the primary vocational vehicle standards.

**Organization:** Innovus Enterprise LLC

Innovus Enterprise, LLC is a certified Service-Disabled Veteran-Owned Small Business. We have been working for over two years preparing to participate in a niche US truck market with new medium-heavy-duty diesel engines in our class 6, 7 and 8 high-mobility specialized vehicles. During this time-frame, we have made visits with the EPA diesel engine certification officials in Washington DC and in Ann Arbor, MI. We are a registered manufacturer in the Verify database and have submitted our letter of intent to certify this new engine family. We have had numerous conference calls with EPA officials concerning certification and continue to converse in order to identify potential options for our small volume/small business. Our anticipated US sales for year-1 are in a low two-digit figure and forecasted to grow at approximately 15% year-on-year. An exceptionally high volume of sales for our business would be in a low three-digit figure. [EPA-HQ-OAR-2014-0827-1116-A1 p.2]

Our business operating model is strong. However, relative to industry standards and market realities, we are without question an ultra-low volume producer. From a quantity of sales perspective, we are not organized nor have the capability to disrupt this heavy-duty market segment; and this is not our intention. Additionally, we understand and respect the tough mandate given to our government agencies with respect to mobile source pollution control and fuel efficiency. We accept the challenge to be part of the solution to help achieve our national GHG program goals. [EPA-HQ-OAR-2014-0827-1116-A1 p.2]

We have analyzed our system, emissions and performance data. From an engineer's standpoint, we have a very high degree of confidence, using quantitative data, our products emissions and fuel performance characteristics will fall within allowable emissions tolerances and positively influence the GHG mandate albeit so small and within the realm of a small business environment. That said, we now face a tremendous hurdle; NHTSA and EPA certification. [EPA-HQ-OAR-2014-0827-1116-A1 p.2]

The current and projected costs (technical, legal, accounting and consulting) we will burden to obtain and hold NHTSA/EPA/CARB certificates for our products are enormous given our small scale business model. The cost of certification is a defining moment for our business. If we are not afforded relief with some form of certification flexibility (possibly using regulatory alternatives) we will in all probability not be able to continue our business in this industry. [EPA-HQ-OAR-2014-0827-1116-A1 p.2]

We find our options extremely limited as we seek to justify this certification burden or soundly amortize it over our low volume of vehicle sales per year. Most certainly, large diesel engine and truck manufacturers in this same industry are fortunate to spread these certification and compliance costs out over the tens of thousands of units they sell; and they most often have dedicated staff to manage the

process. From our position, it really is a disproportionate compliance burden for us. Being a small business and understanding there are provisions for such situations, we would like to suggest some potential regulatory alternatives. These alternatives will achieve the agency's goals while minimizing the burden on small businesses who participate in this industry sector or who would like to enter it. Before we begin with our suggestions and comments, we need to first talk about some of our vehicle/engine characteristics and other defining factors that make our situation a special case. [EPA-HQ-OAR-2014-0827-1116-A1 p.2-3]

**Technology, Characteristics and Operating Parameters:** Our vehicles are high mobility and compact multi-role class 6, 7 and 8 platforms which are often re-configured with a variety of heavy-duty work implements depending on the season and required function. The vehicles are designed for extreme terrain operations in all seasons performing a variety of highly specialized work tasks. The vehicle's MHDD engine is equipped with the latest emissions control technology and is not only for propulsion but to simultaneously power the various vocational attachments and implements by utilizing the unit's various power systems (24V electrics, multi-circuit hydraulics, multi-range/multi-speed PTO's). The vehicle's chassis and body are engineered to quickly accommodate a variety of these remove-and-replace implements to perform various functions on a day-to-day basis depending on situation or role. [EPA-HQ-OAR-2014-0827-1116-A1 p.3]

Our vehicles have special engineering and costly components for high mobility, off-road use and cross functionality. These features add great expense to the vehicle and its flexibility but consequently render it undesirable and impractical for general transportation use. Some of the vehicle's technological features include: [EPA-HQ-OAR-2014-0827-1116-A1 p.3]

- *Portal axles with hub reduction gears/planetary reduction axles:* Exceptional high ground clearance; reduced axle torque; maximum power to drive system.
- *Permanent all-wheel drive/4-mode differential locks:* Superior off-road traction and mobility in austere conditions.
- *Multiple crawler/working gear configurations with constant speed engine control;* electronic quick reverse; opt hydrostatic drive: Operation on difficult terrain; drive high-power implements; continual operation under steady engine speed settings.
- *Extreme high angles of approach/departure:* Off-road operations with steep incline/declines as well as obstacle avoidance.
- *High break-over and tipping angles:* Essential for safely navigating off-road/mountainous terrain.
- *Single wheel/aggressive tread lug tires:* Maximum traction as the rear wheels run in the tracks of the front wheels.
- *Central Tire Pressure Control System:* Cockpit selected increase/decrease depending on surface conditions (mud, sand, snow, gravel) and weight load.
- *Fording ability:* Safe design/protected components; up to 47 inches; for operations in flood waters. [EPA-HQ-OAR-2014-0827-1116-A1 p.3]

Our vehicles have a multitude of functional capabilities and set up for quick interchange of implements. Some examples: In summer, the vehicle could be configured for fighting wild fires, controlling large

swaths of vegetation, or forestry work; in fall for high-pressure water/rotary brush tunnel and industrial cleaning; in winter for extreme snow cutting/blowing, clearing a mountain pass or plowing; in spring for agricultural tasks; flood water response or possibly a hazardous spill response in a remote location. Customers often use our vehicles with many other attachable implements such as a heavy duty knuckle-boom crane, PTO driven compressor or electric generator/welder, excavating or drilling equipment, road improvement/grader, or a boom bucket for utility companies needing to reach elevated work in remote locations. [EPA-HQ-OAR-2014-0827-1116-A1 p.3-4]

*Comment to the Small Business Advocacy Review Panel:* It appears the panel did not have opportunity, or possibly did not see the need to evaluate the Proposed Amendments Related to Heavy-Duty Highway Engines and Vehicles - Alternate Emission Standards for Specialty Heavy-Duty Vehicles, introduced on page 40522. As a small business producing ultra-low volumes of heavy-duty diesel engines, gaining an EPA and CARB certificate of conformity is our most challenging task. Indicative of small business, we are always thinking of ways to do things more efficiently and effectively. [EPA-HQ-OAR-2014-0827-1116-A1 p.5]

President Obama has stated on numerous occasions that the goals and standards of the US and EU vehicle emissions programs are near identical and that our pollution/pollutant standards are relatively the same. He states: There is no reason we should not have mutual recognition of vehicle emission standards. Hearing President Obama makes us think; why can't we use the ECE-EURO VI certification data, to which we have access, to help achieve certification here in the US? We are certain we are not the only small business trying to find ways to overcome the huge financial and logistical burden for certifying engines and vehicle OBD systems. [EPA-HQ-OAR-2014-0827-1116-A1 p.5]

As such, we propose to open a roundtable discussion, maybe just within the realm of your board experts or maybe you have suggestions or contacts for us. The discussion would be; can quantitative data from like emission systems and testing regimens be used along with engineering design to make high reliability predictions for performance in other regimens. For example, if we have an EURO VI HDD OBD certified system with all certification and testing parameters documented by a third party certification official, why could we not use this to reduce the OBD testing burden for US small business trying to get EPA and CARB certificates? Of course the systems are not mirror image and approving officials need to think somewhat outside the box. The overall objective of the program and its goals should be at the forefront. [EPA-HQ-OAR-2014-0827-1116-A1 p.5-6]

*Additional Comments:* On page 40295, there is a discussion about chassis manufacturers, small volume manufacturers and small businesses and a request for comments on alternate approach and sales volume threshold. We can say this: There is often a convolution of the terms "small volume" and "small entity." There are cases where a large manufacturer, with resources normally far exceeding that of the small business, is as a small volume producer, offered flexibility on compliance issues. We are of the opinion that only small volume producers who also qualify as a small entity be the thrust for regulatory flexibility. [EPA-HQ-OAR-2014-0827-1116-A1 p.7][This comment can also be found in section 6.4 of this comment summary]

A request for comment was posed asking for a means to determine what would constitute the correct quantity that amounts to "small volume." We suggest using a formula based on a percentage of market sales in that particular industry; industry being the particular one that a certificate is sought. Actually, it seems the same question is posed every time small volume flexibility is posed - what is the correct or fair quantity? We have developed such a formula and parameters for a program which could apply to all small volume conditions throughout the CAA program. We can share this with the Agency and further discuss

if they are interested. [EPA-HQ-OAR-2014-0827-1116-A1 p.7][This comment can also be found in section 6.4 of this comment summary]

On page 40545, paragraph (x) Custom Chassis Manufacturers, a request is made for suggestions as to a low volume exception. We are fully supportive of this exemption for small entity/small volume custom chassis manufacturers. We feel that a volume of 200 vehicles per year could be adequate since it is consistent with the other like categories. Additionally, we think there could also be some qualifying factor such as: The exemption is warranted when the feasibility to employ fuel saving and emission reduction technologies are beyond the capability of the small entity to reasonably engineer. Or, the vehicles operate in a manner essentially making them incompatible with fuel saving and emission reduction technologies. The recordkeeping, reporting and labeling could follow along the line of that in 1037.631. [EPA-HQ-OAR-2014-0827-1116-A1 p.7][This comment can also be found in section 6.4 of this comment summary]

Comment to the Small Business Advocacy Review Panel: On page 42 of your Final Report dated January 15, 2015 for this proposed rule, in reference to the 9.5.3.2 Off-Road Vocational Vehicle it states: “The Panel believes this exemption is sufficient to cover the small business chassis manufacturers who design chassis for off-road vocational vehicles.” As §1037.631 is currently proposed, our small business and our off-road vocational vehicles would not necessarily be exempted unless our suggestion is accepted (see suggestion above). It is very hard to imagine our purposely engineered high mobility/off road vocational vehicles not fitting this term. Then again, maybe there is a means for our situation to fall within the custom chassis realm. Of course we continue to advocate for remaining within the spirit and intent of the exemption along with the flexibilities often afforded small entities. [EPA-HQ-OAR-2014-0827-1116-A1 p.7-8]

Comment to the Small Business Advocacy Review Panel: On page 15 of your Final Report for this GHG ruling dated January 15, 2015, you mention in reference to OBD; “Small businesses in particular, who don’t have a direct connection with the large manufacturers, will have a difficult time writing new algorithms without access to the diagnostics from the OEM.” You go on to present issues and potential solutions. In 40 CFR 86.094-14, 86.095-14, or 86.098-14, Small-volume manufacturer’s certification procedures, there is a compilation of flexibilities and standards required for SVM certification but exclude any mention of -17 or -18 OBD requirements. [EPA-HQ-OAR-2014-0827-1116-A1 p.8-9]

Having researched EPA’s promulgation of heavy-duty OBD, there appears to be no discussion as to small entity impact assessment or Regulatory Flexibility Analysis with the exception in the justification statement that the rule was not going to impact small entities only large manufacturers. We know this is not the case and therefore... **Our suggestion:** Move to include the -17/-18 OBD requirement to the listing of applicable certification standards along with the other requirements in the -14. At least then maybe there can be a proper discussion as to how small entities are impacted by this requirement and if there are any means for flexible alternatives. [EPA-HQ-OAR-2014-0827-1116-A1 p.9]

**Response:**

Innovus raised a variety of substantive and procedural concerns about the current rulemaking as it relates to policy development and their ability to meet the range of requirements that apply now and in the future. We believe we have included provisions in the final rule that effectively address all these concerns. Most noteworthy is the provisions allowing manufacturers of specialty heavy-duty vehicles to use engines certified to alternative highway standards that are based on nonroad certification requirements. This applies for annual production volumes of up to 200 vehicles, including a specific allowance for applying those provisions to the all-terrain vehicles that Innovus produces. This allows for substantially simplified



OBD requirements and a much wider selection of candidate engines. The specialty vehicle provisions are described in detail in Section 14.3.1.

The procedural concerns are secondary to the substantive items addressed above, but these points also warrant mention:

- We have clarified the small-business provisions in § 86.094-14 to clarify that there is no blanket exemption from OBD requirements for small manufacturers. We believe this is more appropriately addressed based on the technology limitations of the vehicle applications than on the type of company making the engine. Moreover, since the OBD requirements apply to engine manufacturers, it would be impractical to create an exemption from OBD requirements for engines installed by small vehicle manufacturers.
- The regulations include several allowances to use test data from procedures other than those we specify (see 40 CFR 14065.10(c)). These variances are all premised on the expectation that manufacturers may use measurement procedures that are equivalent to or better than the specified procedures, or that they may measure emissions in a way that better represents in-use operation. Test data measured using current European testing and certification procedures would not be useful for demonstrating compliance with EPA standards. We believe the more effective way to address this concern is to adopt standards and measurement procedures based on EPA's nonroad programs. This approach allows vehicle manufacturers to get past the particularly limiting aspects of the heavy-duty highway engine standards.
- The provisions of § 1037.605 and 1037.631 are not limited to small manufacturers, so using these provisions does not depend on meeting some specified criteria.
- other companies as part of the rulemaking process. We believe the final rule properly balances environmental concerns with the technical and financial limitations described in the comments.

**Organization:** Motiv Power Systems

One further method to encourage small, innovative manufacturers is to reduce the regulatory burden, especially when those companies focus on zero-emission technology. [EPA-HQ-OAR-2014-0827-1184-A1 p.2]

For small, innovative manufacturers, it is very important to minimize the regulatory burden of any regulation. As a small company, we focus on technology first – and without clear regulations that can be easily complied with, regulations that serve a wonderful end goal can be cumbersome. California has been a leader in hybrid and electric vehicle deployment to-date as part of the state's commitment to a low-carbon future—the California Air Resources Board (CARB) currently encourages the deployment of these advanced technologies under its Innovative Technology Regulation. As a partner with the EPA and NHTSA under the Clean Air Act, the agencies should work closely with CARB to harmonize the federal and California policies as much as possible to minimize regulatory burden on small manufacturers and provide clarity for future deployment. The success in California has allowed small companies such as Motiv to bring products to market that reduce vehicle emissions, and we strongly support using this model at a national level. [EPA-HQ-OAR-2014-0827-1184-A1 p.2]

**Response:**

The agencies are continuing in Phase 2 the simplified compliance strategy for manufacturers of zero-emission vehicles that is currently in place for Phase 1. They are not required to use our GEM vehicle simulation tool. Instead, they simply submit a report describing their technology, their sales and other relevant information to EPA for compliance. Hybrid systems will require some additional compliance steps (e.g., a powertrain test) to evaluate the performance. The comments related to OBD are addressed in our responses in Section 14.3.3. Note that vehicles that qualify for our alternate engine standards for specialty heavy-duty vehicles have alternate diagnostic requirements. California's authority under the CAA differs from EPA, and EPA cannot always align national standards with requirements in California.

**Organization:** National Propane Gas Association (NPGA)

### **Definition of Small Manufacturers**

We request that the agencies revise the proposed definition for 'small manufacturer' to avoid inconsistency based on engine type. The agencies define 'small manufacturer' according to the code of the North American Industry Classification System (NAICS) with distinctions for manufacturers of vehicles versus alternative fuel businesses that perform engine conversion.<sup>28</sup> The result of the proposed definition is separate classes of small manufacturers that are measured by different criteria.<sup>29</sup> We ask the agencies to apply the same definition of 'small manufacturer' that the agencies implemented in the Final Rule for Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, which is a company with 1,000 or fewer employees.<sup>30</sup> We believe that extension of the same definition from light-duty through heavy-duty vehicle regulations provides consistency and clarity that is valuable for businesses. Additionally, the same definition irrespective of the type of engine permits businesses to diversify engine production without regulatory confusion. [EPA-HQ-OAR-2014-0827-1272-A1 p.4]

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28 Supra note 6, at 40563.

29 Id. For example, the NAICS code defines small manufacturers of gasoline engines according to the number of employees, whereas small manufacturer businesses that convert engines are defined by revenue. See U.S. Small Business Administration, Table of Small Business Size Standards Matched to North American Industry Classification System Codes (2014), at 18; see also id. at 38.

30 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 199, at 62797 (finalized October 15, 2012) (to be codified at 40 C.F.R. 85, 86, 600, 49 C.F.R. 523, 531, 533, 536, 537).

### **Response:**

Our industry-specific definitions of small entity are based on the definitions recommended by the Small Business Administration (SBA), who is represented in our Small Business Advocacy Review Panel. Production volume is not consistently proportional to the number of employees for vehicle and engine manufacturers in the heavy-duty industry and the agencies cannot apply a universal threshold to diverse

sectors. We are adopting the SBA small business thresholds updated in February 2014 for our final small business flexibilities.<sup>272</sup>

### 3 Small Business Categories Potentially Affected by this Regulation

| Industry Expected in Rulemaking          | NAICS Code | NAICS Description                            | SBA Size Threshold (less than or Equal to) |
|--|------------|--|--|
| HD Pick-up Trucks & Vans                 | 336111     | Automobile Manufacturing                     | 1,500 employees                            |
| Vocational Chassis, Class 7 & 8 Tractors | 336120     | Heavy-Duty Truck Manufacturing               | 1,500 employees                            |
| Trailers                                 | 336212     | Truck Trailer Manufacturing                  | 1,000 employees                            |
| HD Spark-Ignition Engines                | 336310     | Motor Vehicle Gasoline Engine & Engine Parts | 1,000 employees                            |
| HD Compression-Ignition Engines          | 333618     | Other Engine Equipment Manufacturing         | 1,500 employees                            |

**Organization:** NGVAmerica

#### Small Manufacturer Definition

The EPA regulation of small businesses refers to 13 CFR 121.201. This is spelled out in section 1036.150 (d) of the EPA regulations. That section also provides, with respect to 13 CFR 112.201, the following: “NAICS code 336310 for engine manufacturers with respect to gasoline-fueled engines, 333618 for engine manufacturers with respect to other engines, and 811198 with respect to fuel conversions with engines manufactured by a different company.” Unfortunately this means that very different rules apply to gasoline engines, diesel engines and alternative fuel conversions. For gasoline engine manufactures, a small business is a company that has 750 or fewer employees, for manufacturers of other engines (presumably including diesel engines and new natural gas engines) it is 1,000 or fewer employees, and for conversions of engines manufactured by a different company the cutoff is based on revenues of \$7.5 million or less. [EPA-HQ-OAR-2014-0827-1270-A1 p.6-7]

We do not believe that there is ample justification for establishing different treatment of businesses that produce gasoline, diesel or natural gas engines. The rules obviously make it more difficult for alternative fuel converters to take advantage of the small business exemption, which we do not believe is intended or rational. We would recommend that the defining criteria for alternative fuel conversion manufacturers be 1,000 or fewer employees and note that this is the figure used for exempting small businesses from EPA rules for light and medium duty greenhouse gas regulations.<sup>1</sup> For consistency, rules for the light, medium and heavy duty conversions should use the same figure. [EPA-HQ-OAR-2014-0827-1270-A1 p.7]

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1 See <http://www3.epa.gov/otaq/consumer/fuels/altfuels/documents/420f12056.pdf>;

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<sup>272</sup> Small Business Size Standards for Manufacturing. Small Business Administration. Docket ID: SBA-2014-0011. Available online at: <https://www.regulations.gov/docket?D=SBA-2014-0011>.

**Response:**

The agencies defer to the Small Business Administration (SBA) for appropriate business sizes for small entity classification. See 3 above reproduced in our response to the National Propane Gas Association. The employee thresholds have been updated to reflect SBA's updated criteria as of February 2016. We have removed reference to alternative fuel converters, because the agencies did not establish standards for converted in-use engines in Phase 2. Instead, these businesses must meet tampering provisions outlined by EPA and we do not provide any small business flexibilities exclusively for converters in this rulemaking. The agencies did establish standards for CI and SI engines. Any small businesses (according to SBA's criteria) that manufacture CI or SI engines are eligible for a 1-year delay at the beginning of the program. Small businesses that manufacturer alternative fuel engines, including secondary manufacturers that modify CI or SI engines to run on alternative fuels *before they enter into commerce*, are eligible for an additional 1-year delay for each increase in stringency. See Section 12 for additional information about applying GHG-related requirements for aftermarket conversions.

**Organization:** Newell Coach Corporation

Although we were exempt from the Phase 1 GHG requirements (because we qualified for the small business exemption that was included in the rule), we use and will continue to use components that reduce GHG emissions, including lower GHG-emitting engines and low rolling resistance tires. Thus, despite being exempt, our vehicles achieve the GHG reductions mandated by the Phase I regulations. [EPA-HQ-OAR-2014-0827-1319-A1 p.1]

As is the case today, we will receive lower GHG-emitting engines and tires regardless of requirements placed upon us. Thus, requiring very small companies like ours to actually 'certify' compliance using the GEM model will yield no environmental benefit. It will only add unnecessary costs and increase the work load on Newell's small staff and EPA's. [EPA-HQ-OAR-2014-0827-1319-A1 p.1-2]

Given the above, wWe respectfully request an extension of the current SBA exception for small manufacturers. In our view, a continuation of the current exemption for small businesses, if not for all small businesses then at least for motorhome chassis, would be the simplest solution for small companies like ours, and for EPA. However, if the EPA should conclude that a continuation of the SBA exemption for motorhome chassis manufacturers is not appropriate, we believe that companies who annually manufacture 500 or fewer Class 8 - HHD motorhome chassis should be provided the opportunity to certify their chassis to a less stringent standard (similar to that which has been proposed for emergency vehicles). [EPA-HQ-OAR-2014-0827-1319-A1 p.2]

**Response:**

Small businesses producing heavy-duty vehicles are not subject to Phase 1 heavy-duty GHG and fuel consumption standards because of a deferral, not a permanent exemption. Before proposing regulations that would apply to small businesses in Phase 2, we conducted an official analysis of small business impacts under the Small Business Regulatory Enforcement Fairness Act (SBREFA). In response to the recommendations of the SBREFA panel as well as public comments, the agencies are adopting provisions that will reduce the compliance burden for small businesses. Primarily, we are including a one-year delay in implementation for all small businesses that will allow them additional time to become familiar with the compliance process, address staffing concerns, and evaluate technologies.

In consideration of current market dynamics where many small businesses compete directly with large diversified manufacturers, as well as comments stating it would be unfair to make less stringent

standards available solely on the basis of sales volume, the agencies are not finalizing a broad sales volume threshold below which a vocational chassis manufacturer would have a different set of requirements. See discussion in Section 6.4 of this RTC.

Based on public comment and extensive stakeholder outreach, the agencies have identified over a dozen chassis manufacturers serving the U.S. vocational market who produce a narrow spectrum of vehicles for which many technologies underlying the primary standards will either be less effective than projected, or are infeasible. We are adopting optional custom chassis standards for these manufacturers, including significant flexibility for motor homes. Manufacturers will have the option to designate the following applications as custom chassis vehicles: coach (intercity) bus, motor home (the type of chassis produced by the commenter), school bus, transit bus, refuse truck, cement mixer and emergency vehicle. See Section 6.2.3 for responses to other comments on the custom chassis program. Chassis so designated may be certified with a default engine map and other default parameters so that manufacturers choosing this option will have fewer technologies to evaluate, and will have unique standards for each vehicle type that reflect use of appropriate technologies.

Further, the agencies are adopting a non-GEM design standard option for motor homes, cement mixers, and emergency vehicle chassis, because we have determined that these vehicles have the least number of feasible technologies that can be applied in Phase 2. Motor homes, for example, have been determined by the agencies to essentially need only apply low rolling resistance tires, certified engines, low leakage air conditioning systems, and tire pressure systems. Where a manufacturer of these vehicles is able to apply the same technology on all of its production without averaging, we offer the non-GEM option as a compliance flexibility to avoid the certification burden associated with running GEM. As discussed in Section 6.4.1, we were unable to identify other custom chassis technology packages that we believed could be applied at a 100% adoption rate; thus, averaging (and use of GEM) was deemed necessary for other vehicles.

We are not restricting the optional custom chassis program to small businesses. Because we are allowing diversified manufacturers to certify some vehicles to the optional custom chassis standards, but some large manufacturers may not have a system for tracking what the final build of a vehicle is, we are adopting compliance procedures to assure that the final intended build will be one of the defined vehicle types. This approach is intended to level the playing field by allowing large manufacturers to choose this option where their tracking (and/or controls imposed on the vehicle) is sufficient to know at the time of certification what the final build will be.

**Organization:** XL Specialized Trailers

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 205.]

As a small business entity, XL Specialized Trailers must consider the potential burden imposed on us by the proposed regulations. Additional pre-production reporting, new compliance and equipment labeling, government mandated warranty requirements not normally seen in this industry, user manual equipment requirements, compliance submissions and record keeping, will create additional burdens to an already cost sensitive industry. As the proposed regulations are presented, this burden will exist whether a company produces a fee regulated product or many.

**Response:**

The final trailer program significantly reduces the number of regulated trailers by limiting the non-box trailer program to tanks, flatbeds and container chassis only, which removes more than 80 trailer manufactures (73 that qualify as small businesses) from the program. The compliance burden on the remaining non-box trailer manufacturers is limited to evaluating and marketing appropriate LRR tires and tire inflation systems, installing a label to indicate that the trailers have these technologies installed, and reporting the use of those technologies to EPA. The annual economic burden of this compliance process is estimated to be less than \$20,000 per manufacturer. We have provided a memo to the docket outlining the compliance burden estimated for small manufacturers.

## 15.5 Public Participation

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**Organization:** Allison Transmission, Inc.

In the four years since the Environmental Protection Agency (“EPA”) and the National Highway Traffic Safety Administration (“NHTSA”) finalized the Phase 1 standards for model years (“MYs”) 2014-2018, Allison has met several times with both agencies concerning the development of the Proposed Rule. Allison also collaborated on testing conducted on transmissions in preparation for the Proposed Rule and has sought to continue a productive dialogue with both agencies on the GHG and fuel efficiency effects of various transmission systems. [EPA-HQ-OAR-2014-0827-1284-A1 p.1]

Since the development of the Phase 1 rule, Allison has worked cooperatively with EPA and NHTSA on the development of a Phase 2 rulemaking for MD/HD engines and vehicles. As indicated at the beginning of these comments, we have been pleased at the receptiveness of the agencies to consider technical input and to undertake additional testing and evaluation of different transmission architectures in support this rulemaking effort. Provided that both agencies act on the basis of verifiable data as well as in accordance with their legal authority, Allison supports the goal of making additional progress in reducing GHGs and improving the fuel efficiency of MD/HD vehicles. Such progress would inure to the benefit of both our customers and the environment. [EPA-HQ-OAR-2014-0827-1284-A1 p.64]

At the same time, EPA and NHTSA must realize that there are legal and practical constraints that prevent the finalization of standards more stringent than Alternative 3. In addition, our comments have pointed out several flaws in the record for this rulemaking with regard to technology penetration rates, cost estimates, various aspects of GEM and the crediting of transmission technologies. Allison has also offered several recommendations for GEM improvements, expansion of off-cycle programs and hybrid vehicles. In particular, EPA and NHTSA must assure that any final rule accurately assess and account for the GHG and fuel efficiency benefits of ATs versus other transmissions, including benefits that accrue with respect to how the operation of the transmission, engine and vehicle is controlled. [EPA-HQ-OAR-2014-0827-1284-A1 p.64]

EPA and NHTSA must work to resolve these and other concerns prior to promulgation of a final rule, allowing for additional public input where needed. This rulemaking will serve to define how different engines, transmissions and vehicles are assessed for compliance with new GHG and fuel efficiency regulatory standards that extend well into the next decade. Thus, accurate information and supporting analysis is essential and we look forward to continued engagement with the agencies. [EPA-HQ-OAR-2014-0827-1284-A1 p.64]

During the public hearing the agencies held in Chicago on August 6, 2015, Allison outlined several deficiencies in the Greenhouse Gas Emission Model (“GEM”) as it existed at the time of the proposed Phase 2 Rule. These deficiencies ranged from relatively small issues, like coding errors, to larger issues with respect to how GEM reflected the operation of automatic transmission systems. Given the vital

importance of the GEM to the final rule, we recommended that EPA and NHTSA either extend the period for public comment, reopen the public comment period at a future date, or explore other options, including the issuance of a Notice of Data Availability (“NODA”). [EPA-HQ-OAR-2014-0827-1892-A1 p.1]

**Organization:** American Automotive Policy Council

AAPC looks forward to continuing its cooperative efforts with the agencies to develop harmonized nationwide fuel consumption and greenhouse gas regulations for the 2019-27 model years that enable motor vehicle manufacturers to build a single fleet of vehicles in these classes capable of complying with all regulations. [EPA-HQ-OAR-2014-0827-1898-A1 p.3]

**Organization:** American Bus Association (ABA)

The American Bus Association (ABA) respectfully requests an extension of the time period for filing comments to the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 proposed rule (GHG-2) issued jointly by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation’s National Highway Traffic Safety Administration (DOT/NHTSA), [Docket ID Nos. EPA-HQ-OAR-2014-0827 and NHTSA-2014-0132—Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2]. ABA requests a 120-day extension to file comments, based on the following: 1) the length and complexity of the rule proposal; 2) the limited resources the Motorcoach industry has at its disposal to analyze the proposal; and 3) the failure of the agencies to engage with motorcoach manufacturers or the motorcoach industry, in any meaningful way, even after an explicit request by ABA to meet, prior to publication of the proposal in August 2015. [EPA-HQ-OAR-2014-0827-1139-A1 p.1]

### **1. Length and Complexity of Proposal.**

The GHG-2 proposal, as published in the Federal Register is over 600 pages long, not including NHTSA’s Environmental Impact Statement (EIS). The original public comment period provided for this proposal was 60 days, which has since been extended for another 20 days. It involves highly technical expertise and resources to interpret the proposal, not readily available to small industries such as the motorcoach industry. [EPA-HQ-OAR-2014-0827-1139-A1 p.2]

In comparison, the two federal agencies involved in this proposal have employed dedicated teams, including numerous economists, scientists, engineers and others, to work on this proposal over the span of at least the past 6 years, including the time spent on the Phase 1 proposal from which this proposal evolved. It is simply unreasonable for these federal agencies to expect those businesses affected by the rule to be in a position of providing thoughtful and functional comments on an extremely complex proposal within this short of time period, particularly if these businesses have not been involved in prior discussions or regulated by previous regulatory proposals of the same nature. [EPA-HQ-OAR-2014-0827-1139-A1 p.2]

Further, significant rulemaking proposals of this nature, especially involving this level of complexity and length, and affecting such a broad swath of industries, at a minimum provide a 120-day comment period. It is beyond reason that EPA and NHTSA would make such a complex proposal as the GHG-2, with an initial comment period of only 60 days. [EPA-HQ-OAR-2014-0827-1139-A1 p.2]

If not provided adequate time during the comment period, as originally proposed, agencies often receive and grant requests for extensions as we have already seen requested in this case. This is done in recognition and interest by the agencies, in order to ensure proper input as intended under the Administrative Procedures Act (APA) and full participation of the community affected. It is reasonable under the APA, considering the nature, length, magnitude, and scope of this rule to allow for 120 days to enable all affected interests of this proposal to properly consider it and provide thoughtful comments. Even if the original proposed period was only 60 days, it is not unusual or unreasonable for agencies to grant extensions well beyond the original proposal. [EPA-HQ-OAR-2014-0827-1139-A1 p.2]

## **2. Motorcoach Industry Resources**

The motorcoach industry is a relatively small industry, in terms of the entire transportation sector industry (can we provide a general figure on that annual income of the industry). It is not heavily subsidized in any significant scale by the Federal Government. Of the approximately 3,400 motorcoach companies<sup>1</sup> currently in operation in the U.S., operating nearly 32,000 motorcoaches, over 90% are small fleets or operating 10 vehicles or less. In addition, while there are 4 major motorcoach vehicle manufacturers who serve the private U.S. motorcoach industry, all but one of these manufacturers are foreign companies, who have not been eligible to participate in the previous “credit” programs provided under Phase 1 and continued under the Phase 2 proposal. Indeed, the motorcoach industry is the “small business” model for the transportation sector – no other transportation mode, aside from automobiles, can compare in terms of the dollar investment for providing a transportation service. This can be both a blessing as well as a curse, however, as demonstrated by this rulemaking. [EPA-HQ-OAR-2014-0827-1139-A1 p.3]

As previously mentioned, this lengthy rule proposal is both complex and a relatively new subject for the motorcoach industry. It requires resources and time to properly analyze the proposal and provide any meaningful comments to the agencies. Such resources are in limited supply to the motorcoach industry for this purpose, and the short comment period designated by the agencies only exacerbates this problem. If it is truly EPA and NHTSA’s goal to continue to “work collaboratively with stakeholders,” as the GHG-2 proposal repeatedly states, then the agencies should extend the comment period to accommodate the needs of smaller businesses and businesses who do not have the relative expertise or familiarity with the issues addressed in the proposal. [EPA-HQ-OAR-2014-0827-1139-A1 p.3]

## **3. Stakeholder Outreach.**

The Preamble of the GHG-2 proposal includes numerous statements on how EPA and NHTSA have “worked with industry” and had “robust collaboration with stakeholders” in preparing not only this proposal, but previous proposals to address greenhouse gas emissions and fuel efficiency. In fact, the Preamble references specifically: the public, heavy-duty vehicle and engine manufacturers, technology suppliers, trucking fleets, truck drivers dealerships, environmental organizations, and state agencies. Noticeably missing from this list are motorcoach or bus manufacturers, motorcoach or bus operators, or motorcoach or bus drivers. [EPA-HQ-OAR-2014-0827-1139-A1 p.3]

However, in anticipation of this rulemaking ABA initiated outreach to its members and specifically requested a meeting with NHTSA on the parameters and information gathering used in the formulating of this proposal. Our request was denied. Nonetheless, we have continued to reach out to ABA members, in an effort to conduct some form of analysis; however, we need more time. The feedback that we have received to date is very limited due to the length and complexity of the rule proposal. [EPA-HQ-OAR-2014-0827-1139-A1 p.4]



The motorcoach industry has a strong record on gas emissions and fuel efficiency. In a study that compared emissions and fuel efficiency by mode, “motorcoaches on average used the least amount of energy and produce the lowest carbon dioxide emissions per passenger mile of any of the transportation modes analyzed.”<sup>2</sup> [EPA-HQ-OAR-2014-0827-1139-A1 p.4]

Based on the motorcoach industry’s vitality to the national transportation network and its contribution to promoting fuel efficient and environmentally friendly transportation options, we believe the motorcoach industry should be permitted the opportunity to provide thoughtful and meaningful input to this rulemaking. In light of little to no “stakeholder outreach” by the EPA and/or NHTSA to the motorcoach industry, along with the denial of ABA’s request to meet prior to the publication of the rule proposal, ABA believes an extension of the comment period is warranted. [EPA-HQ-OAR-2014-0827-1139-A1 p.4]

Based on the three reasons outlined above, ABA respectfully requests EPA and NHTSA to extend the comment period for the GHG-2 proposal for an additional 120 days.

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1 Motorcoach Industry Census 2014, A Study of the Size and Activity of the Motorcoach Industry in the United States and Canada in 2013; John Dunham & Associates, 2014. Available at: <http://www.buses.org/files/Foundation/Census2013data.pdf>

2 Updated Comparison of Energy Use &CO2 Emissions From Different Transportation Modes; MJ Bradley & Associates, 2014. Available at: <http://www.buses.org/files/green.pdf>

**Organization:** American Trucking Associations (ATA)

The American Trucking Associations (ATA) is hereby requesting a time extension of 90-days beyond the September 17, 2015 comment period deadline on the EPA and NHTSA Proposed Rule: Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles - Phase 2 (Phase 2). The magnitude of this rulemaking, both in terms of cost and uncertainty to trucking fleets for decades to come, does not warrant setting artificial and expedited timelines that are neither required by legislation nor legally mandated by the courts. While ATA supports the aims under the Phase 2 Rule, the trucking industry wants to ensure that the final rule is affordable and technologically practical to fleets, manufacturers, and suppliers alike. [EPA-HQ-OAR-2014-0827-0923-A1 p.1]

While a few select stakeholders have established teams to read and analyze the Proposed Rule and the thousands of pages of technical support documents and complex modelling formulations, few throughout the industry have been able to fully review and evaluate how Phase 2 will impact their operations and business plans. This especially holds true for most trucking fleets. ATA and other impacted stakeholders are currently dialoguing, conducting surveys, and gathering data to further assess and develop a sound and achievable regulation that will not result in market disruptions or unattainable goals. [EPA-HQ-OAR-2014-0827-0923-A1 p.2]

Given that fuel is one of the top operating expenses for trucking companies, ATA supports the aims of improving fuel efficiency and reducing the industry’s carbon footprint. However, ATA and its diverse membership seeks additional time to complete its reading to fully understanding this extremely complex and far-reaching rule which will directly impact and transform fleet operations for decades to come. Moving ahead, ATA looks forward to continued cooperative efforts with both EPA and NHTSA in crafting a rule that is both technologically and economically achievable. Thank you for your consideration of this time extension request. [EPA-HQ-OAR-2014-0827-0923-A1 p.2]

**Organization:** Autocar, LLC

Autocar is a small volume manufacturer, and is not subject to existing greenhouse gas standards pursuant to 40 C.F.R. § 1037.150(c). Under the recent proposal, small manufacturers such as Autocar would be newly subject to greenhouse gas emissions standards. Autocar therefore needs ample time to thoroughly review, analyze, understand and respond to the sizable and complex proposal and supporting documents. Although Autocar has begun this process, the 60-day comment period (now extended by six days) is simply inadequate to fully accomplish the task. [EPA-HQ-OAR-2014-0827-0761-A1 p.1]

Autocar respectfully requests that EPA and NHTSA extend the comment deadline for the Phase 2 proposal by a minimum of 90 days, and preferably six months. This extension will allow entities such as Autocar that would be newly subject to the regulations the opportunity to fully consider, and provide informed comment on, the proposal. [EPA-HQ-OAR-2014-0827-0761-A1 p.1]

On behalf of our client Autocar, LLC and Autocar Industries, LLC (“Autocar”), we respectfully request that the Environmental Protection Agency (“EPA”) and the Department of Transportation (“DOT”) extend the comment period for the proposed Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 (“Phase 2 rulemaking”). Autocar also requests that the agencies formally provide an opportunity for public comment on an important document placed in the public docket for this rulemaking. [EPA-HQ-OAR-2014-0827-1869-A1 p.1]

On March 2, 2016, the Environmental Protection Agency and the Department of Transportation issued a notice of data availability (“NODA”) indicating that the agencies had made available new information related to the proposed Phase 2 rulemaking and announced a new 30-day comment period. 81 Fed. Reg. 10,822, 10,822 (March 2, 2016). As described in Section 1 below, Autocar believes that an extension is necessary to ensure that it and other interested stakeholders have a full and fair opportunity to review and analyze documents included in the NODA, and thereafter provide all relevant information to the agencies so that they may make an informed, reasoned, and defensible decision with respect to the rulemaking. As discussed in Section 2 below, Autocar also believes that the agencies must provide for public comment on a critical document placed in the rulemaking docket, “Vocational Vehicle Technology Packages for Custom Chassis.” [EPA-HQ-OAR-2014-0827-1869-A1 p.1-2]

### **1. Extension of Time**

Autocar seeks the current extension in order to respond to two new and material items about which the agencies requested public comment. First, the extension could afford Autocar an opportunity to assess the Greenhouse Gas Emissions Model (“GEM”) P2v2.1. EPA-HQ-OAR-2014-0827-1626, NHTSA-2014-0132-0181. Second, an extension would enable Autocar—and similarly situated stakeholders—to provide EPA and DOT relevant information responsive to the draft report produced by the National Renewable Energy Laboratory (“NREL”) entitled “The Development of Vocational Vehicle Drive Cycles and Segmentation.” EPA-HQ-OAR-2014-0827-1621, NHTSA-2014-0132-0187. EPA requested comment on both these items. See 81 Fed. Reg. at 10,825. [EPA-HQ-OAR-2014-0827-1869-A1 p.2]

An extension of the comment window would also enable Autocar to attempt simulations using the GEM program and compare those findings with the conclusions of the NREL study. The extension would ensure that Autocar and other similarly situated entities have a full and fair opportunity to respond to the newly docketed materials and, thereafter, provide to the agencies all necessary and relevant information. [EPA-HQ-OAR-2014-0827-1869-A1 p.3]

### **3. Conclusion**

Autocar respectfully requests that EPA and DOT release the underlying data relevant to the NREL report, extend the comment deadline for the information covered by the NODA by a minimum of 60 days after that data is released, and specifically open the vocational vehicle technologies memorandum to comment. These steps will allow entities such as Autocar to fully analyze the recently developed information and provide informed comment to the agencies. Thank you for your consideration of this request. [EPA-HQ-OAR-2014-0827-1869-A1 p.4]

**Organization:** Bendix Commercial Vehicle Systems, LLC

Bendix OEM customers make many of our products available as standard or optional equipment and we respect their expertise and position on Phase 2 standards proposed by EPA and NHTSA, as they will be responsible for implementation of technologies to meet the new standards. Their perspectives merit strong consideration by the agencies in ensuring a responsible standard that is realistically implementable in the timeframes under consideration. [EPA-HQ-OAR-2014-0827-1241-A1 p.1]

Bendix commends the agencies for their open and collaborative approach, and their receptiveness to stakeholder suggestions. Collaboration between government officials and a wide variety of stakeholders is key to the success of such a significant and complex technical regulation. We appreciate the opportunity to present our comments and urge the agencies to consider our positions on the following topics. [EPA-HQ-OAR-2014-0827-1241-A1 p.1]

**Organization:** CALSTART

EPA and NHTSA staffs have been and remain highly collaborative with industry in developing these important rules and we look forward to continuing to work with both staffs to finalize the regulations by next spring/summer. [EPA-HQ-OAR-2014-0827-1190-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.150-151.]]

**Organization:** California Air Resources Board (CARB)

Over the past two years, CARB staff has worked closely with the staff of U.S. EPA and NHTSA to develop the technical analyses intended to inform the stringencies of the federal Phase 2 proposal. We commend and appreciate your agencies' significant efforts to build on the success of current Phase 1 standards for the purpose of establishing a strong, national Phase 2 program, particularly one that will support California in achieving its unique climate and petroleum reduction targets. [EPA-HQ-OAR-2014-0827-1265-A1 p.1] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.20.]]

CARB has appreciated the opportunity to work collaboratively with both U.S. EPA and NHTSA in developing the federal Phase 2 proposal. My hope is that U.S. EPA and NHTSA will seriously consider our comments in the spirit they are provided: as an opportunity for our agencies to continue our collaborative efforts to finalize a strong, national Phase 2 program that maintains this country's global leadership role in addressing climate change. [EPA-HQ-OAR-2014-0827-1265-A1 p.5]

**Organization:** Caterpillar Inc., et al.

The major heavy-duty vehicle manufacturers appreciate the time the agencies have given to receive our feedback, through face-to-face meetings and other regular exchanges, through our trade associations, and through our various comment submittals. All stakeholders depend upon a continued good faith

collaboration to see this rule to its successful conclusion, considering all aspects of the public rulemaking process, and we remain hopeful that the agencies will, at all levels, be available to hear our concerns and proposals. Without this open dialogue, the regulation risks being finalized in a way that will not be effective, and will have adverse impacts on the environment and on the users of commercial vehicles and engines. [EPA-HQ-OAR-2014-0827-1215-A1 p.9]

This industry is committed to continuous improvement of heavy-duty vehicle fuel efficiency and greenhouse gas reductions. Heavy-duty truck OEMs and other stakeholders are committing tremendous time and resources toward a successful evolution of this important regulation, one that brings significant reductions through assured market success with minimal unintended consequences. We will continue to work with the agencies to secure the win-win that's available to all of us in the attainment of our shared goals. [EPA-HQ-OAR-2014-0827-1215-A1 p.10]

The proposal requires significant revisions to be feasible. The protocols in the draft regulation have artificially inflated the required greenhouse gas reductions by nearly 50% in some cases, far beyond the targeted levels reported in the agencies' overview announcements. The agencies are refining the proposed test procedures, often in ways that differ considerably from the base proposal. While we acknowledge that many of these adjustments are necessary and appropriate, the current level of uncertainty around the means by which products will be assessed to determine their GHG emissions and fuel efficiency, as well as the continued post-proposal adjustments to stringency targets, renders it impossible for manufacturers to assess their technical and commercial capability to comply with this rule. The expedited timeline of this regulation precludes the opportunity to address this issue in the best way, which would be for the agencies to identify within the public process a means, such as a Supplemental Notice of Proposed Rulemaking, by which stakeholders could formally comment on a more firm proposal, with the latest version of the GEM vehicle simulation tool. This opportunity being unworkable on the current timeline makes close collaboration between the agencies and the industry up to the point of the final rule absolutely essential. It's important in this collaborative process that the procedural and audit provisions are firmed up in a timeframe that still leaves a window of time for the agencies to receive our feedback on the resultant stringency implications of the rule once those issues are settled. We believe that this follow-on process will be critical to the rule's success. [EPA-HQ-OAR-2014-0827-1215-A1 p.9-10]

**Organization:** Con-way Inc.

Con-way respectfully requests that EPA and NHTSA extend the comment deadline for the Phase 2 proposal by a minimum of 90 days, and preferably six months, to allow Con-way and other interested parties a sufficient opportunity to comment on the proposal. The current timeline for submitting comments does not provide adequate time for industry to review and comment on this complex and important rulemaking. [EPA-HQ-OAR-2014-0827-0924-A1 p.1]

**Organization:** Eaton Vehicle Group

Eaton appreciates the open and collaborative approach taken by both the US EPA and NHTSA to engage a broad array of stakeholders for in-depth technology discussions throughout the development of Phase 2 NPRM. It cannot be said that the agencies did not listen to the thoughts and concerns of industry and other stakeholders. [EPA-HQ-OAR-2014-0827-1194-A1 p.4]

**Organization:** FedEx Corporation

Before discussing the proposal itself, we wish to express our appreciation to the EPA's Office of Transportation and Air Quality (OTAQ) and the NHTSA Fuel Economy Division for the collaborative actions undertaken with stakeholders by the agencies throughout the process. FedEx has been pleased to be a stakeholder to help inform with regard to more fuel-efficient and lower-emitting commercial vehicles. We have done so for the same reasons that we focus on improving our own fleet of vehicles – because we feel there is the opportunity to obtain even more fuel efficiencies and lower greenhouse gas emissions from vehicles – but doing so at a national level so that the nation has a comprehensive, harmonized approach that applies to all commercial vehicles. [EPA-HQ-OAR-2014-0827-1302-A1 p.1-2]

**Organization:** Great Dane

We at Great Dane support reductions in Greenhouse Gas emissions and improved energy efficiencies in transportation. However, we note that trailers have not been previously regulated with regard to Greenhouse gas emissions, so the trailer regulatory issue is new to the EPA, NHTSA, and the trucking industry. [EPA-HQ-OAR-2014-0827-0907-A1 p.1]

The issue of Greenhouse Gas (GHG) regulations affecting semi-truck trailers is a complex matter. Trailer designs and specifications vary widely from customer to customer and even within a given customer's fleet based on their operational needs. [EPA-HQ-OAR-2014-0827-0907-A1 p.1]

Great Dane requests a 90-day extension of the September 17, 2015 deadline for comments. This extension will allow Great Dane additional time to understand the NPRM and to interact with the EPA, NHTSA and stakeholders who have valuable information requested in the NPRM. Additionally, a 90-day extension of the formal comment period will allow stakeholders time to respond properly to the proposed regulations. [EPA-HQ-OAR-2014-0827-0907-A1 p.1-2]

Great Dane looks forward to working with both EPA & NHTSA to help answer the questions posed in the NPRM and to develop the best and most appropriate regulations for the industry. We appreciate your consideration of these matters. [EPA-HQ-OAR-2014-0827-0907-A1 p.2]

**Organization:** Innovus Enterprise LLC

1. We are grateful former Congressional Leaders provided the public a vehicle to voice concerns and comments on Agency regulatory development. We also thank the EPA and the NHTSA for following through on these mandates. As Small Business Leaders, we do not take this opportunity for granted and feel it as our duty to contribute positively by keeping a balanced perspective. [EPA-HQ-OAR-2014-0827-1116-A1 p.1]
2. We have diligently studied this proposed ruling; proceeding rulings, as well as support items in the associated dockets. We strongly feel our comments and concerns for the *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles Phase 2* proposed rules will further the Agency's goals as well as those of our small business community. Along with this confidence, we feel our suggestions are well within the allowances of the Regulatory Flexibility Act and those powers afforded by Congressional Act to the NHTSA and EPA Administrators. [EPA-HQ-OAR-2014-0827-1116-A1 p.1]

**Organization:** International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)

We commend the EPA and NHTSA for their diligent work in crafting this proposal and working closely with the California Air Resources Board (CARB). We also appreciate the agencies' willingness to engage meaningfully with the UAW, our members, and other stakeholders on this important matter. This is a complex industry and crafting new greenhouse gas emissions and fuel efficiency standards for medium and heavy-duty engines and vehicles is an extremely difficult task. [EPA-HQ-OAR-2014-0827-1248-A2 p.1]

**Organization:** Meritor, Inc.

Meritor values the professional relationship that has been developed between members of our company and the U.S. EPA and NHTSA as we have worked collaboratively on the content of this proposal.

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

MEMA and the motor vehicle supplier industry are committed to policies that enable the introduction of new technologies needed to support sustainable mobility and we appreciate our engagement with the EPA and NHTSA over the years as the agencies developed and refined their Phase 2 proposals. MEMA commends the agencies for their open and collaborative approach, and their receptiveness to stakeholder suggestions. Collaboration between government officials and a wide variety of stakeholders is key to the success of such a significant and complex technical regulation. [EPA-HQ-OAR-2014-0827-1274-A1 p.2]

[The following comments were submitted as testimony at the Long Beach, California public hearing August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 192.]

MEMA recognizes and respects how important it is for the agencies to meet the administration's deadlines in promulgating this rulemaking. But we also believe it is critical to ensure that all stakeholders have as much time as possible to digest this complex rule and to provide substantive, useful feedback to the agencies. Any additional time the agencies can afford to add to the comment period, even a short-term extension of one or two weeks, would be appreciated.

**Organization:** NAFA Fleet Management Association

NAFA respectfully requests that EPA and NHTSA extend the comment deadline for the Phase 2 proposal by 90 days. This extension will allow NAFA and our members the opportunity to fully consider and provide informed comment on the proposal. [EPA-HQ-OAR-2014-0827-0916-A1 p.1]

**Organization:** National Automobile Dealers Association (NADA)

Earlier this year, NHTSA and EPA solicited comment on a Phase 2 proposal for medium-and heavy-duty engine and truck fuel efficiency and greenhouse gas (GHG) emissions standards. 80 Fed. Reg. 40138, et seq. (July 13, 2015). At some 627 Federal Register pages in length, the proposal is more than twice as big as that for Phase I, huge even by NHTSA and EPA standards. In addition, as of today, the EPA docket contains 732 supporting documents totaling thousands of pages in length and the NHTSA docket contains an additional 9 supporting documents totaling well over 1000 pages. [EPA-HQ-OAR-2014-0827-0909-A1 p.1]

Recognizing the crucial and complex nature of the Phase 2 program and its potential impact on truck dealerships, ATD is devoting considerable staff resources to analyze the proposal and the supporting

documents and to prepare and submit hearing testimony and written comments. Moreover, ATD is engaged in dialogue with truck, component, and equipment manufacturers to better understand the technical issues and concerns raised by the proposal. [EPA-HQ-OAR-2014-0827-0909-A1 p.1]

Supportive of continuous improvements in commercial truck fuel economy and greenhouse gas performance, ATD nonetheless is concerned about numerous issues in the proposal that could dramatically impact vehicle cost, vehicle performance, and/or vehicle reliability. An adequate review and analysis of the proposal's potential impact on dealership truck and tractor sales and parts and service operations requires time. Moreover, an adequate opportunity for notice and comment is critical to the development of technologically feasible and economically practical rules designed to achieve public policy objectives in a timely manner.<sup>1</sup> [EPA-HQ-OAR-2014-0827-0909-A1 p.2]

Fortunately, NHTSA and EPA were not constrained by a statutory deadline dictating when the Phase II proposal had to be published. In fact, as noted in NHTSA's notice to prepare an environmental impact statement for Phase II, the stated goal was to publish a proposal by March of 2015, some four months earlier than what eventually transpired. 79 Fed. Reg. 38842, 38844 (July 9, 2014). Fortunately too, no statutory deadline constrains by when a final rule must be published. Consequently, NHTSA and EPA are not statutorily constrained in their ability to provide for an adequate notice and comment opportunity. [EPA-HQ-OAR-2014-0827-0909-A1 p.2]

The proposal set out a comment deadline of September 11, 2015, which was extended to September 17, 2015 in a subsequent hearing notice. 80 Fed. Reg. 44863-4. (July 28, 2015). Appreciative of these six extra days, ATD nonetheless submits that a comment period of a little over 60 days is insufficient given the volume of documents, the complexity of issues, and the 10-year implementation period involved. Consequently, ATD urges EPA and NHTSA to extend the comment period deadline until December 7, 2015. [EPA-HQ-OAR-2014-0827-0909-A1 p.2]

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<sup>1</sup> In addition, the due process inherent in a sufficient notice and comment opportunity is a constitutional and statutory requirement for federal agencies engaged in rulemaking of this sort.

**Organization:** Navistar, Inc.

#### Adequate Notice and Comment

Agencies must provide for adequate notice and opportunity for comment when developing a rule. This means that the public should both be notified of the content of the rule and also be given an adequate opportunity to comment on the rule. There are several areas, covered in more depth below, where the NPRM contains proposals that do not appear to be in final form. Navistar is concerned that the Proposed Rule as published in the NPRM is not sufficiently definite to allow adequate opportunity to comment. This will be explained more fully below as it pertains to specific areas. [EPA-HQ-OAR-2014-0827-1199-A1 p.4]

However, in this respect our most significant concern relates to GEM and the opportunity Navistar, and the public in general, have been given to analyze and comment on this key aspect of the Proposed Rule. GEM, including its source code, should be considered a rule and subject to the same notice and comment process as the text in the Code of Federal Regulations. GEM is the sole means by which an emission level is set for a particular vehicle. There is no alternative to the use of GEM. Nor is it, like some modeling tools used in various compliance contexts, a tool used in the process of assessing a facility permit, for example. Instead, this software directly functions as the rule. If there is a variation

between what is said in the text of the Code of Federal Regulations and the result or process in the software, the software essentially wins since it sets the result for a particular vehicle. [EPA-HQ-OAR-2014-0827-1199-A1 p.4]

The source code that underlies GEM is as much a part of the rule as the regulatory language in the Code of Federal Regulations. For instance, executable file version 1.1 of GEM was posted to the docket on August 19, 2015. However, that was not the end. As of this writing, EPA had reached GEM executable file version 1.6. Since version 1.1 was posted, there have been at least *five* subsequent versions to GEM that have not yet been posted to the docket. Furthermore, there is no indication in the docket that the source code was posted at all, certainly not for versions subsequent to version 1.1. Navistar did receive a copy of the source code for version 1.1 on August 20. A notice to the docket relating to the availability of the source code for version 1.1 was posted as well, but that has been the last publicly released document. [EPA-HQ-OAR-2014-0827-1199-A1 p.4-5]

There is a significant difference between the source code and the executable file. With access to the source code one can analyze the actual functions of the application in much greater detail than simply through access to the application itself. One can also isolate the functions of particular systems within the application and determine where changes in the emission results are impacted by those functions. Without such access, by contrast, a result can be seen from a particular set of inputs, but there is no way to see what specific input is driving what portion of the result. Without the source code there is also little way to tell whether the GEM result matches the language in the NPRM or the CFR itself. [EPA-HQ-OAR-2014-0827-1199-A1 p.5]

Moreover, the GEM executable file, a key element of the compliance mechanism and therefore a key element of the rule, was issued with the NPRM. However, it has continued to evolve even during the comment period. A number of the concerns we express below seem only capable of being addressed through modifications to the GEM. EPA acknowledged during the comment period that there will be several additional changes. Again, GEM is the mechanism for determining a vehicle's emission level. As such it is probably the single most important aspect of this rulemaking. Despite that, it appears not to be fully ready and to be in the midst of development. GEM also has significant errors, which we will discuss more fully below, including to the baseline assumptions on which the proposed emission standards are built. Full access to the source code, from the first, with sufficient time to analyze, is what is required for a meaningful opportunity to comment. [EPA-HQ-OAR-2014-0827-1199-A1 p.5]

There are other examples where key elements of the Proposed Rule are not fully explained. For example, in the vocational vehicle standards the NPRM used a "normalization" process to change would be what the ordinary starting point, the 2017 standards by adjusting those standards according to a presumed vehicle population by broad use category. This element of the rule is not fully explained. It appears to Navistar to be largely arbitrary, although we cannot tell since there is no in-depth explanation of this normalization factor.<sup>5</sup> Other elements of the vocational rule also appear to be in a fairly rudimentary state, as discussed more fully below. [EPA-HQ-OAR-2014-0827-1199-A1 p.5]

The opportunity to comment has to be meaningful. That is, it needs to be more than just a general awareness of the areas in which the agencies propose to regulate. The Proposed Rule is of such complexity, and carries such widespread ramifications for the industry, that we believe the burden of adequate notice and comment is increased commensurately and that EPA has met its burden in a number of areas in the Proposed Rule. [EPA-HQ-OAR-2014-0827-1199-A1 p.5]

In particular, we believe that GEM is a key portion of the Proposed Rule, and should be subject to notice and comment to the same extent as the language in the Code of Federal Regulations since it



directly sets the regulatory fuel efficiency (gallons per thousand ton-mile) level for the vehicle, which determines whether the vehicle is compliant or not. We do not think that adequate notice and comment procedures have been followed with regard to GEM because, among other reasons, the source code has not been posted for public comment or provided for each version of the executable GEM file. [NHTSA-2014-0132-0094-A1 p.3]

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5 In fact, despite the notation in the NPRM, the normalization process is only briefly explained over the course of two pages. RIA at 2-116-17 and discussion below.

**Organization:** Nissan North America, Inc.

The GHG and fuel efficiency programs for medium duty and heavy duty classes have been driven by collaboration between EPA, NHTSA, the California Air Resources Board (CARB), and Original Equipment Manufacturers (OEMs or vehicle manufacturers). [EPA-HQ-OAR-2014-0827-1026-A1 p.2]

**Organization:** North American Die Casting Association (NADCA)

While NADCA believes the Administration did not provide sufficient time for the public to provide input given the length and scope of the proposal, the Association hereby submits these abbreviated comments on the die casting industry's capabilities and role in improving efficiency performance. [EPA-HQ-OAR-2014-0827-1283-A1 p.1]

**Organization:** Owner-Operator Independent Drivers Association (OOIDA)

As the representatives of our nation's small business and independent truckers and professional truck drivers, the Owner Operator Independent Drivers Association (OOIDA) greatly appreciates the outreach which has been demonstrated leading up to the publishing of the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2 Notice of Proposed Rulemaking (Phase 2 NPRM). The engagement from your agencies has been a significant increase from the Phase 1 process. [EPA-HQ-OAR-2014-0827-0738-A1 p.1]

OOIDA notes the decision by the EPA and NHTSA to extend the comment period for Phase 2 to September 17, 2015. This is an extremely complex proposal, and a longer comment period ensures that OOIDA and other stakeholders, as well as our membership of small business owners and professional truck drivers, has ample opportunity to review the proposal and comment. While extending the comment period 30 days beyond the last planned public meeting is a laudable decision, it does not adequately provide for sufficient time. [EPA-HQ-OAR-2014-0827-0738-A1 p.1]

OOIDA's members are primarily small business owners and they collectively own and operate more than 200,000 individual heavy-duty trucks. They will be greatly impacted by this proposed rule along with the majority of truck owners. With 90 percent of carriers being comprised of six trucks or less this concern is substantial. As such we have the responsibility to thoroughly assess the over 2,000 pages of documents in order to produce adequate comments for the rulemaking. [EPA-HQ-OAR-2014-0827-0738-A1 p.1]

This entails a great deal of time in order to read the proposed rule, while continuing with our additional duties to our members. In addition we require the opportunity to compile our findings and share those

with our members, as well as time to elicit feedback from our members. OOIDA members consist of individuals who have very full schedules on a daily basis. To complete this process properly and provide useful feedback to the EPA we require sufficient time. Despite the 6 day extension to September 17, 2015 allotted for this proposed rule, additional time is necessary to ensure that all issues and aspects of EPA's proposal are adequately understood. Given these concerns we respectfully request an additional 90 days for comment submission. [EPA-HQ-OAR-2014-0827-0738-A1 p.1]

OOIDA further understands that the agencies will be conducting two public hearings in regards to this proposal. One will be at the Palmer House Hilton Hotel, 17 East Monroe Street, Chicago, Illinois on August 6, 2015 and the second will be at the Westin Hotel Long Beach, 333 East Ocean Boulevard, Long Beach, California on August 18, 2015. [EPA-HQ-OAR-2014-0827-0738-A1 p.1]

We are concerned that the Chicago hearing provides limited opportunities for truck drivers to attend and participate given the significant restrictions on truck access and parking in downtown Chicago. Even legal and available truck parking outside the downtown core of Chicago does not provide easy access to public transportation. This was a similar concern raised by OOIDA during the Phase I process, where one of the three public hearings was held at a similar downtown Chicago hotel and the other two were held in Washington, DC and Cambridge, MA. Despite the fact that they were concerning a regulation impacting truck owners, none of these locations had nearby truck parking. [EPA-HQ-OAR-2014-0827-0738-A1 p.1-2]

OOIDA is hopeful that the proximity of the location for the Long Beach hearing to a convention center will allow for adequate truck parking for attendees. That said, OOIDA is concerned that by only holding two hearings in the downtown areas of major cities, the agencies will not have the benefit of hearing directly from the long-haul/over-the-road segment of the trucking industry. Long-haul truckers largely avoid traveling into downtown areas of cities due to restrictions on their vehicles, lack of parking, and a desire to limit exposure to the added accident risk that comes with congested urban areas. [EPA-HQ-OAR-2014-0827-0738-A1 p.2]

As such, we encourage the agencies to add a third public hearing at a location that is more focused on this segment of trucking. For instance, there are several large truck stops located throughout major freight corridors that would be able to accommodate a trucker-focused public hearing at a likely limited cost to the agencies. Or, if the agencies would prefer to conduct its hearings in downtown areas, conducting a hearing to coincide with the Great American Trucking Show (GATS) in Dallas, Texas should be considered. This event, which runs from August 26-30, 2015, already accommodates hundreds of trucks every year in downtown Dallas due to existing arrangements with the City and parking providers. In addition to thousands of truck drivers and fleet owners, others within the commercial vehicle industry will be in attendance. GATS is also host to the annual Commercial Vehicle Outlook Conference, another opportunity for the agencies to gain insight for a wide group of experts. [EPA-HQ-OAR-2014-0827-0738-A1 p.2]

**Organization:** PACCAR, Inc.

PACCAR recognizes that EPA and NHTSA have had ongoing discussions with the industry on some aspects of the proposed rule. PACCAR appreciates this opportunity to engage with the agency to identify the most appropriate way to craft and implement the Phase 2 standards. We further request the opportunity to comment on the record is provided for any provisions that the agencies intend to finalize that were not anticipated at the time of publication of the NPRM. [EPA-HQ-OAR-2014-0827-1204-A1 p.1]

**Organization:** SABIC Innovative Plastics US LLC

#### The Open Rulemaking Process has Produced a Smarter Rule

SABIC commends the agencies for their open and collaborative approach to public input, and their receptivity to stakeholder suggestions. As the agencies note, more than 200 meetings took place with manufacturers, suppliers, trucking fleets, dealerships, state air quality agencies, non-governmental organizations (NGOs), and other stakeholders to understand the opportunities and challenges involved in Phase 2. SABIC was pleased to participate in this dialogue, both directly and through industry trade associations. We believe the agencies' engagement with stakeholders has led to a proposal that better recognizes the mileage and emission benefits of lightweighting and aerodynamic technologies, thereby providing OEMs with cost-effective pathways to Phase 2 compliance. [EPA-HQ-OAR-2014-0827-1207-A1 p.2]

**Organization:** Truck & Engine Manufacturers Association (EMA)

- The agencies are still revising the GEM inputs for vocational vehicles, which means that GEM still is not suitable for assessing the Phase 2 vocational vehicle program. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]
  - Only on March 25, 2016, (just one week ago), did the agencies provide access to the necessary “baseline” vehicle data (including the baseline vehicles’ GHG technology packages and “default” fuel-efficiency percentage improvement values) that the agencies are using to model and derive the various Phase 2 vehicle stringency standards at issue. This last-minute disclosure of key GEM inputs has frustrated stakeholders’ ability to assess either the reasonableness of GEM or any GEM-based standards, which again raises fundamental issues under the APA and the CAA. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]
  - The agencies have indicated that they are still assessing and modifying the duty cycles and weighting factors that will apply to the different categories of Heavy-Duty On-Highway (“HDOH”) vehicles. That continuing uncertainty regarding fundamental elements of the rulemaking package frustrates the ability to meaningfully assess the feasibility or reasonableness of the Proposed Phase 2 Standards. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]
  - The 30-day comment period for the NODA is not sufficient to conduct any fair evaluation of the revised GEM, especially when GEM is not yet suitable for use in any comprehensive assessment of vocational vehicles. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]
  - The assumption that manufacturers can reasonably assess the stringency and feasibility of the Proposed Phase 2 Vehicle Standards when GEM is still undergoing development, when the vocational vehicle subcategories and standards are still subject to ongoing baseline assessment and “normalization,” and when the aerodynamic and compliance test procedures are ill-defined, is fundamentally unreasonable and inconsistent with administrative due process. [EPA-HQ-OAR-2014-0827-1269-A1 p.72]
- The 30-day comment period for the NODA is not sufficient to conduct any fair evaluation of the revised GEM, especially when GEM is not yet suitable for use in any comprehensive assessment of vocational vehicles. [EPA-HQ-OAR-2014-0827-1891-A1 p.3]

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Conclusion

EMA appreciates the agencies' publication of the NODA and its associated information. Nevertheless, basic information gaps still remain that go to the core of the feasibility and cost effectiveness of the Proposed Phase 2 Vehicle Standards. EMA urges the agencies to disclose that necessary information promptly to facilitate a fair and proper rulemaking process. [EPA-HQ-OAR-2014-0827-1891-A1 p.5]

**Organization:** Truck Trailer Manufacturers Association (TTMA)

TTMA values this opportunity to comment on the Proposal and appreciates that the EPA and NHTSA have been consulting with us while they were initially considering this proposal. Further, we appreciate that as the rule took shape, staffers from EPA and NHTSA took time to share with us the directions they thought the agencies would go with this rulemaking, such as they could. [EPA-HQ-OAR-2014-0827-0727-A1 p.1]

However, the details, which could not be shared ahead of publication, are critical to evaluating this proposal. This rulemaking is exceptionally involved for the truck trailer industry, which is both smaller in total and composed of many smaller entities catering to a much higher degree of specialization and customization than for the entities covered under Phase 1 of these regulations. The Proposal not only seeks to bring our entire industry under new regulation, but asks us to consider alternative phase-in periods. [EPA-HQ-OAR-2014-0827-0727-A1 p.1-2]

The EPA & NHTSA seem to have had dedicated teams working on crafting this rule for approximately 16 months. TTMA member companies have been given only 60 days (plus the short time the rule was released in its signed pre-publication form) to both read and comment on the proposal. While TTMA and its member companies have placed an exceptionally high priority on comprehending this proposal and have vigorously worked with EPA & NHTSA representatives to gain understanding, the time provided is simply too short for us to adequately review and comment on the multitude of claims and proposals in the docket as well as consider the full set of implications of being subject to regulation by an agency we have never worked with before. [EPA-HQ-OAR-2014-0827-0727-A1 p.2]

In light of this, TTMA would like to officially request a 90 day minimum, and ideally 6 month, extension of the September 11, 2015 deadline for comments. This extension will allow TTMA to respond properly to the regulations that EPA & NHTSA are proposing. [EPA-HQ-OAR-2014-0827-0727-A1 p.2]

As always, TTMA looks forward to working with both EPA & NHTSA to help craft the best and most appropriate regulations for the industry. Please contact TTMA with any concerns. [EPA-HQ-OAR-2014-0827-0727-A1 p.2]

The Truck Trailer Manufacturers Association (TTMA) has petitioned EPA to extend the comment period beyond September 11, 2015. Strick Trailers, LLC is a member of the TTMA. Strick Trailers, LLC is in full support of the petition to request a 90 day minimum, and ideally 6 months, extension of the September 11, 2015 deadline for comments. [EPA-HQ-OAR-2014-0827-0742 p.1]

We also had asked for a longer time to pursue a more detailed evaluation of the proposal. TTMA is an organization of trailer manufacturing companies and we rely on voluntary participation of our member companies. As the agencies admit, a large proportion of these member companies are small manufacturers and as such, lack the time and resources to detail to such a long and complicated proposal. We had asked for a 90 – 180 day extension to allow those small manufacturers to adequately be brought up to speed and provide specifics to our commentary, but were granted only a 14 day extension. We will continue to pursue a dialog with the agencies past the October 1st, 2015 deadline and

encourage the agencies to reach out to us as they have been doing so that we can work together to craft the best possible solutions. [EPA-HQ-OAR-2014-0827-1172-A1 p.2]

**Organization:** United Parcel Service (UPS)

UPS hereby requests a 90-day time extension beyond the September 17, 2015 comment period deadline on the EPA and NHTSA Proposed Rule: Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles - Phase 2 (Phase 2). [EPA-HQ-OAR-2014-0827-0917-A1 p.1]

While our company fully supports the objectives of increased fuel efficiency and reduced carbon emissions in our trucks, we also believe that this Phase II rulemaking is too important and too complex to shortchange the time for public comment. The subject is, simply put, too important to get wrong the first time. We have studied the thousands of pages involved in this rulemaking and conferred on the proposed regulations with other affected stakeholders in our industry. Frankly, we are dependent on our suppliers to understand the proposed regulations and prepare themselves to provide compliant trucks and equipment. Nevertheless, UPS will make every effort to file on time, but we would feel much more comfortable that we understand the issues raised in this docket, if we had more time. [EPA-HQ-OAR-2014-0827-1262-A1 p.1]

While a few select stakeholders have established teams to read and analyze the Proposed Rule and the thousands of pages of technical support documents and complex modelling formulations, few throughout the industry have been able to fully review and evaluate how Phase 2 will impact their operations and business plans. This especially holds true for most trucking fleets. ATA and other impacted stakeholders are currently dialoguing, conducting surveys, and gathering data to further assess and develop a sound and achievable regulation that will not result in market disruptions or unattainable goals. [EPA-HQ-OAR-2014-0827-1262-A1 p.2]

Given that fuel is one of the top operating expenses for trucking companies, ATA supports the aims of improving fuel efficiency and reducing the industry's carbon footprint. However, ATA and its diverse membership seeks additional time to complete its reading to fully understanding this extremely complex and far-reaching rule which will directly impact and transform fleet operations for decades to come. Moving ahead, ATA looks forward to continued cooperative efforts with both EPA and NHTSA in crafting a rule that is both technologically and economically achievable. [EPA-HQ-OAR-2014-0827-1262-A1 p.2]

**Organization:** Volvo Group

We are, however, deeply concerned that the proposed rule is seriously flawed in both process and substance. First, we note that major parts of the proposal are incomplete, undecided, or subject to on-going changes such that it is impossible to make any reasonable assessment of the true stringency of the proposal or the relative merits of various technology packages to meet the proposed targets. An adequate and firm proposal is lacking for vehicle duty cycles, aerodynamic testing, engine fuel mapping, vocational vehicle standards, vocational vehicle segmentation, powertrain testing, and the vehicle simulation software (GEM). Individually and collectively, this undermines the agencies' responsibility to provide appropriate notice, allowing for informed and effective comments. EPA is required to provide, in its notice of a proposed rulemaking, information that is sufficient to allow the public a reasonable opportunity to participate in the rulemaking process. To participate meaningfully, interested parties must have a complete and settled picture of what the Agency is proposing. In light of the substantial elements of the proposal that remain either incomplete, unsettled or both, it simply

cannot be said that Volvo Group and other interested parties have had a reasonable opportunity to provide fully informed input into the rulemaking process. [EPA-HQ-OAR-2014-0827-1290-A1 p.10]

[Table, 'Protocol Impacts on Tractor Stringency', can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1290-A1]

While these issues all result in underestimating the rule's true stringency, the proposed rule also overestimates the potential penetration levels of many efficiency technologies used to set the standards. The agencies have attempted to determine appropriate market acceptance rates (apparently without any market studies) for the various technologies deemed as feasible up through 2027 model year. In so doing, they have predicated the standards on some technologies that have not even been demonstrated as feasible such as stop/start for HHD engines, aerodynamic drag reduction levels, "deep integration," and waste heat recovery; on penetration rates that are infeasible due to legal impediments such as 6x2 axles; or technologies that do not meet significant market requirements such as the low rolling resistance tire targets. [EPA-HQ-OAR-2014-0827-1290-A1 p.11]

Taken together, these substantial issues result in a proposed rule that is inadequately defined, incomplete, and technically infeasible. As noted, the proposal does not provide adequate notice to interested parties to allow for meaningful comment. Further, the agencies have not satisfied their obligation to identify support for and explain the factual basis for the proposal.<sup>2</sup> These issues must be corrected and changes clearly communicated for additional review and comment before issuing a final rule. [EPA-HQ-OAR-2014-0827-1290-A1 p.11]

### **The Agencies' Regulatory Proposal is Incomplete and Inadequate**

The Volvo Group has spent many hours analyzing the content of the proposal, and worked with industry colleagues to identify issues, present feedback, and propose corrective measures to the agencies. Although we have undertaken considerable effort to study the NPRM, we remain concerned that, with a regulation of this size and complexity, there may remain many potential problems that we have not identified; some of which may only surface upon full implementation. Because of the strong financial impact of fuel efficiency on commercial fleet operations, the actual results of efficiency regulation will be closely measured and monitored by fleet owners. If the required technologies do not deliver expected fuel savings at affordable total cost, or result in excessive maintenance and down-time, fleets will not purchase vehicles. Instead, they will repair and rebuild their existing vehicles as they have increasingly done, due to costs and operational problems from recent emissions technologies. Thus, it is important that the regulation deliver the expected in-use performance. Given the complexity and potential for unintended consequences, it is essential that this rule is carefully considered and reviewed by industry and other experts, and that this detailed feedback be incorporated into the rulemaking. [EPA-HQ-OAR-2014-0827-1290-A1 p.12-13]

Although the agencies sought stakeholder inputs and provided some preliminary information prior to the issuance of the NPRM, these discussions have primarily focused on technology and efficiencies. Manufacturers have only gained visibility to many fundamental processes and test procedures, certification and audit protocols, and many more details since the release of the NPRM. Far too many of these details remain unclear, are still under development, or are even being reconsidered for totally new approaches barely mentioned in the NPRM. These include: the segmentation, duty cycles, and targets for vocational vehicles; duty cycle grades for tractors; method of engine efficiency mapping; the functionality of the GEM simulation model; the process for aerodynamic testing and analysis; and many more. With respect to these components of the rule, it is simply not possible for Volvo Group to conduct

the analysis necessary to provide meaningful input into the rulemaking process, which it is entitled to do. [EPA-HQ-OAR-2014-0827-1290-A1 p.13]

With major parts of the proposal still in flux and the overwhelming complexity of the rule itself, it is impossible to do a thorough evaluation, and likewise impossible to perform a thorough assessment of the underlying stringency. In addition, we assert that insufficient notice is provided when significant parts of the NPRM are modified through obscure and unclear memos to the docket<sup>4</sup> (currently populated with more than 700 documents designated as “supportive,” many of which are not clearly delineated in the proposal). Given this, it is appropriate and necessary for the agencies to consider the comments submitted to the NPRM, improve the certification protocols accordingly, and by some formal mechanism, make the modified regulatory text, revised GEM simulation, and associated stringency proposals available for review by stakeholders. Stakeholders must be given opportunity to comment on these revisions. [EPA-HQ-OAR-2014-0827-1290-A1 p.13]

Volvo Group and its subsidiary companies in the U.S. appreciate the opportunity to comment on this Notice of Proposed Rulemaking for the Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2. Recognizing the need for sustainability of commercial transportation systems, we share a common goal to mitigate petroleum demand and reduce greenhouse gas emissions. We have been working proactively with EPA and NHTSA to develop these regulations, and we will continue to do so as the agencies work to finalize this important regulation. While we have attempted to conduct a thorough evaluation, the size and complexity of the proposal and supporting documentation virtually ensures that new issues will continue to surface. We will continue to work with the agencies to resolve the existing issues and any new issues. Given the cost and impact of this regulation, the agencies should take the time necessary to appropriately resolve these issues, rather than conform to an arbitrary time schedule. The Volvo Group remains committed to expend the resources necessary to ensure that the Phase 2 regulation drives significant real world efficiency gains and dramatic reductions in greenhouse gas emissions, in support of shared national goals to advance energy independence and stem the tide of climate change. It is our sincere hope to be able to support the final rule, but we can only do so if the significant issues that we have raised are addressed. [EPA-HQ-OAR-2014-0827-1290-A1 p.81]

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<sup>2</sup> See *Motor Vehicle Manufacturers Ass’n v. State Farm Mutual Automobile Ins. Co. et al*, 463 U.S.29, 43 (1983) (citation omitted). (Agencies are obligated to “examine the relevant data and articulate a satisfactory explanation for its action including a ‘rational connection between the facts found and the choice made.’”)

Given the broad scope of issues Volvo and other stakeholders raised in comments to the NPRM, we find the NoDA to be disappointingly limited in scope. The Agency action to issue a NoDA should have been used to rectify and clarify far more of the provisions set forth in the NPRM, so as to enable manufacturers to evaluate their ability to comply with the regulation. Without this needed clarity, manufacturers are still working with incomplete, unclear or undefined processes in many areas, and with unknown stringency targets. This is further complicated by not having a clear view of how the agencies will accommodate the additional stringency imposed by protocol and common certification and enforcement practices such as Selective Enforcement Audits that fundamentally force manufacturers to over-comply with the stated efficiency targets. (We recognize that a significant measure of this effect will be reduced by the modifications foreseen in the Final Rule). This continued uncertainty not only frustrates our ability to put into place the proper technology development and product planning to meet the requirements of the rule with any level of confidence, but more urgently precludes any opportunity to give timely feedback to the agencies as to our ability to comply, or any needed re-balancing of

stringency demands among product segments before the rule is finalized. [EPA-HQ-OAR-2014-0827-1928-A1 p.2]

Since that time, we have understood that the agencies have worked to address many of the issues Volvo noted; however, there are several important issues that remain unresolved. More importantly, very few of the concerns raised by Volvo and other stakeholders were addressed within the NoDA release. The agencies should have used this opportunity to publically communicate many more significant revisions to the NPRM, so as to provide stakeholders the opportunity to review and submit comments, consistent with the requirements of the Administrative Procedures Act. Failing this, the following items from the Volvo Group's NPRM comments are still of concern (listed by page number for the Volvo Group's comments to the NPRM). We will continue submitting data, information, and recommendations to EPA and NHTSA, to the best of our ability, to support the goal that the agencies finalize a rule that meets the aforementioned prerequisites, providing real-world emissions reductions with substantive cost of ownership reductions for vehicle owners. [EPA-HQ-OAR-2014-0827-1928-A1 p.6]

**Organization:** Waste Management (WM)

Before discussing our views on particular aspects of the proposal, we want to commend the management and staff of the Office of Transportation and Air Quality (OTAQ) and the NHTSA Fuel Economy Division for the very collaborative process they used to develop this proposal.

**Organization:** Werner Enterprises

Werner respectfully requests the EPA and NHTSA to extend the comment period by providing an additional 60 days for public review and input. [EPA-HQ-OAR-2014-0827-1236-A1 p.1]

However, Werner respectfully requests the EPA and NHTSA to extend the comment period by providing an additional 60 days for public review and input, as we need more time to evaluate how Phase 2 will impact our operations and business plans. [EPA-HQ-OAR-2014-0827-1236-A1 p.2]

This rule will have a significant effect on Werner's business operations, our employees, and our professional drivers, and must be evaluated carefully. Werner urges the agencies to extend the comment period, as it does not currently provide an adequate amount of time to review and respond to the complexity of the proposed rule. By extending the rulemaking process a minimum of 60 days it will allow Werner additional time to review the significant effect the rule will have on our company and evaluate the difficult decisions to be made to ensure compliance with the proposed rule. [EPA-HQ-OAR-2014-0827-1236-A1 p.3]

**Organization:** XL Specialized Trailers

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 202-203.]

XL Specialized Trailers is officially requesting a 90-day minimum, ideally six-month extension to the now September 17th, 2015 deadline for comments period. TTMA has petitioned EPA to extend the comment period beyond that original date of September 11th, 2015, and as a member, XL Specialized Trailers is in full support of this petition.



**Response:**

Many commenters thanked the agencies for their continued efforts to collaborate with and collect feedback from stakeholders and the public. We appreciate these comments, as the agencies have been committed to meaningful collaboration throughout the rulemaking process. During the development of this Phase 2 program, the agencies held over 400 meetings to gather input, data and views from heavy-duty vehicle and engine manufacturers, technology suppliers, trucking fleets, truck drivers, dealerships, environmental organizations, and state agencies (as documented in the extensive Stakeholder Meeting Log and in specific meeting memos found in the rulemaking dockets: EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). The NPRM was posted on the agencies' websites on June 19, 2015. Following publication of the NPRM in the Federal Register on July 13, 2015, the agencies held two public hearings, one in Chicago, IL on August 6, 2015 and one in Long Beach, CA on August 18, 2015. The comment period for the proposed rules was to end on September 17, 2015. The DEIS was published to a NHTSA Docket on June 19, 2015, and the comment period for that document was to end on August 31, 2015. In response to comments above calling for an extension of the public comment period, the agencies extended the original comment period for both the NPRM and the DEIS to October 1, 2015. Some commenters requested an additional extension of the comment period, citing reasons such as the length and complexity of the rule. However, we find that with the early notice of the Phase 2 proposal by posting it on the agencies' websites upon signature, the two public hearings, the granted extension of the comment period, our considerable stakeholder outreach effort (documented in the Stakeholder Meeting Log and specific meeting memos, see above), and our consideration of late comments (see the Introduction to this RTC document), stakeholders and the public have indeed had notice and comment of all issues and have had adequate amount of time to review and provide meaningful comment on the proposal; further, the agencies have gone beyond the procedural steps required by law to promote transparency and public participation. Finally, in the spirit of our commitment to meaningful collaboration with stakeholders and the public, we are also addressing comments received after the comment periods were closed to the extent that they were received in time to include in this document.

With respect to the comments raising claims of inadequate notice, the agencies have met all legal notice and comment requirements through Federal Register notices for the NPRM and DEIS, a Notice of Data Availability (NODA) pointing to information in the public docket obtained after the proposal, and through specific outreach to affected stakeholders as documented in the Heavy-Duty Stakeholder Meeting Log and specific meeting memos in the rulemaking dockets (Dockets: EPA-HQ-OAR-2014-0827, NHTSA-2014-0132; examples of specific memos: "Record of Webinar on Vocational Custom Chassis" (EPA-HQ-OAR-2014-0827-1944), "Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking," "Summary of Meetings and Conference Calls with Allison Transmission to Discuss the Phase 2 Heavy-Duty GHG Rulemaking"). We disagree with comments, such as those from Volvo, that suggest the proposed rules were incomplete and therefore inadequate. At the time of the proposal, the agencies clearly laid out a comprehensive program that allowed stakeholders and the public to provide meaningful comment. The agencies' requests for comment on specific aspects of the program should not be confused with uncertainty about the program or about standard stringencies; rather, these requests were made to encourage stakeholder feedback (especially in areas where they had not communicated their concerns to us previously). The Heavy-Duty Stakeholder Meeting Log and memos recording specific stakeholder meetings (e.g., Record of Webinar on Vocational Custom Chassis" (EPA-HQ-OAR-2014-0827-1944), "Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking," "Summary of Meetings and Conference Calls with Allison Transmission to Discuss the Phase 2 Heavy-Duty GHG Rulemaking") demonstrate that the development of the Phase 2 was an iterative process, with the agencies considering stakeholder and public concerns well beyond the public comment period for the proposal, through meetings, phone calls, and an additional public comment period on information in the

public docket obtained after the proposal (the NODA). The meeting log and stakeholder meeting memos can be found in the rulemaking dockets (EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). Where commenters have pointed to notice and comment issues about detailed aspects of the program or the GEM vehicle simulation model, we respond to those comments in earlier sections of this RTC (e.g., see Section 6.2.3 for comments on the custom chassis part of the vocational vehicle program, and Section 2 for comments on GEM), and as a whole below.

### Engines in GEM Changes

Some commenters maintain that they did not receive sufficient notice to provide informed comment on the GEM. The agencies disagree. As described in the Section II.C of the Preamble, the agencies have provided numerous opportunities for comment on GEM, and its iterative development.

Shortly after the Phase 2 proposal's publication in July 2015 (and before the end of the public comment period), the agencies received comments on GEM. Based on these early comments, the agencies made minor revisions to fix a few bugs in GEM software and in August 2015 released an updated version of GEM to the public for additional comment, which also included new information on GEM road grade profiles. The agencies also extended the public comment period on the proposal, which provided at least 30 days for public comment on this slightly updated version of GEM.<sup>273</sup> Then, in response to comments submitted at the close of the comment period, in early January 2016 the agencies released a "debugging" version of GEM to a wide range of expert reviewers.<sup>274</sup> The agencies provided one month for expert reviewers to provide informal feedback for debugging purposes.<sup>275</sup> Because the changes for this debugging version mostly added new features to make GEM easier to use for certifying via optional test procedures, like the powertrain test, there were only minor changes to the way that GEM performed. In the March 2016 NODA, the agencies included another developmental version of GEM<sup>276</sup> for public comment and provided 30 days for public comment. Based on the NREL report, which was also released as part of the NODA for public comment, the NODA version of GEM contained updated weighting factors of the duty cycles and idle cycles.<sup>277</sup> Therefore, the outputs of GEM for a given vehicle configuration changed because these duty cycle weighting factors changed, but there were only minor updates to how the individual technologies were simulated in GEM. Based on comments received on the NODA, the agencies made minor changes to GEM and released another debugging version in May 2016 to manufacturers, NGOs, suppliers, and CARB staff.<sup>278</sup> The most significant change to GEM for the May 2016 version was that 0.5 miles of flat road was added to the beginning and end of the 55 mph and 65 mph drive cycles in response to concerns raised by manufacturers.<sup>279</sup> This

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<sup>273</sup> U.S. Environmental Protection Agency, GEM new release (GEM P2v1.1) and known issues and workarounds for GEM P2v1.0), Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 - EPA-HQ-OAR-2014-0827, August 19,2015.

<sup>274</sup> See EPA's web site at <http://www3.epa.gov/otaq/climate/gem.htm> for the Phase 1 GEM revision dated May 2013, made to accommodate a revision to 49 CFR 535.6(b)(3).

<sup>275</sup> See EPA's web site at <http://www3.epa.gov/otaq/climate/gem.htm> for the Phase 1 GEM revision dated May 2013, made to accommodate a revision to 49 CFR 535.6(b)(3).

<sup>276</sup> U.S. Environmental Protection Agency, GEM new release (GEM P2v1.1) and known issues and workarounds for GEM P2v1.0), Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 - EPA-HQ-OAR-2014-0827, August 19,2015.

<sup>277</sup> EPA-HQ-OAR-2014-0827-1621 and NHTSA-2014-0132-0187.

<sup>278</sup> U.S. Environmental Protection Agency, GEM Power User Release for Debugging, Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 - EPA-HQ-OAR-2014-0827, January 27, 2016.

<sup>279</sup> Memo to Docket, "Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking," August 2016.

change did not change the way that GEM worked, but it did change GEM results because of the change in the duty cycles. This change was made to better align GEM simulation with real-world engine operation. The agencies provided the expert reviewers with at least a 3-week period in which to review GEM and provide feedback. Details on the history of the comments the agencies received and the history of the agencies responses leading to these multiple releases of GEM can be found in Section II.C.(1). The following list summarizes the changes in GEM in response to those comments and data submitted to the agencies in response to the Phase 2 proposal, NODA and other GEM releases:

- Revised road grade profiles for 55- and 65-mph cruise cycles, only minor changes since August 2015.
- Revised idle cycles for vocational vehicles with new vocational cycle weightings, weightings released for public comment in NODA.
- Made changes to the input file structures. Examples includes additions of columns for axle configuration (“6x2,” “6x4,” “6x4D,” “4x2”), and additions of a few more technology improvement inputs, such as “Neutral Idle,” “Start/Stop,” and “Automatic Engine Shutdown.” These were minor changes, all were in NODA version of GEM.
- Made changes to the output file structures. Examples include an option to allow the user to select an output of detailed results on average speed, average work at the input and output of the transmission, and the numbers of shifts for each cycle (e.g., 55 mph cycle, 65 mph cycle and the ARB Transient cycle). These were minor changes, all were in NODA version of GEM.
- Added an input file for optional axle power losses (function of axle output speed and torque) and replaced a single axle efficiency value with lookup table of power loss. These were minor changes to streamline the use of GEM, all were in NODA version of GEM.
- Modified engine torque response to be more realistic, with a fast response region scaled by engine displacement, and a slower torque response in the turbo-charger’s highly boosted region. These were minor changes, all were in NODA version of GEM.
- Added least-squares regression models to interpret cycle-average fuel maps for all cycles. These were minor changes to streamline the use of GEM, all were in NODA version of GEM.
- Added different fuel properties according to 40 CFR 1036.530. This was a fix to align GEM with regulations.
- Improved shift strategy based on testing data and comments received. These were minor changes, all were in NODA version of GEM.
- Added scaling factors for transmission loss and inertia, per regulatory subcategory. These were minor changes, all were in NODA version of GEM.
- Added optional input table for transmission power loss data. These were minor changes to streamline the use of GEM, all were in NODA version of GEM.
- Added minimum torque converter lock-up gear user input for automatic transmissions. This was a minor change to streamline the use of GEM, this change was in the NODA version of GEM.
- Revised the default transmission power loss tables, based on test data. This was a minor change to streamline the use of GEM, this change was in the NODA version of GEM.
- Added neutral idle and start/stop effects idle portions of the ARB Transient cycle. These were minor changes, all were in NODA version of GEM
- Adjusted shift and torque converter lockup strategy. This was a minor change to streamline the use of GEM, this change was in the NODA version of GEM.

Notwithstanding these numerous opportunities for public comment (as well as many informal opportunities via individual meetings), some commenters maintained that they still had not received

sufficient notice to provide informed comment because each proposal represented too much of a “moving target.”<sup>280,281,282</sup> The agencies disagree. Even at proposal, Phase 2 GEM provided nearly all of the essential features of the version we are promulgating in final form. These include: (1) the reconfiguration of the engine, transmission, and axle sub-models to reflect additional designs and to receive manufacturer inputs; and (2) the addition of road grade and idle cycles for vocational vehicles, along with revised weighting factors. Moreover, the changes the agencies have made to GEM in response to public comment indicates that those comments were highly informed by the proposal. The agencies thus do not accept the contention that commenters were not afforded sufficient information to provide meaningful comment on GEM.

### Custom Chassis Vocational Vehicles

In their comments on the scope of the NODA, Volvo and Autocar specifically express concerns about the opportunity for notice and comment with respect to the vocational vehicle program. We disagree with these commenters that adequate notice and comment was not given. Besides the proposal and other notices published in the Federal Register, the agencies conducted timely outreach to affected stakeholders during the deliberative phase of this rulemaking, to share interim information about program revisions being considered in response to the initial round of public comments, conducting a web conference on March 22, 2016 for chassis manufacturers (EPA-HQ-OAR-2014-0827-1944) and many face-to-face meetings and telephone conferences as documented in the Heavy-Duty Stakeholder Meeting Log in the rulemaking dockets (EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). Please see Section 6 of this RTC for further discussion of comments received expressing specific concerns with the custom chassis program (which, among other things, indicate the adequacy of notice provided, given the detailed and pertinent range of the comments in response).

### Selective Enforcement Audits and Confirmatory Testing

As part of the NODA, EPA placed into the docket a memorandum providing additional discussion of SEAs and confirmatory testing with respect to aerodynamic testing for both tractors and trailers.<sup>283</sup> This memorandum discussed key principles behind such testing and included draft regulatory text detailing a potential SEA structure for tractors. EPA made this available to the public in response to comments asking for more detail about how SEAs for aerodynamics would be conducted. NODA comments supported both the general principles and the specific regulatory text. EPA has finalized changes consistent with both this memorandum and these comments.

In response to comments from engine and vehicle manufacturers, EPA is also making changes to the regulations for SEAs and confirmatory testing with respect to engine fuel maps and other GEM inputs. These were discussed with manufacturers during meetings between EPA and the manufacturers to discuss compliance issues after the NPRM.<sup>284</sup>

### Other Comments in this Section

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<sup>280</sup> Memo to Docket, “Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking,” August 2016.

<sup>281</sup> Memo to Docket, “Summary of Meetings and Conference Calls with Allison Transmission to Discuss the Phase 2 Heavy-Duty GHG Rulemaking,” August 2016.

<sup>282</sup> “Heavy-Duty Phase 2 Stakeholder Meeting Log,” August 2016.

<sup>283</sup> “Additional Discussion of Selective Enforcement Audit and Confirmatory Testing for Aerodynamic Parameters for Combination Tractors and for Trailers,” February 19, 2016, Docket ID:EPA-HQ-OAR-2014-0827-1625.

<sup>284</sup> Memo to Docket, “Summary of Meetings and Conference Calls with the Truck and Engine Manufacturers Association to Discuss the Phase 2 Heavy-Duty GHG Rulemaking,” August 2016.

We disagree with the EMA comment that it is “fundamentally unreasonable and inconsistent with administrative due process” to expect manufacturers to “reasonably assess the stringency and feasibility of the Proposed Phase 2 Vehicle Standards” when parts of the rule are still being revised. First, it is a legal commonplace that an agency may issue a final rule that does not coincide with a proposed rule as long as the final rule is a “logical outgrowth” of the proposed rule. Otherwise, a comment period would become a perpetual exercise, with every change occasioning a new comment period. See, e.g. *Small Ref. Lead Phase-Down Task Force v. EPA*, 705 F. 2d 506, 546-47 (D.C. Cir. 1983); *Fertilizer Inst. v. EPA*, 935 F. 2d 1303, 1311 (D.C. Cir. 1991); *Conn. Light and Power Co. v. NRC*, 673 F. 2d 535, 533 (D.C. Cir. 1982). Second, notice and comment obligations are fully satisfied when a commenter has actual notice. *Small Ref. Lead-Phase Down*, 705 F. 2d at 548, 549. Under section 307 (d) of the Clean Air Act (and section 553 (c) of the APA), the purpose of the public comment period is to give interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments and to give affected parties an opportunity to develop evidence in the record to support their objections to a rule. See, e.g. *Small Ref. Lead Phase-Down*, 705 F. 2d at 547. All stakeholders had such an opportunity, and could reasonably anticipate not only the issues at stake, but also the contents of the final rule. See, e.g., *Anne Arundel County v. EPA*, 963 F. 2d 412, 418 (D.C. Cir. 1992); *Am. Med. Ass’n v. United States*, 887 F. 2d 760, 768 (7th Cir. 1989). Indeed, the agencies did not limit the manufacturers’ input to that provided within the two formal public comment periods. The agencies held numerous meetings and conference calls with the manufacturers until very late in the process. Clearly, throughout this rulemaking, manufacturers had ample opportunity to provide written data, views, and arguments on each area of the rulemaking.

We received comments from the motorcoach industry claiming that the agencies did not “engage with motorcoach manufacturers or the motorcoach industry, in any meaningful way.” This comment was made during the public comment period, when the agencies were in fact collecting feedback from all stakeholders. We note also that the list of stakeholder outreach we mention in the Preamble to the rulemaking is not meant to be comprehensive, but rather is as an example of all the types of stakeholders included. The complete list of stakeholders and our documented outreach can be found in the Stakeholder Meeting Log in the rulemaking dockets (EPA-HQ-OAR-2014-0827; NHTSA-2014-0132). Documented as part of the list are numerous meetings, phone calls, and conversations that the agencies have had with representatives of the motorcoach industry.<sup>285</sup> As detailed in Section 6 of this RTC document, we have carefully considered the motorcoach industry’s comments and in response to their concerns we are adopting optional standards for seven applications of vocational vehicles, including motorcoaches, that we are calling custom chassis.

We received several comments with respect to the scope of the agencies’ release of a NODA, which called for public comment on information in the public docket obtained after the proposal. Some commenters felt that the scope was too limited. The purpose of a NODA is to provide an opportunity for stakeholders and the public to comment on *new* information being made available by the EPA and by NHTSA; it did not serve as means to make policy changes to the proposal. In fact, what the commenters are requesting by broadening the scope of the NODA would be a Supplemental Notice of Proposed Rulemaking, which is not needed because the agencies have provided ample notice and comment on all aspects of the rules and, after considering stakeholder feedback and public comments, have made changes that are logical outgrowths of the proposal and, in many instances, reflect determinations of which stakeholders had direct notice. We discuss how we have met our notice and comment obligations as part of this response above, and with respect to specific aspects of the program

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<sup>285</sup> See emails with ABC Companies and CH Bus Sales/Temsa between September 2015 and April 2016; See also phone log for August 2015 call with MCI.

throughout this RTC. On the issue of the NODA, Autocar comments include a request for extension of the NODA comment period. We find the 30 days given as sufficient time for stakeholders and the public to review and provide meaningful comment, as we requested comment on only the following 10 items: powertrain data; additional aerodynamic test data; supplemental data relating to drive cycles for vocational vehicles; cycle average mapping data; certain revised test reports; a revised version of GEM; default gasoline engine fuel maps for GEM; a memorandum addressing potential requirements for selective enforcement audits and confirmatory testing related to greenhouse gas emissions; a memorandum addressing the applicability of emission standards and certification responsibilities for trailers, glider vehicles, and glider kits; and a late comment related to light-duty motor vehicles used for racing. Many other commenters provided detailed, exacting comments addressing these items. Moreover, the agencies further engaged with Autocar on the concerns expressed in their NODA comments, including multiple meetings and telephone calls as documented in the Stakeholder Meeting Log in the rulemaking docket, and the final program addresses their detailed issues as described further in Section 6 of this RTC.<sup>286</sup>

In their comments, OOIDA encouraged the agencies to add a third public hearing at a location more focused on their representative segment of trucking, or to conduct a hearing to coincide with the Great American Trucking Show (GATS) in Dallas, Texas. The agencies accommodated this request by sending a representative to the GATS event to hear specifically from truck drivers and fleet owners; however, few of these stakeholders attended the meeting.

## **15.6 Mid-term Review**

2024

**Organization:** American Iron and Steel Institute

An additional or alternative option would be for EPA and NHTSA to incorporate a 'mid-term evaluation' provision such as that incorporated in the MY 2017-2025 LDV rule. [EPA-HQ-OAR-2014-0827-1275-A1 p.19]

**Organization:** American Trucking Associations (ATA)

### **A Contingent Mid-Course Review Should be Incorporated into the Final Rule**

Regulating heavy-duty vehicles is far more complex than that of light-duty vehicles. As such, it is imperative upon the agencies to ensure the multiple fuel efficiency milestones set out for trailers, engines, and vehicles under Phase 2 proceed in an achievable and orderly manner. ATA therefore strongly urges the agencies to undertake a mid-course review during the implementation process if warranted. [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

Mid-course reviews are not unfamiliar to the agencies. EPA and NHTSA endorsed a mid-course review process under the Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for MY 2017-2025. Such a review can determine whether the multiple standards remain appropriate in light of technological and other changes that may have occurred since the time of proposal. A mid-course evaluation, if necessary, would include consideration of the state of technology development, technology and fuel costs, market penetration rates, national harmonization of standards, the state of the national economy and the trucking industry, safety considerations, impacts of superseding regulatory or legislative activities, other factors considered by the agencies in setting the

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<sup>286</sup> See [Emails between EPA and Autocar from August 2015 to June 2016](#).

standards, and the expected impact of those factors on the OEMs ability to comply. [EPA-HQ-OAR-2014-0827-1243-A1 p.26]

Of critical importance are the event or events that would trigger such a review. One such trigger would be finalizing any new state and/or federal NO<sub>x</sub> or PM emission standards for medium and heavy-duty engines and vehicles during the implementation period under Phase 2. Additional standards triggering an evaluation would include state-specific deviations from Phase 2; widespread OEM non-compliance due to impossibility (including agency miscalculations in technology market penetration rates, equipment cost estimates, economic factors, and other matters resulting in the agencies not achieving their respective GHG and fuel efficiency goals and objectives as set out under the final rule). [EPA-HQ-OAR-2014-0827-1243-A1 p.26-27]

If triggered, a mid-course review should be pursued as expeditiously as possible while ensuring any modifications to the standards enacted by the final rule are consistent with the lead time and stability requirements of the Clean Air Act (42 USC §7521(a)(3)(C)). Using the Light-Duty Rule as a guide, EPA and NHTSA should prepare and publish a draft Technical Assessment Report that should be peer-reviewed and made available for public comment. The agencies should also solicit comments on whether the standards and specific targets are being achieved. If the agencies conclude that the standards are not being achieved or likely will not be achieved due to some triggering effect, the agencies will initiate a rulemaking to revise the original standards, as appropriate under Section 202(a), and issue a joint rulemaking at least 18 months prior to the beginning of the next full model years of regulated equipment [EPA-HQ-OAR-2014-0827-1243-A1 p.27]

A mid-course review is more than just appropriate; it is a critical component of this rulemaking package if these standards are to be successful. Phase 2 will govern vehicle production 12 years from now and beyond, a particularly long time period when predicting the state of technology development, equipment costs and durability, maintenance issues, driver satisfaction, fuel pricing and consumption levels, consumer behaviors, the state of the economy and the trucking industry, other state and federal regulatory and legislative requirements, and future equipment build rates. As we are just beginning implementation under Phase 1, the trucking industry is now tasked with assessing potential impacts and feasibility under Phase 2, along with the real possibility of a Phase 2 conflict that will likely occur as a result of CARBs upcoming revisions to its truck GHG efforts. [EPA-HQ-OAR-2014-0827-1243-A1 p.27]

The Phase 2 effort and expense will further our country's energy and environmental goals, but only if fleets choose to purchase these fuel-efficient, climate-friendly vehicle technologies. Any mid-course evaluation will allow the agencies to determine whether the standards are in fact achievable and make appropriate changes to ensure that progress in reducing GHGs and saving fuel will proceed based upon the multitude of factors that can impact the original targets established in 2016. [EPA-HQ-OAR-2014-0827-1243-A1 p.27]

**Organization:** Great Dane

We believe that careful consideration and review of the impact of the proposed regulations and further interaction with stakeholders is necessary to properly weigh the effects on our industry and to reduce the probability of unintended consequences. Thus we feel that an arbitrary schedule to impose a regulation is inappropriate and that an aggressive schedule introduces additional risks. Thus we suggest that the agencies consider the potential benefits of incorporation of a review and adjustment process at the mid-point of the proposed regulatory period. [EPA-HQ-OAR-2014-0827-1219-A1 p.4-5]

**Organization:** National Automobile Dealers Association (NADA)

NADA/ATD specifically suggests that a mid-term “reality check” review be used to reassess the appropriateness, cost-effectiveness, and technological feasibility of the Phase 2 program and whether changes are warranted. Ideally, the review should be conducted in calendar year 2021 and would cover key variables and assumptions applicable to MY 2024 and beyond. If a determination is made that the standards for those years require modification, they should be adjusted expeditiously. A “reality check” should not be used to strengthen the stringency or significantly revise the structure of the Phase II program, but rather only to account for new or previously unexpected information critical to program achievability. [EPA-HQ-OAR-2014-0827-1309-A1 p.11]

**Organization:** United Parcel Service (UPS)

Need for Mid-Course Progress Review

UPS believes that the time horizon for this rule is so distant and the technology availability and affordability is so uncertain, that a mid-course review is needed as a safeguard to ensure the program is viable. We believe that the decision on a review should come at a time when at least a year of data is in hand. We suggest that a midcourse review be triggered when a significant proportion of the engine or truck manufacturer capacity, as determined by the EPA Administrator and the Secretary of Transportation, is in danger of future non-compliance. [EPA-HQ-OAR-2014-0827-1262-A1 p.14]

**Organization:** Utility Trailer Manufacturing Company

**Any Rule that the Agencies adopt should be reevaluated within a few years to account for uncertainties and changes, as well as availability of proven devices to comply with the Rule.**

The Proposed Rule will establish regulations for the next dozen years and beyond. It is difficult, to say the least, to anticipate with any accuracy what the transportation, environmental, or regulatory landscape will look like at that time or what complying devices will be available. Rather than set guidelines now for those out years, Utility Trailer urges the agencies to limit its adoption to proposals for the first 6 years – through 2021, with the understanding that the agencies will revisit the topics as those deadlines approach to determine how the Regulations should be modified. [EPA-HQ-OAR-2014-0827-1183-A1 p.22]

For example, even if it used all the currently available existing efficiency-improving devices set forth in the EPA tables in 100% of trailer production (automatic tire inflation systems, level 2 low-rolling-resistance tires, combination of skirts and trailer tales and a roughly 950 pound weight reduction in refrigerated trailers), Utility Trailer would not be able to qualify its long-box dry-van trailer for the years 2024 and beyond, and it would not be able to qualify its long-box refrigerated trailer for the years 2027 and beyond. [EPA-HQ-OAR-2014-0827-1183-A1 p.22]

**Organization:** Walsh, Michael and Charlton, Stephen

3. If the agencies determine there is a need to manage risk associated with new technologies, they could consider a biennial review – as defined and implemented for the 2010 criteria pollutant program, Final Rule section III.H [19]. At each review, EPA collected and analyzed information from engine manufacturers, catalyst manufacturers, internal testing, and other sources as a mechanism for monitoring and evaluating technological progress. [NHTSA-2014-0132-0102-A1 p.10]



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19 “Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements,” EPA 40 CFR Parts 69, 80, and 86, Federal Register / Vol. 66, No. 12 / Thursday, January 18, 2001.

**Response:**

We believe that it is inappropriate to schedule a formal mid-term review within the Phase 2 program because the agencies have confidence that the Phase 2 standards are feasible and cost-effective; especially considering the long lead time and the variety of compliant technology paths we project to be available to manufacturers and users of heavy-duty vehicles and engines (see also our response in Section 1.5 of this document on lead time). While the agencies are not finalizing a formal process for such a review, we note that we expect to carefully monitor program as we work with the regulated industries to implement this program. In addition, manufacturers and other stakeholders retain the ability to formally petition us for a reconsideration of some or all of the Phase 2 program based on new information.

## **15.7 Comments Related to Competition Vehicles 2027**

**Organization:** Alliance of Automobile Manufacturers and Association of Global Automakers

The Alliance of Automobile Manufacturers (“Auto Alliance”) and the Association of Global Automakers (“Global Automakers”) respectfully submit these comments to the Environmental Protection Agency (“EPA” or “Agency”) in response to its Notice of Data Availability (NODA) to re-open the comment period for certain aspects of the Proposed Rule for comments on the impact the proposed language would have on off-road racing/competition vehicles [81 Fed. Reg. 10822, March 2, 2016].<sup>1</sup> [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

### **INTRODUCTION**

In the proposed rule Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, 80 Fed. Reg. 40,138 (July 13, 2015) (Proposed Rule), in addition to proposing new greenhouse gas standards for medium- and heavy-duty vehicles, EPA included proposed language to insert in 40 C.F.R. § 86.1854-12 pertaining to new and in-use light-duty vehicles, that would make the modification of certified production or street vehicles for off-road racing/competition<sup>2</sup> a prohibited act if such vehicles did not remain in their emissions-certified status. [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

While EPA staff have claimed that the proposal is merely a clarification of the Agency’s position with regard to competition vehicles, the proposed amendment to Part 86 represents a significant departure from EPA’s longstanding approach with respect to the emissions certification of these types of vehicles. The proposal also could create conflicts with the longstanding regulatory approach the California Air Resources Board (CARB) and EPA apply to aftermarket parts. [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

This issue was brought to our attention by the Specialty Equipment Market Association (SEMA), whose December 28, 2015 comments we support. [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

To the extent that EPA intends the proposed amendment to Part 86 to reduce tampering of certified vehicles driven on the U.S. roadways, we provide a recommendation that would accomplish this while

preserving the exclusion of off-road racing/competition vehicles from Clean Air Act (CAA) regulation and preserving the aftermarket programs. [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

We hereby submit these comments pursuant to the NODA. [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

## **A. OVERVIEW OF EPA'S PROPOSAL**

The Proposed Rule seeks to amend 40 C.F.R. § 86.1854-12, which is the section of EPA's light-duty vehicle regulations on prohibited acts, by adding the following subsection: [EPA-HQ-OAR-2014-0827-1884-A1 p.2]

(a) (5) Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1884-A1 p.2-3]

80 Fed. Reg. at 40,565. This section of the federal regulations includes the general compliance provisions for controlling air pollution emissions from new and in-use light-duty vehicles, light-duty trucks, and heavy-duty trucks, and new and in-use engines. Thus, the Proposed Rule's change for off-road racing/competition vehicles would have a wide-reaching effect on a variety of vehicles. In essence, this proposed amendment would prohibit the conversion of any production or "street" vehicles for off-road racing/competition use by the installation of performance-enhancing parts or making other alterations that take the vehicle out of its certified configuration. [EPA-HQ-OAR-2014-0827-1884-A1 p.3]

The proposed changes to Part 86 are accompanied by the following Preamble discussion:

The existing prohibitions and exemptions in 40 CFR part 1068 related to competition engines and vehicles need to be amended to account for differing policies for nonroad and motor vehicle applications. In particular, we generally consider nonroad engines and vehicles to be "used solely for competition" based on usage characteristics. This allows EPA to set up an administrative process to approve competition exemptions, and to create an exemption from the tampering prohibition for products that are modified for competition purposes. There is no comparable allowance for motor vehicles. A motor vehicle qualifies for a competition exclusion based on the physical characteristics of the vehicle, not on its use. Also, if a motor vehicle is covered by a certificate of conformity at any point, there is no exemption from the tampering and defeat-device prohibitions that would allow for converting the engine or vehicle for competition use. There is no prohibition against actual use of certified motor vehicles or motor vehicle engines for competition purposes; however, it is not permissible to remove a motor vehicle or motor vehicle engine from its certified configuration regardless of the purpose for doing so. [EPA-HQ-OAR-2014-0827-1884-A1 p.3]

80 Fed. Reg. at 40527. EPA appears to be signaling that it will no longer recognize an exclusion for vehicles that have been modified to be used solely for competition purposes. As SEMA's comments explain, such action would be contrary to both the statutory text and the legislative history of the CAA.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1884-A1 p.3]

EPA'S PRESS RELEASE ON PROPOSED RULE CHANGE TO PART 86

In response to SEMA's comments and its public media efforts on this issue, EPA's Deputy Press Secretary, Laura Allen, released the following public statements, which merely restate the Agency's position on the prohibition against modifying certified vehicles for competition articulated in the Proposed Rule: [EPA-HQ-OAR-2014-0827-1884-A1 p.4]

People may use EPA-certified motor vehicles for competition, but to protect public health from air pollution, the Clean Air Act has – since its inception – specifically prohibited tampering with or defeating the emission control systems on those vehicles. The proposed regulation that SEMA has commented on does not change this long-standing law, or approach. Instead, the proposed language in the Heavy-Duty Greenhouse Gas rulemaking simply clarifies the distinction between motor vehicles and nonroad vehicles such as dirt bikes and snowmobiles. Unlike motor vehicles – which include cars, light trucks, and highway motorcycles – nonroad vehicles may, under certain circumstances, be modified for use in competitive events in ways that would otherwise be prohibited by the Clean Air Act. [EPA-HQ-OAR-2014-0827-1884-A1 p.4]

This clarification does not affect EPA's enforcement authority. It is still illegal to tamper with or defeat the emission control systems of motor vehicles. In the course of selecting cases for enforcement, the EPA has and will continue to consider whether the tampered vehicle is used exclusively for competition. The EPA remains primarily concerned with cases where the tampered vehicle is used on public roads, and more specifically with aftermarket manufacturers who sell devices that defeat emission control systems on vehicles used on public roads. [EPA-HQ-OAR-2014-0827-1884-A1 p.4-5]

Both statements are a departure from what has been understood to be EPA's approach to street vehicles used for off-road racing/competition. The second statement at least makes the distinction between modified vehicles used on the street or highway versus those used for competition and notes that EPA's enforcement office focuses on former. However, in our view, the CAA's definition of "motor vehicle"<sup>4</sup> does not include vehicles that have been modified for use solely for competition purposes, nor for use solely for off-roading purposes, and EPA therefore has no enforcement authority with respect to such vehicles in the first place. At the very least, it affords EPA with the discretion to categorically exempt such vehicles from its regulations concerning vehicle modifications—a position which we understand that EPA has long held. [EPA-HQ-OAR-2014-0827-1884-A1 p.5]

## B. CAA PROVISIONS AND EPA REGULATIONS ADDRESSING MOTOR VEHICLES USED FOR OFF-ROAD RACING/COMPETITION

EPA's proposed regulatory revision to Part 86 in the Proposed Rule would be a departure from how EPA has historically treated the conversion of street vehicles to off-road use, including for racing or competition. To date, the Agency has not attempted to regulate such conversions and thereby prohibit individual vehicle purchasers from engaging in lawful uses of their property. [EPA-HQ-OAR-2014-0827-1884-A1 p.5]

The CAA defines "motor vehicle" in Section 216(2) of the Clean Air Act (42 U.S.C. § 216(2)) as "any self-propelled vehicle designed for transporting persons or property on a street or highway."<sup>5</sup> Since off-road racing/competition vehicles ought not and generally are not driven on streets or highways, they have long been considered to fall outside of the CAA anti-tampering provisions. Additionally, 40 C.F.R. § 85.1703 provides the criteria for determining the applicability of § 216(2) of the CAA: [EPA-HQ-OAR-2014-0827-1884-A1 p.5]

(a) For the purpose of determining the applicability of section 216(2), a vehicle which is self-propelled and capable of transporting a person or persons or any material or any permanently or temporarily

affixed apparatus shall be deemed a motor vehicle, unless any one or more of the criteria set forth below are met, in which case the vehicle shall be deemed not a motor vehicle: [EPA-HQ-OAR-2014-0827-1884-A1 p.5]

(1) The vehicle cannot exceed a maximum speed of 25 miles per hour over level, paved surfaces; or [EPA-HQ-OAR-2014-0827-1884-A1 p.5-6]

(2) The vehicle lacks features customarily associated with safe and practical street or highway use, such features including, but not being limited to, a reverse gear (except in the case of motorcycles), a differential, or safety features required by state and/or federal law; or [EPA-HQ-OAR-2014-0827-1884-A1 p.6]

(3) The vehicle exhibits features which render its use on a street or highway unsafe, impractical, or highly unlikely, such features including, but not being limited to, tracked road contact means, an inordinate size, or features ordinarily associated with military combat or tactical vehicles such as armor and/or weaponry.<sup>6</sup> [EPA-HQ-OAR-2014-0827-1884-A1 p.6]

Vehicles that have been modified for off-road racing/competition have traditionally been held to fall under the second criterion. Modified competition vehicles have features that are not associated with “safe and practical street or highway use” and indeed, are meant to be used on racetracks and closed circuits. Some competition vehicles may also fall under the third criterion, depending on how they are equipped. Similarly, modified off-roading vehicles virtually always fall under the second or third criterion, generally because components or features are added to the vehicle to enhance the off-roading experience, not that components are removed to enhance racing. [EPA-HQ-OAR-2014-0827-1884-A1 p.6]

Addressing solely competition vehicles, EPA has teamed up with the U.S. Department of Energy (DOE) since 2006 to develop and implement a Green Racing Program, which according to the agencies’ website, is an initiative to encourage “the racing industry to embrace innovation and enhance existing vehicle technologies to maximize efficiency.”<sup>7</sup> The Green Racing program developed protocols that establish guidelines for motorsport competitors to utilize and develop technologies and fuels that support emissions reductions. If EPA meant to prohibit the modification of certified motor vehicles for racing/competition, establishing voluntary standards for those vehicles is contrary to EPA’s proposed “clarification” to Part 86. [EPA-HQ-OAR-2014-0827-1884-A1 p.6]

As noted above, it has been a long accepted understanding that the CAA does not prohibit the modification of certain vehicles and/or engines if those vehicles and/or engines are used “solely for competition” on race tracks and closed circuits, or used for exclusive use at off-road rally events. This understanding has been based, in large part on the CAA definition of “motor vehicle” and EPA’s regulations, as well as EPA’s practice in not pursuing enforcement actions against individuals and manufacturers who modify vehicles and/or engines for off-road racing/competition purposes. [EPA-HQ-OAR-2014-0827-1884-A1 p.6]

Finally, when considered in the broader context of permissible modifications to certified motor vehicles that occur in the aftermarket parts context, EPA’s proposed change to Part 86 to prohibit the modification of certified vehicles would conflict with California law which specifically exempts competition and racing vehicles that are not used on highways. See, California Health and Safety Code §§ 43001(a) and 39048. With regard to other aftermarket performance components that are used in on-highway vehicles, CARB has had a long standing program for approving aftermarket parts for certified vehicles through the Executive Order process. The proposed revision also conflicts with the Agency’s

own longstanding guidance with regard to aftermarket parts in EPA's Enforcement Memorandum 1A (June 25, 1974), which recognizes express representation by a state agency that a reasonable basis exists that an aftermarket part (which would modify a certified vehicle) does not adversely affect emissions performance, and therefore, can be lawfully installed on a certified vehicle and is not considered tampering under the Act. EPA's enforcement guidance also permits emissions testing to serve as a reasonable basis. EPA's Proposed Rule could be interpreted as completely eliminating the ability to rely on this longstanding guidance for on-highway vehicles. [EPA-HQ-OAR-2014-0827-1884-A1 p.6-7]

### C. REGULATORY TREATMENT OF OTHER COMPETITION VEHICLES

Attached is a matrix of the various regulatory provisions addressing competition vehicles in other vehicle segments as well as the general provision on prohibited acts and the exemption for equipment and engines used solely for competition. Included at the beginning of the matrix are the definitions and prohibited act provisions pertaining to light-duty "motor vehicles" for comparison purposes. [EPA-HQ-OAR-2014-0827-1884-A1 p.7][Attachment can be found in docket number EPA-HQ-OAR-2014-0827-1884-A2]

When reviewing the competition provisions for marine engines, recreational vehicles, and other types of nonroad engines and equipment, it is clear that manufacturers producing competition vehicles, in most cases, must affirmatively request an exemption from EPA, demonstrate that particular criteria are met, and must label the vehicle accordingly. See §§ 1042.620, 1045.620, 1048.630 (incorporating by reference § 1054.620), 1051.620, and 1054.620. [EPA-HQ-OAR-2014-0827-1884-A1 p.7]

With regard to modifying certified vehicles for competition, the general provisions in Part 1068 allow these vehicles to be modified without request so long as they are used solely for competition and the original emission labels are destroyed. Specifically, this provision states: [EPA-HQ-OAR-2014-0827-1884-A1 p.7]

(b) If you modify any nonroad engines/equipment after they have been placed into service in the United States so they will be used solely for competition, they are exempt without request. This exemption applies only to the prohibition in § 1068.101(b)(1) [tampering] and is valid only as long as the engine/equipment is used solely for competition.<sup>8</sup> [EPA-HQ-OAR-2014-0827-1884-A1 p.7]

All the vehicle segments referenced above incorporate the general compliance provisions in Part 1068 by reference; thus, § 1068.235 applies to all the nonroad vehicle segments. In summary, there are two different pathways for vehicles in these other nonroad segments to become competition vehicles – they can be either manufactured specifically for that purpose and exempted through the specific provision in the relevant part applicable to those engines/vehicles, or they can be in-use vehicles/engines that are modified for that purpose according to Part 1068. Both pathways are lawful, provided that the regulations are followed and similar consideration should be applicable to light-duty vehicles. [EPA-HQ-OAR-2014-0827-1884-A1 p.7-8]

While the approaches outlined above are appropriate for nonroad vehicles, it is far easier to address light duty vehicles used for competition and off-roading. There are self-policing mechanisms that make it far easier to determine if a light-duty vehicle is used for competition purposes. These vehicles either will not be registered in a state or were formerly registered but modified and driven on non-highway terrain, insurance is typically unavailable, and in any instance, if the modifications are such the vehicle would fail state safety inspections if an owner attempted to drive this on public roads, that mechanism will serve as enforcement. For these reasons, a system such as contained in Part 1068 for nonroad vehicles need not be utilized for light duty vehicles. [EPA-HQ-OAR-2014-0827-1884-A1 p.8]

#### D. PROCEDURAL CONCERNS

SEMA's comments raise a number of valid Administrative Procedure Act (APA) issues with regard to the lack of public notice, germaneness, and the arbitrary and capricious nature of the proposed revision to Part 86. Specifically, SEMA points to the fact that EPA's statement regarding the prohibition against modification of certified motor vehicles even if used for competition is buried in the 629-page proposal for greenhouse gas standards for medium- and heavy-duty vehicles and that the Preamble discussion does not clearly identify the proposed regulatory revision to Part 86. While EPA has made it a practice over the years of including a number of different regulatory changes in a rule package, it was not clear, or even intuitive that the Proposed Rule for medium- and heavy-duty vehicles would include changes to the light-duty vehicle regulations. [EPA-HQ-OAR-2014-0827-1884-A1 p.8]

EPA has received 769 comments on the Proposed Rule. Of the organizations submitting comments that we were able to briefly review, those comments have not focused on the competition or off-roading issue discussed herein. Rather, they have focused mainly on fuel efficiency, the proposed emission standards, and greenhouse gas credits for medium- and heavy-duty vehicles and engines, the obvious and overtly intended purpose of the Proposed Rule itself. In addition to these comments, there were 49 anonymous comments filed since February 16 objecting to EPA's proposed prohibition against modifying certified vehicles due to the negative effects on racing. It is very likely that these individuals commented as a result of SEMA's press efforts on this issue. The lack of comments on the proposed Part 86 revision submitted during the comment period, followed by these late comments, demonstrates that EPA did not give adequate public notice of its proposal. [EPA-HQ-OAR-2014-0827-1884-A1 p.8]

#### E. POSITION OF ALLIANCE OF AUTOMOBILE MANUFACTURERS AND GLOBAL AUTOMAKERS

As discussed above, EPA's proposal to prohibit the conversion of certified on-road vehicles to competition vehicles is a major departure from the Agency's approach to this issue throughout the 40+-year history of the Clean Air Act. Moreover, the proposal would have the effect of depriving consumers of property rights by prohibiting legitimate uses of motor vehicles and depriving vehicle and engine manufactures, aftermarket component manufacturing and sellers, and dealers and retail establishments from their trade and commercial rights. [EPA-HQ-OAR-2014-0827-1884-A1 p.8]

We begin by acknowledging that EPA has the authority and the obligation, under the CAA, to prohibit tampering with certified motor vehicles. Individuals and entities who remove emissions control equipment from certified vehicles, or otherwise put such vehicles into an uncertified configuration, and then drive them on public roads, commit tampering under the Act. Likewise, outfits that sell "power chips" and other devices under false pretenses (often promising consumers that the devices do not affect their emissions or their warranty) tend to induce or encourage tampering, likely committing fraud or other violations of law in the process. We support EPA's efforts to put an end to such practices. [EPA-HQ-OAR-2014-0827-1884-A1 p.8-9]

In cracking down on tampering, however, EPA must not go so far as to outlaw legitimate activities and businesses. If an individual purchases an emissions-certified production sports car, adds aftermarket components or removes production parts to convert it to a non-emissions-certified competition vehicle, and uses it only for competition, that individual has not engaged in tampering or otherwise violated the Clean Air Act. If an individual purchases an emissions-certified production sport utility vehicle, adds aftermarket components or removes production parts to convert it to a non-emissions-certified off-roading vehicle, and uses it only off-road, say, driving it over terrain an unmodified production vehicle could not, that individual similarly has not committed tampering or otherwise violated the Clean Air

Act. Thousands of vehicles sold annually are legitimately converted to competition or off-roading vehicles. EPA's proposed rule would, with the stroke of a pen, prohibit these legitimate activities and suddenly deprive all vehicle owners of their right to convert an emissions-certified vehicle into a legitimate non-emissions-certified vehicle, and will suddenly deprive manufacturers and sellers the right to sell those owners the components they need for such vehicle uses. While such a broad-brush rule would undoubtedly make life easier for EPA, the deprivation of property rights inherent in the Proposed Rule it is neither consistent with, nor authorized by, the CAA. [EPA-HQ-OAR-2014-0827-1884-A1 p.9]

Like EPA, the Alliance and Global Automakers oppose vehicle tampering. We support more education and outreach to inform consumers about the CAA prohibition on tampering, and to explain the rules with respect to the conversion of emissions-certified vehicles to non-emissions-certified competition or off-roading vehicles. We also support government efforts to enforce the tampering prohibition against individuals and entities when warranted by the facts. We cannot, however, support an EPA initiative to enact a total ban on vehicle conversions, including legitimate activities that have been taking place since the inception of the CAA and before. Rather than "throwing the baby out with the bathwater" by banning legal activities as well as illegal ones, we recommend that EPA take a different approach as outlined below. [EPA-HQ-OAR-2014-0827-1884-A1 p.9].]

While the approaches outlined above are appropriate for nonroad vehicles, it is far easier to address light duty vehicles used for competition. There are self-policing mechanisms that make it far easier to determine if a light-duty vehicle is used for competition purposes. These vehicles will not be registered in a state, insurance is typically unavailable, and in any instance the modifications made make it almost certain that such a vehicle would fail state safety inspections if an owner attempted to drive this on public roads. For these reasons, a system such as contained in Part 1068 for nonroad vehicles need not be utilized for light duty vehicles. [EPA-HQ-OAR-2014-0827-1884-A1 p.9]

## F. RECOMMENDED ACTIONS

In response to EPA's NODA and request for comment on SEMA's December 28, 2015 comments on how the proposal would impact off-road racing/competition, we recommend that EPA amend § 86.1854-12 as follows: [EPA-HQ-OAR-2014-0827-1884-A1 p.9]

(a)(5) Certified motor vehicles and motor vehicle engines that are designed to be operated on a street or highway and their emission control devices must remain in their emissions-certified configuration unless good engineering judgment or emissions testing provides a reasonable basis for knowing that a modification will not affect emissions performance. Anyone modifying such a certified motor vehicle or motor vehicle engine that renders such motor vehicle or motor vehicle engine non-compliant with its certificate of conformity and who drives such motor vehicle on a U.S. street or highway is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. § 7522(a)(3). [EPA-HQ-OAR-2014-0827-1884-A1 p.10]

In conjunction with the change noted above, EPA also needs to include a new criterion excluding competition and off-roading vehicles from the definition of "motor vehicle" in § 85.1703. Specifically, EPA should add a new § 85.1703(a)(4) that would state: "The vehicle is used solely for competition or off-roading use." This new criterion would reflect the concept in the statutory definition of "motor vehicle" in CAA § 216(2) that such vehicles are used for transporting persons or property on a street or highway and codify EPA's longstanding treatment of these vehicles. This twofold approach would create a regulatory prohibition on modifying certified vehicles operated on U.S. roadways that would retain EPA's, as well as CARB's, regulatory programs for aftermarket parts and modifications, as well

as preserve the longstanding enforcement policy of EPA with regard to off-road racing/competition vehicles. [EPA-HQ-OAR-2014-0827-1884-A1 p.10]

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1 Auto Alliance members include BMW, FCA U.S, Ford, General Motors, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi, Porsche, Toyota, Volkswagen and Volvo. See [www.autoalliance.org](http://www.autoalliance.org) for further information. Global Automakers' members include Aston Martin, Ferrari, Honda, Hyundai, Isuzu, Kia, Maserati, McLaren, Nissan, Subaru, Suzuki, and Toyota. Please visit [www.globalautomakers.org](http://www.globalautomakers.org) for further information.

2 In these comments, the term “off-road racing/competition” is intended to include exclusive off road use at rallies and similar events as long as the vehicle is not used on public roads or streets.

3 In addition to the proposed change to Part 86, the Agency is proposing to modify or add new regulatory definitions and provisions to several other sections of the C.F.R. that may impact vehicles modified for competition purposes. First, the Proposed Rule would amend the definition of “motor vehicle” in Part 85. Specifically, EPA is proposing to add a new § 85.1703(b) that would state:

Note that, in applying the criterion in paragraph (a)(2) [state and/or federal safety features] of this section, vehicles that are clearly intended for operation on highways are motor vehicles. Absence of a particular safety feature is relevant only when absence of that feature would prevent operation on highways.

Proposed Rule at 40,552.

As discussed in greater detail in the following section of these comments, the lack of safety features is one way that competition vehicles are distinguished from motor vehicles. While EPA explains that this regulatory language is intended to ensure that glider kits and glider vehicles are regulated as motor vehicles, the proposed language seems to narrow the kinds of competition vehicles that could be excluded from the definition of motor vehicle. When discussing this proposed change in the Preamble, EPA states that the Agency “is also considering whether to simply eliminate the clause ‘or safety features required by state and/or federal law’ from the regulatory definition.”<sup>3</sup> This is particularly troubling given that the lack of safety features is often relied on when distinguishing a competition vehicle from a motor vehicle used on streets and highways.

Second, the Proposed Rule would add new sections 40 C.F.R. §§ 1036.601(a)(2) and 1037.601(a)(3), which govern the control of emissions from new and in-use heavy-duty highway engines and heavy-duty motor vehicles. These proposed changes state that the §1068.235 exemption for vehicles used solely for competition does not apply to heavy-duty vehicles or heavy-duty engines. Third, the Proposed Rule would add a new definition to 40 C.F.R. §1068.30 – a section of EPA’s regulations that govern the general compliance provisions for highway, stationary, and nonroad programs. Finally, the Proposed Rule would add a new provision at 40 C.F.R. §1068.101(b)(4)(ii), which deals with prohibited acts under the Agency’s general compliance provisions for highway, stationary, and nonroad programs. This proposed provision reiterates the same language proposed for Part 86 that will require certified motor vehicles and engines to remain in their certified condition, regardless of whether they are used solely for competition.

4 42 U.S.C. § 7550(2).



5 42 U.S.C. § 7550(2) (emphasis added).

6 40 C.F.R. § 85.1703 (emphasis added).

7 <https://www4.eere.energy.gov/vehiclesandfuels/greenracingcup/what-is>.

8 40 C.F.R. §1068.235 (see attachment for entire provision).

**Organization:** American Council for an Energy-Efficient Economy (ACEEE) et al.

### **EPA's Clean Air Act Authority**

#### *Protecting Against Defeat Devices*

Comments submitted in response to the Notice of Data Availability and raised in the media have expressed concern about EPA's authority to regulate aftermarket modification of vehicles. Our organizations strongly support EPA's long-standing authority to prevent tampering with emissions control systems, including the installation of defeat devices, on vehicles used on public roads. Many such technologies that alter or bypass emissions control systems are sold under the guise of competitive racing, but marketed for use on vehicles that are used on public roads. Such defeat devices lead to increased emissions of a range of pollutants which threaten public health. Going forward, EPA should continue to ensure that aftermarket defeat devices do not lead to increased emissions of health-threatening pollution from on-road vehicles. We note that EPA's record of enforcement has focused on technologies that are being sold to defeat emission control devices in vehicles that are being used on public roads, not competitive racecars used off public roads. [EPA-HQ-OAR-2014-0827-1896-A1 p.7]

**Organization:** American Motorcyclist Association et al.

In support of the Specialty Equipment Market Association's (SEMA) statement of December 28, 2015 to the EPA in opposition to that portion of the rule banning conversion of street vehicles into racecars and competition motorcycles, the following comments question the merits of the EPA's proposal and the procedures taken by the EPA in pursuing it. [EPA-HQ-OAR-2014-0827-1929-A1 p.1]

The undersigned entities represent businesses encompassing all sectors of the racing industry. This includes companies that produce converted race vehicles, manufacturers of products for both converted and purpose-built race vehicles and race-sanctioning organizations. The issue has broad economic impact for millions of people employed in the racing sector in manufacturing, distribution, retailing, installation, marketing, publishing and entertainment, as well as millions of racing enthusiasts and spectators. [EPA-HQ-OAR-2014-0827-1929-A1 p.1]

In its July 13, 2015, proposed regulation the EPA included a provision to clarify that it has always been illegal to modify a motor vehicle into a race vehicle used solely for competition if the vehicle no longer remains in its certified configuration. The undersigned companies and organizations strongly disagree and respectfully request that the EPA withdraw its clarification. Congress did not intend for the EPA to regulate race vehicles, including production vehicles that have been converted into race vehicles and products used solely for racing. [EPA-HQ-OAR-2014-0827-1929-A1 p.1]

#### EPA's Proposed Racing Vehicle Conversion Prohibition

On pages 429 and 584 of the 629-page proposed rule addressing greenhouse gases for trucks and buses, the EPA inserted the following proposed regulatory text on racecar and competition motorcycle conversions: [EPA-HQ-OAR-2014-0827-1929-A1 p.2]

## **PART 86--CONTROL OF EMISSIONS FROM NEW AND IN-USE HIGHWAY VEHICLES AND ENGINES**

### **Subpart S--General Compliance Provisions for Control of Air Pollution From New and In-Use Light-Duty Vehicles, Light-Duty Trucks, and Heavy-Duty Vehicles**

67. Section 86.1854-12 is amended by adding paragraph (b)(5) to read as follows:

§ 86.1854-12 Prohibited acts.

(b) \* \* \*

(5) Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1929-A1 p.2]

### **Part 1068 - Subpart B—Prohibited Actions and Related Requirements**

236. Section 1068.101 is amended by revising the introductory text and paragraphs (a)(1), (b), and (h) introductory text to read as follows: [EPA-HQ-OAR-2014-0827-1929-A1 p.2]

[40 CFR 1068.101(b)(4)(ii)]

Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of 40 CFR 1068.101(b) and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1929-A1 p.2]

The EPA's proposed regulation would affect any racing vehicle that started its life as a street car or motorcycle. It would cover all motor vehicles produced since 1968 (1978 for motorcycles), the first year federal emissions standards took effect, which are used solely for racing and no longer remain in their certified configuration with respect to emissions-related equipment. The EPA provided little guidance on its goal beyond an intent to prohibit modifications affecting any emissions-related component. "Emissions-related" is broadly construed to include any change to a vehicle's engine, engine control module, intake, exhaust system or other related part, even if the vehicle is converted into a dedicated track car and never again used on the streets. [EPA-HQ-OAR-2014-0827-1929-A1 p.2]

#### Clean Air Act Racing Vehicle Exclusion

Enacted more than 45 years ago, the Clean Air Act (CAA) prohibits the EPA from regulating "vehicles used solely for competition" (more commonly known as racecars and competition motorcycles). In the ensuing years, the regulated industry is unaware of a single instance in which the EPA previously took

the position that the CAA applies to vehicles converted for race-use-only purposes. At a March 15, 2016 hearing before the House Science, Space, and Technology's Oversight Subcommittee, Brent Yacobucci with the Congressional Research Service (CRS) testified that the CRS was unable to identify any EPA document before this current rulemaking that stated motor vehicles converted for racing were ineligible for the CAA exclusion. [EPA-HQ-OAR-2014-0827-1929-A1 p.2-3]

Industry, the public and lawmakers have a clear understanding that these vehicles are excluded from the CAA. Today, there are more than 1,300 race tracks in the United States and the vast majority are not dedicated to purpose-built race vehicles. Tens of thousands of enthusiasts race converted street vehicles that are trailered to their local tracks. Most of these vehicles are sold through auto dealerships across the nation both as new and used vehicles to be converted into race cars. Furthermore, many dealerships, dealership organizations, and dealership employees are involved in sponsoring race teams, building out race cars, and even sitting behind the wheel on race day. [EPA-HQ-OAR-2014-0827-1929-A1 p.3]

### Legislative History

The CAA prohibits modifications to motor vehicles used on public roads that would take the vehicle out of compliance. Under the law, the term "motor vehicle"[1] is limited to a vehicle designed for transport "on a street or highway." When Congress authorized the EPA to regulate nonroad vehicles, it explicitly made clear that the term "nonroad vehicle"[2] did not include a "motor vehicle" or a "vehicle used solely for competition." When enacting the CAA in 1970, Congress even confirmed in conference committee deliberations that the term "motor vehicle" does not extend to vehicles manufactured or modified for racing.[3][EPA-HQ-OAR-2014-0827-1929-A1 p.3]

### Flawed Regulatory Process

Further, this proposed racing conversion prohibition raises significant fairness and due process concerns. The proposed prohibition was buried within a wholly unrelated 629-page greenhouse gas rule for trucks and buses. There was not even a subject heading alerting the public to its insertion. Rather, it was addressed along with other miscellaneous issues under the generic heading "XIV. Other Proposed Regulatory Provisions." [EPA-HQ-OAR-2014-0827-1929-A1 p.3]

As a consequence, the EPA failed to comply with the Administrative Procedure Act and Clean Air Act requirements requiring that the public be notified and given an opportunity to comment on a proposed rule. Constitutional due process also demands agencies provide adequate notice to regulated individuals. [EPA-HQ-OAR-2014-0827-1929-A1 p.3-4]

Further, the EPA failed to conduct an economic analysis, regulatory-flexibility analysis or small business analysis on the race vehicle provisions, as required by law. [EPA-HQ-OAR-2014-0827-1929-A1 p.4]

When it published the March 2nd Notice of Data Availability, the EPA had an opportunity to acknowledge the inclusion of the unrelated prohibition of modified race vehicles and rescind that portion of its proposal. Instead, the EPA simply asked the public to comment on SEMA's comments. The EPA did not defend its position and once again failed to provide an economic analysis, regulatory-flexibility analysis and small business analysis. [EPA-HQ-OAR-2014-0827-1929-A1 p.4]

### Conclusion

The EPA has threatened to make illegal activities that have taken place for decades and accounted for billions of dollars of economic activity, and would account for billions more moving forward. This unannounced and unilateral action is being taken without regard to the decades-long understanding of the application of the law to street vehicles modified for exclusive use at the track or as much as a single economic analysis. [EPA-HQ-OAR-2014-0827-1929-A1 p.4]

The EPA's proposed prohibition would be devastating to many types of racing, especially at the amateur level where the racers are not in a position to purchase purpose-built race vehicles. As previously noted, it would also threaten jobs and economic well-being for the entire racing industry, from companies that manufacture and market racing products to media outlets that cover amateur racing and communities that support the tracks. [EPA-HQ-OAR-2014-0827-1929-A1 p.4]

Despite the seeming clarity of the Clean Air Act statute and legislative history, the EPA is ignoring Congressional intent and previous application of the law, which has allowed street vehicles to be converted into racecars and competition motorcycles used solely for competition. The undersigned respectfully request that the EPA withdraw its clarification. Congress did not intend for the EPA to regulate racecars and competition motorcycles, including vehicles converted into race vehicles and products used solely for racing. [EPA-HQ-OAR-2014-0827-1929-A1 p.4]

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[1] 42 U.S.C. § 7550(2).

[2] 42 U.S.C. § 7550(11).

[3] See House Consideration of the Report of the Conference Committee, Dec. 18, 1970 (reprinted in A legislative history of the Clean air amendments of 1970, together with a section-by-section index, U.S. LIBRARY OF CONGRESS, ENVIRONMENTAL POLICY DIVISION, Washington: U.S. Govt. Print. Off. Serial No. 93-18, 1974, p. 117) (Representative Nichols: "I would ask the distinguished chairman if I am correct in stating that the terms "vehicle" and "vehicle engine" as used in the act do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events which, of course, are held very infrequently but which utilize all types of vehicles and vehicle engines?"; Representative Staggers: "In response to the gentleman from Alabama, I would say to the gentleman they would not come under the provisions of this act, because the act deals only with automobiles used on our roads in everyday use. The act would not cover the types of racing vehicles to which the gentleman referred, and present law does not cover them either.").

**Organization:** BorgWarner

As one of the top 30 automotive suppliers, employing over 6,900 people in the U.S., BorgWarner's mission is to deliver innovative powertrain solutions that improve fuel economy, emissions and performance. We support regulations that help to create a clean, energy-efficient world. [EPA-HQ-OAR-2014-0827-1883-A1 p.1]

As a key industry stakeholder, BorgWarner offers the following comments in response to the Notice of Data Availability issued by the National Highway Traffic Safety Administration (NHTSA) and the U.S. Environmental Protection Agency (EPA) on the proposed Phase 2 Heavy-Duty National Program to reduce greenhouse gas emissions (GHG) and fuel consumption for new on-road heavy-duty vehicles and engines. We oppose the provision that emission control devices must remain in their certified

configuration, even if converting street vehicles into dedicated racecars. [EPA-HQ-OAR-2014-0827-1883-A1 p.1]

The Phase 2 provision on dedicated racecar conversions has the potential consequence of regulating the market and sport of competition racing out of existence. This provision will result in negative economic impact on jobs and revenue at our manufacturing facility in Asheville, North Carolina. [EPA-HQ-OAR-2014-0827-1883-A1 p.1]

Further, due to the competitive aspects of their business, motorsport customers are early adopters of advanced technologies. Their activities help companies, like BorgWarner, gather test data, performance data and determine manufacturing methods for volume production of advanced technologies. Product enhancements that improve fuel economy, emissions and performance can and do transition from competitive racing to production vehicle applications. An example of this technology transfer is BorgWarner's Engineered for Racing (EFR) turbochargers, which include non-standard features such as Gamma-Ti turbine wheels, a dual-row ceramic ball bearing system and an all-aluminum water cooled bearing housing. These features, which are being considered for production applications, reduce the rotational inertia and weight resulting in better fuel economy and performance. [EPA-HQ-OAR-2014-0827-1883-A1 p.1-2]

Consequently, BorgWarner fully supports the comments of The Motor & Equipment Manufacturers Association (MEMA) and Specialty Equipment Market Association (SEMA) in their opposition to the EPA's proposed provision on converting street vehicles into dedicated racecars: [EPA-HQ-OAR-2014-0827-1883-A1 p.2]

- This provision is not appropriate to be addressed in the Phase 2 proposed rule, as it is not related to medium- and heavy-duty vehicles. [EPA-HQ-OAR-2014-0827-1883-A1 p.2]
- Congress did not intend for dedicated racecars to be within the jurisdiction of the Clean Air Act (CAA). [EPA-HQ-OAR-2014-0827-1883-A1 p.2]
- The 1970 CAA Amendments included an exemption for anti-tampering provisions for the emission control devices of manufactured or modified racing vehicles, and the 1990 CAA Amendments clarified that EPA did not have authority to regulate "vehicles used solely for competition." [EPA-HQ-OAR-2014-0827-1883-A1 p.2]
- The proposed racing conversion prohibition raises significant fairness and due process concerns. EPA's process did not properly alert stakeholders of this significant policy change to an exemption that has been in place for decades. [EPA-HQ-OAR-2014-0827-1883-A1 p.2]

We strongly urge EPA and NHTSA to remove this provision from the Phase 2 proposed rule. We believe that policy change in this area should be studied further based on the economic and innovative impact of this market in the United States so that the complex issues raised by the key stakeholders may be carefully evaluated. The racecar conversion market plays an important role for BorgWarner in implementing advanced technologies for improving fuel economy, emissions and performance. [EPA-HQ-OAR-2014-0827-1883-A1 p.2]

**Organization:** Clean Air Task Force et al.

In this rulemaking, some organizations have questioned EPA's authority to regulate aftermarket modifications of emission control systems on certified vehicles used for on-road use. We strongly support EPA's authority to protect the health and welfare of all citizens by ensuring that the appropriate emission control devices are used on all vehicles driven on our nation's roads. As we saw from the Volkswagen scandal, even a relatively small number of defeat devices can have an outsized impact on health-threatening pollution. [EPA-HQ-OAR-2014-0827-1925-A1 p.2]

**Organization:** Diaz, Miguel

Regarding the light duty motor vehicles used for racing, I don't think it should be a concern at this very moment. It would be counterproductive to address such topic in a world that can't actually control the emissions of larger pollutants. Racing cars produce a relative small amount of emissions compared to the commercial trucks that are used every day. If you do a life cycle analysis of any aliment or product, you will notice that most of the time the most pollutant element is transportation by trailer. Besides, many of the racing cars are used sporadically while most of the trucks, trailers, buses and so are used daily. Addressing this topic should be the priority, while concerning whether the racing cars should be included or not, could create a great impact on the sport's economy, a huge American tradition. This could cause many complaints from the people and loss of faith on the job EPA is currently doing. I'm not saying it shouldn't be done, I'm just saying that is not the right moment to do it. You have to throw the big rock first before throwing the little ones and we are still struggling with the bigger emissions. We need to lower them down before trying to address every problem in the country. [EPA-HQ-OAR-2014-0827-1848-A1 p.2]

**Organization:** Harley-Davidson Motor Company

Among other things, the EPA and NHTSA are soliciting feedback from interested parties on the Specialty Equipment Market Association's (SEMA) additional comments on issues discussed in a late comment related to motor vehicles used for competition. We will also take this opportunity to comment on the July 13, 2015 EPA Proposed Rule itself because the agency failed to appropriately notify the public of the rule or solicit feedback from affected parties. [EPA-HQ-OAR-2014-0827-1893-A1 p.1]

Harley-Davidson, Inc. is the parent company of Harley-Davidson Motor Company and Harley-Davidson Financial Services. Since 1903, Harley-Davidson Motor Company has fulfilled dreams of personal freedom with custom, cruiser and touring motorcycles, riding experiences and events and a complete line of Harley-Davidson motorcycle parts, accessories, general merchandise, riding gear and apparel. Harley-Davidson maintains an active interest in continuing an earnest dialogue with the agency to address greenhouse gas emissions. The Company, however, does not condone the EPA's actions in its Proposed Rule, which would unilaterally and without congressionally mandated authority materially change provisions within the Clean Air Act. [EPA-HQ-OAR-2014-0827-1893-A1 p.1]

On pages 429 and 584 of the 629 page rule addressing greenhouse gases for medium and heavy duty vehicles, the EPA inserted the following proposed regulatory text on race car and competition motorcycle conversions: [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

## **PART 86--CONTROL OF EMISSIONS FROM NEW AND IN-USE HIGHWAY VEHICLES AND ENGINES**

### **Subpart S--General Compliance Provisions for Control of Air Pollution From New and In-Use Light-Duty Vehicles, Light-Duty Trucks, and Heavy-Duty Vehicles**

67. Section 86.1854-12 is amended by adding paragraph (b)(5) to read as follows:

§ 86.1854-12 Prohibited acts.

(b) \* \* \*

(5) Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

#### **Part 1068 - Subpart B—Prohibited Actions and Related Requirements**

236. Section 1068.101 is amended by revising the introductory text and paragraphs (a)(1), (b), and (h) introductory text to read as follows: [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

[40 CFR 1068.101(b)(4)(ii)]

Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of 40 CFR 1068.101(b) and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

Broadly, Harley-Davidson supports the comments submitted in the docket by SEMA on December 28, 2015<sup>1</sup>. Explicitly, the Motor Company asserts that the agency's proposal would make inappropriate and unnecessary changes to current law and practice, the agency does not have the authority to make the changes it proposes, adequate notice was not given for the proposed changes, and the agency did not follow government mandated protocols for evaluating economic impacts to small businesses and others according to the Administrative Procedure Act (APA), the Small Business Regulatory Enforcement Fairness Act (SBREFA), and the Regulatory Flexibility Act as they relate specifically to the race car and competition motorcycle conversion section above. [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

Vehicles used solely for competition of all kinds, including racing vehicles created by converting certified vehicles into racing motorcycles, are not within the purview of the Clean Air Act. As drafted, the proposal would allow the EPA to broadly enforce this new provision against anyone making such changes including the owner, service provider, seller and manufacturer of competition vehicles and parts used for such conversions. Administrative rulemaking is not a process by which an agency is permitted to circumvent Congress. Only Congress is empowered to change the Clean Air Act. [EPA-HQ-OAR-2014-0827-1893-A1 p.2]

The EPA did not adequately notify the public in its original Notice of Proposed Rulemaking (NPRM) to encourage dialogue with affected parties. The EPA included the disputed language within a 629 page rulemaking entitled Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles Part 2. The agency did not call out motorcycles in the title, nor did it note the proposed change in the table of contents. However, the results of such a change would dramatically and negatively impact motorcycle competition, those who service those vehicles, and the supporting industry of vendors who make their livelihoods in the related industries of motorsports. The proposed

rule, if finalized, would effectively eviscerate an industry that has been around for decades. [EPA-HQ-OAR-2014-0827-1893-A1 p.3]

Currently, all motorcycles manufactured in or before 2005 are not required to meet EPA certification. The EPA allows certified motorcycles made from 2006 to be used exclusively for competition purposes if they meet certain criteria. According to an excerpt from the agency's own Frequently Asked Questions (FAQ) document issued in 2002 entitled "Emission Exemption for Racing Motorcycles and Other Competition Vehicles"<sup>2</sup>, a motorcycle certified by the EPA is allowed to be used for competition under the following conditions: [EPA-HQ-OAR-2014-0827-1893-A1 p.3]

[Table, 'Restrictions on Use and Maintenance', can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1893-A1]

SBREFA requires agencies to take steps to collect input from small entities on regulations and to determine whether a rule is expected to have a significant economic impact on a substantial number of small entities. No such analysis of the effects of the proposed prohibited acts appears to have been completed by the agency prior to the proposed rule being issued. Proposing such a significant and far-reaching change to the existing rule and practice will require additional due diligence by the agency to prove that there are no negative consequences to affected small businesses. [EPA-HQ-OAR-2014-0827-1893-A1 p.3-4]

The APA is intended to provide protections to the public to ensure that interested parties are given sufficient opportunity to comment on proposed rules. H-D contends that EPA did not provide sufficient opportunity to provide comment. [EPA-HQ-OAR-2014-0827-1893-A1 p.4]

We reject the EPA's assertion that this is simply a clarification of the existing rules. The proposed prohibition of modifications to engines, exhaust, engine control modules and intakes of competition vehicles stands in stark contrast to 40 years of practice by the agency and directly contradicts the agency's own guidance in the 2002 FAQ. This action would effectively kill the vast majority of motorsports that rely heavily on OEM vehicles as the primary source of competition vehicles. [EPA-HQ-OAR-2014-0827-1893-A1 p.4]

A modification to a certified motor vehicle for purposes of competition does not constitute "tampering" if that vehicle is then used solely for competition purposes. Indeed, in response to the now public proposed rule changes, Congress acted swiftly to address the overreach by the agency, introducing bipartisan legislation in March in the House and Senate, HR 4715 (114th Cong. 2nd Session) and S 2659 (114th Cong. 2nd Session), to more expressly codify the existing practice of allowing competition vehicles to be used outside the Clean Air Act. [EPA-HQ-OAR-2014-0827-1893-A1 p.4]

In light of the fact that the EPA failed to adequately notice the public, attempted to hide the proposed changes in a non-germane rulemaking, did not conduct a Regflex assessment, SBREFA analysis, or small business economic impact analysis, and attempted to significantly alter a rule and practice that has been in effect for 40 years without the approval of Congress, we respectfully request that the EPA withdraw its "clarification." [EPA-HQ-OAR-2014-0827-1893-A1 p.4]

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1 Specialty Equipment Market Association, December 28, 2015, EPA-HQ\_OAR-2014-0827; Comments: Proposed Rule: Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and heavy Duty Engines and Vehicles—Phase 2: Vehicles Used Solely in Competition



2 Emissions Exemption for Motorcycles and Other Competition Vehicles, FAQ, EPA420-F-02-045, Sept. 2002

**Organization:** International Council on Clean Transportation (ICCT)

*Protection against defeat devices.* Commenters in the rulemaking and NODA docket have raised a concern about the issue of modifying vehicles emission control equipment. It is important that EPA affirms its long-standing authority and continues to refine the specific regulatory language to prevent the proliferation of defeat devices for vehicles that are driven on public roads. Enforcement cases such as the one with Casper's Electronics' 44,000 defeat devices (see US EPA, 2015) highlight the importance of monitoring and enforcing which companies are developing the devices, and especially ensuring the devices are not being used on public roads. As such, we believe it is important that EPA continue to recognize that there is a legitimate concern about illegal aftermarket devices being used on public roads, and the EPA act to prevent their use (e.g., see US EPA, 2015). Such actions include ensuring that defeat devices are not sold under the guise of competitive race cars while being used on public roads. [EPA-HQ-OAR-2014-0827-1876-A1 p.2

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U.S. Environmental Protection Agency (US EPA). (2015). Casper's Electronics Inc. Clean Air Act. <https://www.epa.gov/enforcement/caspers-electronics-inc-clean-air-act>

**Organization:** Manufacturers of Emission Controls Association (MECA)

The Manufacturers of Emission Controls Association (MECA) is pleased to provide comments in response to the U.S. EPA's request for public comments on their Notice of Data Availability covering the prohibition against tampering or disabling of emission controls on motor vehicles used for competition (Docket ID No. EPA-HQ-OAR-2014-0827-1469-A1). MECA supports the agencies position that the Clean Air Act expressly prohibits the tampering with the emission controls on certified motor vehicles that may be used for racing but may also find their way to occasional use on public roads. [EPA-HQ-OAR-2014-0827-1868-A1 p.1]

MECA is a non-profit association of the world's leading manufacturers of emission control technology for motor vehicles. Our members have over 40 years of experience and a proven track record in developing and manufacturing emission control technology for the entire spectrum of internal combustion engines and mobile sources for gasoline, diesel, and alternative-fueled engines. A number of our members have extensive experience in the development, manufacture, and application of aftermarket emission control technologies for existing gasoline and heavy-duty engines to insure that emission controls originally certified on motor vehicles continue to operate beyond the vehicles emission warranty period. [EPA-HQ-OAR-2014-0827-1868-A1 p.1]

To protect public health, as intended by the Clean Air Act, it is imperative that the emission control systems that were originally certified on motor vehicles remain on these vehicles over their full operating life even once the OEM emissions warranty expires. Some MECA members develop and manufacture aftermarket converters that are legal to replace a damaged OEM converter on a vehicle outside of the OEM emissions warranty. Over the past 40 years, catalytic converter technology has advanced significantly to where the exhaust exiting the tailpipe is 99% cleaner than that coming out of the engine. [EPA-HQ-OAR-2014-0827-1868-A1 p.1]

Many states have implemented inspection and maintenance (I/M) programs to periodically inspect the emissions from passenger cars to insure that the emission controls continue to operate properly. There are many areas of the country that do not require I/M inspection and once a vehicle is sold, it may never be checked. The air quality is not confined to any particular area and pollution travels downwind to other parts of the country that may not benefit from up-wind clean air. Without I/M programs, emission controls may be tampered on a motor vehicle under the guise that the vehicle is used for racing. Such activity may be limited to weekends and the vehicle continues to operate on public roads during the week. Furthermore, there are manufacturers that offer exhaust modification kits for competition vehicles. Without an active I/M program there is no way to insure that these devices are not being misapplied to vehicles that may occasionally operate on public roads. Many of these purchases occur over the internet so there is no way to insure that the vehicle that is being tampered is used solely for the purpose of racing competition and never driven on public roads. The California Air Resources Board requires aftermarket parts manufacturers to inform the installer of the legal and proper installation of their parts and to retain records of the owner and vehicle where the parts have been installed. [EPA-HQ-OAR-2014-0827-1868-A1 p.1-2]

MECA members are avid car enthusiasts and many enjoy racing, however, our members believe that emission standards need to be enforced and emission controls should not be defeated. We support the EPA's long standing policy against tampering or disabling emission control systems on roadworthy passenger cars from their originally certified configuration. We also believe that the sale of devices that defeat emission control systems should be banned on competition racing vehicles that may be periodically operated on public roads. Thank you for consideration of our comments. [EPA-HQ-OAR-2014-0827-1868-A1 p.2]

**Organization:** Mass Comment Campaign sponsored by anonymous 2 (web) - (369)

I must speak up and protest the EPA's proposed rule 'Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2', specifically the following sections: [EPA-HQ-OAR-2014-0827-1513 p.1]

I propose that these rules be struck out of the 'Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles; Phase 2' or that the entire Proposed Rule be eliminated altogether if these sections regarding converting on-highway vehicles to non-highway vehicles cannot be modified or eliminated from the Proposed Rule. [EPA-HQ-OAR-2014-0827-1513 p.2]

>>Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of 40 CFR 1068.101(b) and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1513 p.1]

This means that EPA is proposing that we as enthusiasts would potentially violate emissions equipment laws intended for vehicles to be used upon a highway for vehicles that have been declared to never to be used upon said highway. Even if a vehicle was once an on-highway vehicle, a non-highway vehicle is no longer legal to operate on-highway and no longer subject to on-highway vehicle emissions standards. These vehicles are driven less and are transported by trailer to and from closed courses, thus never polluting as an on-highway vehicle would. [EPA-HQ-OAR-2014-0827-1513 p.1-2]

>>Note that a new vehicle that will be used solely for competition may be excluded from the requirements of this part based on a determination that the vehicle is not a motor vehicle under 40 CFR 85.1703. [EPA-HQ-OAR-2014-0827-1513 p.2]

This means that only body-in-white vehicles would be the only form of legal racecar available to enthusiasts. A body-in-white car is a vehicle that has no VIN number and is intended as a non-highway vehicle. However, most enthusiasts are not able to afford such a vehicle as they can cost as low as \$300,000 (US), a number most entry level enthusiasts cannot afford and is why we convert on-highway vehicles into non-highway vehicles for the sole purpose of racing on closed courses. [EPA-HQ-OAR-2014-0827-1513 p.2]

**Organization:** Mass Comment Campaign sponsored by anonymous 2 (web) - (369)

>>Competition engines/equipment. (i) For uncertified engines/equipment that are excluded or exempted as new engines/equipment from any requirements of this chapter because they are to be used solely for competition, you may not use any of them in a manner that is inconsistent with use solely for competition. Anyone violating this paragraph (b)(4)(i) is deemed to be a manufacturer in violation of paragraph (a)(1) of this section. We may assess a civil penalty up to \$37,500 for each engine or piece of equipment in violation. [EPA-HQ-OAR-2014-0827-1513 p.2]

If these rules are enacted, the enthusiast who has converted their once on-highway vehicle to a non-highway vehicle will be subjected to a fine that is out of touch with reality in both the rule and the amount. These converted non-highway vehicles are transported by trailer, only started and ran on a closed course, never seeing an on-highway mile. Non-highway vehicles should not be subject to on-highway laws, no matter if they are originally non-highway vehicles or on-highway vehicles converted to non-highway use. [EPA-HQ-OAR-2014-0827-1513 p.2]

What you are doing is punishing thousands of United States Citizens and Taxpayers by creating a rule that limits them to buying a purpose built vehicle that is out of their reach. You are punishing enthusiasts who are doing the right thing and using their non-highway converted vehicles as they are intended; to be used off the highway. [EPA-HQ-OAR-2014-0827-1513 p.2]

**Organization:** Mazda North American Operations

In addition to proposing new greenhouse gas standards for medium- and heavy-duty vehicles, EPA included proposed language to insert in 40 C.F.R. § 86.1854-12 pertaining to new and in-use light-duty vehicles, that would make the modification of certified production or street vehicles for off-road racing/competition a prohibited act. [EPA-HQ-OAR-2014-0827-1924-A1 p.2]

MNAO is headquartered in Irvine, CA and oversees the sales, marketing, parts and customer service support of Mazda vehicles in the United States and Mexico through nearly 700 dealers. The EPA noted in its most recent Light Duty Fuel Economy Trends report that Mazda is the most fuel-efficient auto manufacturer in the U.S for the third year in a row. Mazda's unique SKYACTIV Technology has made this level of efficiency possible. SKYACTIV is a suite of component and engineering technologies intended to cut vehicle weight and improve engine efficiency for outstanding environmental and safety performance, without sacrificing the brand's renowned driving pleasure. [EPA-HQ-OAR-2014-0827-1924-A1 p.2]

Mazda Motorsports is part of MNAO and provides a support program for anyone racing or building a Mazda car for racing. The Mazda Motorsports Competition Parts program serves 9,000 registered grassroots racers across the United States. These racers compete in up to 25,000 races and events each year across the country. Mazda has 58% market share in the Sports Car Club of America (SCCA) grassroots club racing program as of 2015 participation data. The cars that Mazda racers use in competition range from legally registered street going vehicles to full-on “race track only” vehicles. [EPA-HQ-OAR-2014-0827-1924-A1 p.2]

Mazda Motorsports members can purchase competition and stock parts directly from Mazda. This is a Membership only program and competition parts are not for sale to the general public. The parts available are all non-emissions affecting parts. Racers register with Mazda Motorsports through [www.mazdamotorsports.com](http://www.mazdamotorsports.com) and provide proof images of the car they compete with. These racers have the opportunity to purchase racing or “competition only” parts, as well as, stock and production parts directly from Mazda through this motorsports program. The customer has to accept and acknowledge the terms and conditions agreement prior to purchasing parts. The disclaimer specifically states that the competition only parts being purchased are not for on-road use. [EPA-HQ-OAR-2014-0827-1924-A1 p.2]

The Mazda MX-5 Miata is the best-selling two seat sports car in the world, according to the Guinness Book of World Records. The car has also become the most road raced car in the world. Established in 2001, Spec Miata (as it is named), is “stock” car racing in the truest sense. The 2.0-liter four-cylinder engine is sealed to prevent any internal tampering/modifications and the race exhaust runs through a catalytic converter. This allows Mazda to make production changes to the road-going Miata when it uncovers issues on the track that may warrant changes to production components. Mazda has sold nearly 3,000 kits to turn a road-going Miata into a race car. Spec Miata also grew into the Mazda MX-5 Cup professional series which started in 2006. As of 2015, Mazda now sells a Global MX-5 Miata Cup car. This is a ready-to-race Miata based on the vehicle sold in dealerships nationwide. The U.S.-spec MX-5 Cup Car allows racers to bypass conversion kits for a conventional Miata and buy a pre-assembled racecar through a third-party supplier (Long Road Racing in Statesville, North Carolina). [EPA-HQ-OAR-2014-0827-1924-A1 p.2]

Through Mazda’s involvement in the American Le Mans series Prototype racing category (2005-2013), Mazda worked closely with the Green Racing Work Group, the EPA, the SAE, and the DOE to bring several alternative technologies and fuels to the race track. From 2005-2006, Mazda competed with a 3-rotor Mazda engine in the LMP2 category. This efficient engine technology is one of the cornerstones of the Mazda brand philosophy. From 2007-2013, Mazda competed with a 2.0L 4-cylinder single turbo engine. This engine was the smallest capacity/displacement engine in the series and competed with IMSA 100 fuel initially. In 2008, Mazda was given the opportunity to bring Isobutanol Fuel to the series to showcase this next generation fuel and Mazda earned the 2011 Michelin Green Racing Challenge Award after earning several race victories and the season long Championship. Finally, in 2013-2015, Mazda brought Clean Diesel technology and renewable synthetic diesel fuel to Grand-Am and the United Sports Car Championship. [EPA-HQ-OAR-2014-0827-1924-A1 p.2-3]

Mazda Motorsports also launched the Racing Accelerates Creative Education (R.A.C.E.) outreach program. RACE is a national touring program from Mazda Motorsports that uses the science, technology and math of auto racing to inspire students to consider the many career options in the STEM disciplines. The program has positively impacted more than 10,000 middle and high school students across the country. Our Motorsports program also supports Project Yellow Light, a national organization dedicated to eliminating distracted driving by high school and college age drivers. [EPA-HQ-OAR-2014-0827-1924-A1 p.3]

Mazda is a leading player in all aspects of sports car racing with an emphasis on endurance road racing. Mazda is the number-one brand for road-racers across North America among both club racers and professionals. Mazda Motorsports traces its origin to an independent racing team in 1967. Mazda remains the only Asian car company to score an overall win at the 24 Hours of Le Mans in 1991. Mazda is proud of our grass-roots racing heritage and view motorsports as an integral part of our brand identity. [EPA-HQ-OAR-2014-0827-1924-A1 p.3]

MNAO supports the position of the Alliance of Automobile Manufacturers and Association of Global Automakers on the EPA's proposal to prohibit the conversion of certified on-road vehicles to competition vehicles. Individuals and entities who remove emissions control equipment from certified vehicles, or otherwise put such vehicles into an uncertified configuration, and then drive them on public roads, commit tampering under the Clean Air Act. MNAO opposes illegal tampering of road use vehicles. However, the EPA must not go so far as to outlaw legitimate activities and businesses. MNAO believes converting a certified on-road vehicle into an uncertified competition vehicle, and using that vehicle only for competition, does not constitute tampering or otherwise violate the Clean Air Act. [EPA-HQ-OAR-2014-0827-1924-A1 p.3]

**Organization:** Mead, Nathan

I am submitting comments below with respect to: ENVIRONMENTAL PROTECTION AGENCY  
[EPA-HQ-OAR-2014-0827-1864-A1 p.1]

40 CFR Parts 85, 86, 1036, 1037, 1065, 1066, and 1068

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Parts 523, 534, and 535

[EPA-HQ-OAR-2014-0827; NHTSA-2014-0132; FRL-9942-94-OAR]

RIN 2060-AS16; RIN 2127-AL52

In particular I find the following paragraphs troublesome: [EPA-HQ-OAR-2014-0827-1864-A1 p.1]

§ 86.1854-12 Prohibited acts.

(b) \* \* \*

(5) Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3). [EPA-HQ-OAR-2014-0827-1864-A1 p.1]

Here is my problem(s) with the above language.

So let's say a guy decided to starry racing his late model car he makes a few street legal modifications but eventually wants get more serious and use the vehicle for racing only and escalates his program incrementally. By my interpretation of the above language he will either have to find an older vehicle which of course there is a limited supply or step up to a built for racing only engine and chassis which for any is cost prohibitive. And all for what? To make sure that racers burn their negligible amount of fuel in exactly the way the manufacturer intended. Rules like this will have virtually no impact on improving the environment but a huge impact on individuals right to enjoy the sport of their choice and kill yet more domestic jobs held by those who manufacture and sell parts for modifying late model engines for off highway use. [EPA-HQ-OAR-2014-0827-1864-A1 p.1]

For sake of perspective I did a brief analysis: [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

According espn.go.com over 17.3 million people attended pro football games in 2015 [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

Let's discount 10% that walked, biked or took public transportation although they all left a carbon footprint (we exhale more CO2 when exercising). [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

That brings us to 15.57M

If we take the following averages: 3 people per car and a round trip of 50 miles in a vehicles that gets 20 mpg we get 12,975,000 gallons of fuel consumed just to see pro football games. Although my numbers except for attendance are arbitrary I think any reasonable person would agree they are reasonable. At en.m.wikipedia.org it states that NASCAR consumes 216,000 gallons at the 36 cup points races combined. [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

It goes without saying there is much more fuel consumed by race cars in the aggregate, and of course a vastly larger amount by several orders of magnitude in fact consumed by fans traveling to pro and college and other amateur sporting events, cross country skiing, fishing, golfing and other sports that in and of themselves don't necessarily involve burning fuel, directly. [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

So what's next? No more attending live games or concerts the coverage is better on TV anyway with instant replay, and the album is generally as good or in many times better than a live concert? [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

Really if you want to take away our freedom to modify and race our cars. Then you should only allow people to travel within a certain radius to enjoy hiking or cross country skiing. [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

These rules have unpleasant consequences for everyone by infringing on individual freedom to pursue the hobby of choice by the precedent they set. All for a minuscule reduction in greenhouse gases. [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

These rules ring insincere to me and damage the credibility of the EPA. [EPA-HQ-OAR-2014-0827-1864-A1 p.2]

**Organization:** Motor & Equipment Manufacturers Association (MEMA)

MEMA supports comments submitted by the Specialty Equipment Market Association (SEMA) in opposition to the EPA's proposed provision that emission control devices must remain in their certified configuration even if converting street vehicles into race vehicles.<sup>2</sup> MEMA respectfully request that EPA withdraw this proposed provision. Our comments will address only this issue. [NHTSA-2014-0132-0229-A1 p.1]

In October 2015, MEMA submitted comments to the Phase 2 regulations that were generally supportive of the EPA's endeavor while addressing some specific issue areas of concern to medium- and heavy-duty suppliers.<sup>4</sup> MEMA and the motor vehicle supplier industry are committed to policies that enable the introduction of new technologies needed to support sustainable mobility. [NHTSA-2014-0132-0229-A1 p.1]

Within the 629-page Phase 2 proposed rule to establish regulations for GHG emissions and fuel consumption for medium- and heavy-duty vehicles, EPA included a policy revision that would make it illegal for certified motor vehicles to be converted into vehicles used solely for competition by reconfiguring emission control devices. MEMA supports the comments submitted by SEMA and objects to EPA's tactic to revise current policy by including a provision in the context of the Phase 2 proposed rule on medium- and heavy-duty engines and vehicles. Furthermore, MEMA agrees with SEMA that Congress did not intend racecars to be within the jurisdiction of the Clean Air Act (CAA). [NHTSA-2014-0132-0229-A1 p.2]

MEMA shares SEMA's concerns regarding EPA's process. First, EPA did not alert impacted stakeholders that the agency was proposing a significant policy change. The current exemption, which is on vehicles used solely for competition, has been in place for decades. Second, the proposed provision on the modification of a certified vehicle for competition use is not germane to the Phase 2 proposed rulemaking on GHG emissions and fuel efficiency standards for medium- and heavy-duty vehicles and engines. Third, EPA failed to provide any economic analysis with this revision to a long-standing policy. EPA lifting this established CAA exemption on vehicles used solely for competition would impact the aftermarket industry's performance sector and put an end to most forms of amateur racing and car shows, adversely impacting the sport with minimal gains on GHG emissions. [NHTSA-2014-0132-0229-A1 p.2]

Most importantly, according to statutory text and legislative history of the CAA, it is clear that vehicles used solely for competition are not within the jurisdiction of the CAA. The 1970 CAA Amendments included an exemption for anti-tampering provisions for the emission control devices of manufactured or modified racing vehicles, and the 1990 CAA Amendments clarified that EPA did not have authority to regulate "vehicles used solely for competition." Further, at the March 15, 2016 House Science Oversight Subcommittee hearing, Brent Yacobucci with the Congressional Research Service (CRS) testified that the CRS could not identify any EPA document prior to the July 2015 proposed rule that stated converted racecars were ineligible for the CAA exclusion. [NHTSA-2014-0132-0229-A1 p.2]

For all these reasons, MEMA respectfully requests that EPA withdraw the proposed provision that would make it illegal for certified motor vehicles to be converted into vehicles used solely for competition by reconfiguring emission control devices. [NHTSA-2014-0132-0229-A1 p.2]

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2 Submitted on December 28, 2015 to Docket No. EPA-HQ-OAR-2014-0827-1469.

4 Docket No. EPA-HQ-OAR-2014-0827-1274

**Organization:** Motorcycle Industry Council, Inc. (MIC)

In its July 13, 2015 Notice of Proposed Rulemaking, EPA stated: 'The existing prohibitions and exemptions in 40 CFR part 1068 related to competition engines and vehicles need to be amended to account for differing policies for nonroad and motor vehicle applications.' This was proposed to be accomplished by adding a new subsection 40 CFR 86.1854-12(b)(5) stating that 'Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines'. Similar language appears in proposed section 40 CFR 1068.101(b)(4)(ii). In conjunction with a proposed section 40 CFR 1068.1(a)(3) subjecting highway motorcycles to part 1068, the language of 40 CFR 1068.101(b)(4)(ii) would extend the tampering prohibition to highway motorcycles used for competition. [NHTSA-2014-0132-0219-A1 p.1]

In comments dated December 28, 2015, the Specialty Equipment Market Association (SEMA) explained why it believes the proposed addition to 40 CFR 86.1854-12(b)(5) should be rescinded. The Motorcycle Industry Council agrees with SEMA's comments and also recommends that 40 CFR 1068.101(b)(4)(ii) be amended by striking the following text: [NHTSA-2014-0132-0219-A1 p.1]

*Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of 40 CFR 1068.101(b) and 42 U.S.C. 7522(a)(3).* [NHTSA-2014-0132-0219-A1 p.1]

In support, MIC submits the following comments.

#### A Tampering Prohibition for Racing Vehicles is Inappropriate

MIC acknowledges that highway motorcycles and other on-road motor vehicles are subject to the anti-tampering provisions of section 203 of the Clean Air Act. We also acknowledge that there is no exception in Sec. 203 for racing vehicles or racing conversions. If a literal, facial reading of Sec. 203 is controlling, any conversion that falls under its prohibitions (e.g., a conversion that removes or modifies a catalytic exhaust system or involves reprogramming of the fuel injection system) would not be legal, even if the conversion were done solely for racing purposes. [NHTSA-2014-0132-0219-A1 p.1-2]

However, we do not believe such a literal reading is controlling and that there is an alternative reading of the applicability of Sec. 203 to racing conversions that is more consistent with Congressional intent and established EPA policy with regard to modification of vehicles for racing. EPA has both the authority and the obligation to exempt vehicles being used for racing for a number of reasons: [NHTSA-2014-0132-0219-A1 p.2]

#### • Congressional Intent is Clear

Congress did not intend for the anti-tampering provisions of the Clean Air Act Amendments of 1970 to apply to vehicles converted to competition use. In the Conference Report, after Mr. Nichols asked for confirmation that vehicles affected '...do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events,' Mr. Staggers (Chairman of the House Interstate and Foreign Commerce Committee and floor manager of the bill) confirmed that understanding<sup>1</sup>. [NHTSA-2014-0132-0219-A1 p.2]



Consistent with the Congressional intent, Section 202(b)(3)(B) of the 1970 Clean Air Act clearly gave EPA the authority to exempt subcategories of 'light duty vehicles' by stating that: 'The term 'light duty vehicles and engines' means new light duty motor vehicles and new light duty motor vehicle engines, as determined under regulations of the Administrator.' This language was not only broad enough to allow EPA to exempt vehicles used for competition, it allowed EPA to initially exempt motorcycles from emission standards altogether. [NHTSA-2014-0132-0219-A1 p.2]

- Avoiding Disparate Results

If the absence of an explicit exemption for racing conversions from the anti-tampering provisions is construed as an immutable statement that racing conversions are prohibited, the result would be an irrational and economically unfair non-uniform treatment of onroad motorcycles vis-à-vis nonroad motorcycles, where conversions are not allowed for the former but (as explained below) allowed for the latter. It is an established rule of construction that implying an intent to Congress that causes such disruptive, disparate results should be avoided. [NHTSA-2014-0132-0219-A1 p.2]

- EPA's Adoption Of An Anti-tampering Regulation For Nonroad Motorcycles

When Congress added current Sec. 213 to the CAA in 1990 requiring EPA to study and regulate nonroad vehicle and engine emissions, it did not extend the anti-tampering provisions in Sec. 203 to the nonroad sector. As noted above, Sec. 203 by its very terms is limited to vehicles used on a street or highway. But Congress did expressly exempt nonroad vehicles and engines used solely for competition from the definitions of nonroad vehicle and nonroad engine (CAA Sec. 216 subsecs. (10) and (11)). System or involves reprogramming of the fuel injection system) would not be legal, even if the conversion were done solely for racing purposes. [NHTSA-2014-0132-0219-A1 p.2]

So, with respect to nonroad motorcycles converted for racing, in 1990 EPA was faced with the obverse of the CAA treatment of onroad motorcycles converted for racing, i.e., no tampering prohibition and a racing exemption for the nonroad sector, and a tampering prohibition but no racing exemption for the onroad sector. [NHTSA-2014-0132-0219-A1 p.3]

Under those circumstances, EPA decided that it had the authority to fill the gap created by the Congressional silence on tampering for the nonroad sector by adopting a tampering prohibition in its nonroad regulations. Specifically, when EPA first adopted its general compliance regulations governing nonroad vehicles (67 FR 68242 et seq, Nov. 8, 2002), in its discretion it included anti-tampering provisions at 40 CFR 1068.101(b)(1)-(3). EPA did not explain why it took this action and its decision in this regard was not questioned or challenged during the regulatory adoption process (see 66 FR 51098 et seq., Oct. 5, 2001 (proposed rulemaking), and 67FR 68242 et seq., Nov. 8, 2002 (final rulemaking)). [NHTSA-2014-0132-0219-A1 p.3]

discretion to adopt, or otherwise enforce, a racing vehicle exemption from the anti-tampering provisions for onroad vehicles in Sec. 203. [NHTSA-2014-0132-0219-A1 p.3]

- Prior Recognition of a Racing Exemption by EPA

There are several indications in prior EPA regulatory and policy actions confirming that Congress's failure to mention a racing exception from the CAA anti-tampering provisions applicable to onroad vehicles, is merely a policy oversight or omission that can be addressed by EPA and is not an implied ban. [NHTSA-2014-0132-0219-A1 p.3]

For example, EPA has created a regulatory process for exclusion of racing vehicles from the restriction against the import of uncertified vehicles in Sec. 203(a)(1) of the CAA, even though Congress did not mention a racing exclusion or exemption in that section. (See 40 CFR Sec. 85.1511 establishing a racing exclusion and 40 CFR Sec. 85.1703 defining what constitutes a racing vehicle. Also See. 2.3.3 of EPA's 'Procedures for Importing Vehicles and Engines in the United States.') [NHTSA-2014-0132-0219-A1 p.3]

Likewise, in EPA's Document No. EPA420-R-03-016, dated December 2003, entitled 'Summary and Analysis of Comments: Control of Emissions from Highway Motorcycles', EPA states (at p.7) that while school buses and police vehicles must meet CAA emission standards, '...the Clean Air Act specifically exempts from emission regulation vehicles that are used solely for competition.' On p. 7, EPA goes on to state that NASCAR race vehicles, which were and are converted onroad vehicles, '... are not required to comply with emission regulations, and we do not have the authority to regulate them.' EPA states further (at p.107) in the specific context of discussing whether motorcycle customization and modification is allowed under the CAA anti-tampering prohibition, that 'Selling a 'competition only' version is allowed, but EPA expects aftermarket dealers and retailers to use reasonable prudence so that abuse of this provision does not result in an act of tampering by consumers.' [NHTSA-2014-0132-0219-A1 p.3]

Additional evidence of prior recognition of a racing exemption was noted in SEMA's comment: 'EPA personnel participated in a presentation at an industry trade show sponsored by SEMA on November 5, 2015 to speak to this very issue and made no mention of the pending rulemaking proceeding.' Indeed, EPA personnel routinely participated in SEMA trade shows at least as far back as the mid-1990s<sup>2</sup> at which hundreds of products were on display that were designed for competition use only and not emissions compliant. EPA never informed SEMA that the sale of such products was inconsistent with EPA policy. [NHTSA-2014-0132-0219-A1 p.4]

For the reasons outlined above, EPA has both the authority and the obligation to exempt motor vehicles being used for competition without any statutory or regulatory changes. [NHTSA-2014-0132-0219-A1 p.4]

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1 House Consideration of the Report of the Conference Committee, Dec. 18, 1970, page 117 (see attached). <http://babel.hathitrust.org/cgi/pt?id=mdp.39015077941642;view-1up;seq-120>

2 Personal communication with Edward Gardetto, former EPA employee.

**Organization:** National Association of Clean Air Agencies (NACAA)

3. December 28, 2015 comments from SEMA related to light-duty motor vehicles used for competition racing

NACAA is troubled by the December 28, 2015 comments submitted by SEMA to the Phase 2docket, which we believe misconstrue EPA's intent, existing rules and policy and the Clean Air Act. In its comments, SEMA takes issue with language in the proposed Phase 2 rule where EPA seeks to clarify that certain regulatory provisions related to nonroad vehicles do not, and cannot under the Clean Air Act, apply to onroad vehicles. Under the Clean Air Act, EPA has discretion to allow certified nonroad vehicles to be modified and used for competition. The statute does not provide EPA discretion for certified onroad vehicles. Certified onroad vehicles that are outfitted with aftermarket parts such as

those that defeat or delete emission controls are illegal under the Clean Air Act, even if the intention is to use such converted vehicles only for the purposes of competition. [EPA-HQ-OAR-2014-0827-1890-A1 p.2]

The proposed language in the Phase 2 rule is intended to clarify this distinction; it does not, in any way, change any existing rule or policy. In explaining this provision, EPA is clear that it does not apply to dedicated racecar vehicles – such as NASCAR and Indy vehicles – originally manufactured for the purpose of competition (and, therefore, never certified for onroad use). EPA has also been clear that the Clean Air Act plainly prohibits tampering and the agency has always had the authority to enforce against individual vehicles/owners that violate this law. EPA has never pursued an enforcement case against an individual, as SEMA implies the agency will in the future. Instead, EPA’s primary concern is the proliferation and increasing sales and installation of aftermarket parts that defeat or delete emission controls on cars and trucks used on the road in every state across the nation. These parts are readily available for sale online to anyone who wishes to purchase them for any purpose. (Though some of these conversions are intended for creating vehicles that will be used only for competition, many others are done on vehicles intended for continued use on the road. In either case, though, they are not allowed under the Clean Air Act). [EPA-HQ-OAR-2014-0827-1890-A1 p.3]

**Organization:** National Automobile Dealers Association (NADA)

## II. LIGHT-DUTY RACE VEHICLES

In its October 1, comments, NADA/ATD did not address a proposal to regulate as tampering the conversion of light-duty “street” vehicle to dedicated race cars.<sup>2</sup> At the time, NADA/ATD focused exclusively on the commercial truck standards set out in the proposal. A review of the NODA has caused NADA/ATD to take a position on the issue. [EPA-HQ-OAR-2014-0827-1932-A1 p.2]

Light-duty vehicle dealerships sell new and used vehicles that customers sometimes convert into race cars. Moreover and just as importantly, many dealerships and their employees are involved in sponsoring race teams, building out race cars, and driving or supporting cars and teams on race day. These time-honored activities have occurred throughout the 100 + years dealers have sold cars and are sometimes elegantly summarized by the phrase “race on Sunday, sell on Monday.” At the same time, dealers are aware of the Clean Air Act’s anti-tampering provisions, they recognize the importance of emissions tampering issues, and they endeavor to ensure that emissions systems are not tampered with when servicing or selling vehicles for road use. [EPA-HQ-OAR-2014-0827-1932-A1 p.2]

NADA concurs with positions taken by the Specialty Equipment Manufacturers Association (SEMA) on the race car tampering proposal. In fact, NADA has signed onto a set of joint industry comments on the issue. Note that by objecting to this provision, NADA is in no way arguing in support of clear-cut emissions tampering activities involving the improper modification of, or instillation of defeat devices into, vehicles used on public roads. Moreover, NADA fully supports EPA’s efforts to appropriately regulate companies that manufacture, import, market, or sell devices designed to “defeat” emissions performance under the guise of doing so only for the dedicated race vehicle marketplace to the extent that such is not the case. [EPA-HQ-OAR-2014-0827-1932-A1 p.2]

With respect to tampering, commercial truck dealerships have seen a surge in the number of tampered vehicles entering their service bays and used truck lots since at least 2007. Apparently, certain truck owners and operators have elected to tamper with emission systems as a means of avoiding the cost and burden of properly maintaining those systems or in an attempt to improve vehicle performance or reduce operating costs.<sup>3</sup> In lieu of creating an unnecessary and inappropriate constraint on race vehicles,

NADA/ATD urges EPA to focus some of its limited but valuable tampering enforcement resources on this area of concern. [EPA-HQ-OAR-2014-0827-1932-A1 p.2]

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2 40 CFR § 86.1854-12(b)(5) was proposed to be amended to include the following:

Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified motor vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions of paragraph (a)(3) of this section and 42 U.S.C. 7522(a)(3).

3 See e.g., <http://www.successfuldealer.com/dealing-with-emission-tampering/>

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

The Northeast States for Coordinated Air Use Management (NESCAUM)<sup>1</sup> submits these comments in response to the joint Notice of Data Availability (NODA) issued by the U. S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation National Highway Traffic Safety Administration (NHTSA) on March 2, 2016 associated with the proposed rule – Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (81 Fed. Reg. 10822). NESCAUM’s comments are limited to issues raised in a December 28, 2015 comment on the Phase 2 rule from the Specialty Equipment Market Association (SEMA) related to the use of certified light-duty motor vehicles for competition racing. [EPA-HQ-OAR-2014-0827-1871-A1 p.1]

At issue is proposed new text in 40 C.F.R. §§ 86.1854-12<sup>2</sup> intended by EPA to clarify the existing statutory and regulatory distinction between nonroad vehicles and certified motor vehicles as it relates to disabling or tampering with air pollution control devices: [EPA-HQ-OAR-2014-0827-1871-A1 p.1]

Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines; anyone modifying a certified vehicle or motor vehicle engine for any reason is subject to the tampering and defeat device prohibitions[.] 80 Fed. Reg. 40565 (July 13, 2015). [EPA-HQ-OAR-2014-0827-1871-A1 p.1-2]

In its comments, SEMA asserts that the proposed regulatory text represents a significant EPA policy change and, insofar as it would ban the conversion of motor vehicles originally designed and certified for onroad use into race cars, is contrary to congressional intent. [EPA-HQ-OAR-2014-0827-1871-A1 p.2]

NESCAUM supports the proposed amendments, which are consistent with the Clean Air Act and do not change any existing EPA requirements or enforcement policy. [EPA-HQ-OAR-2014-0827-1871-A1 p.2]

SEMA suggests that the proposed regulatory amendments will expose owners of modified motor vehicles converted solely for nonroad competition to enforcement actions and civil penalties. This suggestion is at odds with EPA’s track record. EPA can and has consistently exercised its enforcement

discretion by targeting manufacturers of defeat devices that sell their illegal products to vehicle owners who continue to drive their cars on public roads.<sup>3</sup> The agency has not indicated any intention of expanding its enforcement effort to competition car owners or hobbyists. [EPA-HQ-OAR-2014-0827-1871-A1 p.2]

In areas of the Northeast, as well as elsewhere in the nation, air quality does not meet national health-based air quality standards. Sales of aftermarket parts that defeat emission controls to owners of certified motor vehicles still operating on public roads further degrade air quality. Under present circumstances, EPA's enforcement approach to tampering with pollution control devices is a practical and straightforward application of the rule of law. [EPA-HQ-OAR-2014-0827-1871-A1 p.2]

Thank you for the opportunity to provide comments on the Notice of Data Availability. [EPA-HQ-OAR-2014-0827-1871-A1 p.2]

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1 NESCAUM is an association of the state air quality agencies in the six New England States, New Jersey, and New York. This letter reflects the majority views of NESCAUM as a state membership organization. Individual NESCAUM member states may hold views different from the NESCAUM states' majority consensus.

2 EPA has proposed a corresponding amendment applicable to certified heavy-duty engines and vehicles in 40 CFR § 1037.601(a)(3), 80 Fed. Reg. 40650.

3 See, e.g., *United States of America v. Edge Products, LLC*, <https://www.epa.gov/sites/production/files/documents/edgeproducts-cd.pdf> ; *United States of America v. Casper Electronics, Inc.*, <https://www.epa.gov/sites/production/files/2013-09/documents/casper-cd.pdf>.

**Organization:** Ohio Attorney General's Office

I am writing to express my deep concerns about a conflict with the federal Clean Air Act buried within the provisions of the 629-page rule referenced above, which states: "Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines." As written, this proposed addition attempts to expand the EPA's statutory jurisdiction under the Clean Air Act to cover vehicles modified for racing or hobbyist competition. Such an approach would contravene the law and reverse decades of EPA practice.

I am writing to express my deep concerns about a conflict with the federal Clean Air Act buried within the provisions of the 629-page rule referenced above, which states: "Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines." As written, this proposed addition attempts to expand the EPA's statutory jurisdiction under the Clean Air Act to cover vehicles modified for racing or hobbyist competition. Such an approach would contravene the law and reverse decades of EPA practice. [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

This unnecessary expansion conflicts with the expressed intent of Congress, and I urge you to remedy this problem in the final rule by deleting the provision quoted above. [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

The specialty automotive industry is an important part of our economy. In 2014, consumers spent \$36 billion on automotive specialty equipment parts and accessories. Ohio is home to Summit Racing Equipment and JEGS High Performance, America's two largest retailers selling high performance automotive equipment. These companies, as well as many equipment manufacturers and racing venues in Ohio, employ thousands of Ohioans and are responsible for hundreds of millions of dollars in economic activity. This proposed rule would damage Ohio's economy by making many of the products sold and installed by Ohio businesses illegal. [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

While the federal Clean Air Act prohibits certain modifications to everyday motor vehicles used on public roads, statutory language and the EPA's historic practice have made it clear that vehicles built or modified for racing purposes, and not used on public streets, are not regulated under the Clean Air Act. For example, 42 U.S.C. § 7550(2) limits the definition of a covered "motor vehicle" to a vehicle designed for transport "on a street or highway" as opposed to operation on a racetrack. Correspondingly, 42 U.S.C. § 7550(10) limits the term "nonroad engine" to an engine "that is not used in a motor vehicle or a vehicle used solely for competition," while 42 U.S.C. § 7550(11) makes clear that the term "nonroad vehicle" also does not apply to "a motor vehicle or a vehicle used solely for competition." [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

Congress did not make these choices by happenstance. It intended to differentiate between a vehicle covered by this sort of rule and "a vehicle used solely for competition." In fact, the U.S. House Committee on Foreign and Interstate Commerce identified and discussed this issue before passing the Clean Air Act in 1970: [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

MR. NICHOLS. I would like to ask a question of the chairman, if I may.

I am sure the distinguished chairman would recognize and agree with me, I hope, that many automobile improvements in the efficiency and safety of motor vehicles have resulted from experience gained in operating motor vehicles under demanding circumstances such as those circumstances encountered in motor racing. I refer to the tracks as Talladega in my own State, to Daytona and Indianapolis, competition. I would ask the distinguished chairman if I am correct in stating that the terms "vehicle" and "vehicle engine" as used in the act do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events which, of course, are held very infrequently but which utilize all types of vehicles and vehicle engines? [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

MR. STAGGERS. In response to the gentleman from Alabama, I would say to the gentleman they would not come under the provisions of this act, because the act deals only with automobiles used on our roads in everyday use. The act would not cover the types of racing vehicles to which the gentleman referred, and present law does not cover them either<sup>1</sup>. [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

Statutory language and legislative history clearly show that vehicles used solely for competition, including a race vehicle that has been converted from a certified highway vehicle, are not regulated under the Clean Air Act. The EPA is authorized to create regulations that interpret laws that Congress passes. However, the Agency cannot rewrite statutory definitions and -- as the U.S. Supreme Court has made clear -- "must always give effect to the unambiguously expressed intent of Congress."<sup>2</sup> [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

I strongly urge the EPA to remove the language referencing vehicles “used solely for competition” from the final rule. Not only is this language inconsistent with the federal Clean Air Act, but any measurable benefit from this change would pale in comparison to the economic harm from lost jobs and reduced tax revenues in Ohio. [EPA-HQ-OAR-2014-0827-1799-A1 p.1]

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1 House Consideration of the Report of the Conference Committee, Dec. 18, 1970 (reprinted in A legislative history of the Clean air amendments of 1970, together with a section-by-section index, U.S. LIBRARY OF CONGRESS, ENVIRONMENTAL POLICY DIVISION, Washington: U.S. Govt. Print. Off. Serial No. 93-18, 1974, p. 117).

2 Utility Air Regulatory Group v. Environmental Protection Agency 573 U. S. \_\_\_\_ (2014), quoting National Assn. of Home Builders v. Defenders of Wildlife, 551 U. S. 644, 665.

**Organization:** Specialty Equipment Market Association (SEMA)

The EPA published a Notice of Proposed Rulemaking (NPRM) on July 13, 2015 for the primary purpose of proposing a second round of greenhouse gas emission standards for medium- and heavy-duty vehicles. Within the NPRM, the EPA included changes to existing regulations to put in place a policy that would prohibit any person from decertifying a motor vehicle to transform it into a vehicle to be used solely for competition (i.e., a racing vehicle). This new regulatory framework for racing vehicles represents a departure from previous EPA policy and was included in the NPRM without adequate notice or consideration of the impact on affected parties. Further, the changes are not in accord with the Clean Air Act, the statute under which they have been proposed. Lastly, the proposal is unnecessary and unreasonable in relation to the EPA’s stated purpose to enforce against the sale of illegal emissions defeat devices used on street vehicles. [EPA-HQ-OAR-2014-0827-1931-A1 p.1]

When the NPRM was originally released in the summer of 2015, industry stakeholders were unaware that changes to prohibit the conversion of mass-produced street vehicles into track-only racing vehicles had been included within the 629-page proposed rule on greenhouse gas standards for medium- and heavy-duty vehicles. SEMA did not discover the changes until late in 2015, after the comment period had closed, and submitted comments to the docket on December 28, 2015.<sup>4</sup> Prior to SEMA’s submission, not a single comment out of the thousands that were submitted to the docket made any mention of the racing vehicle issue. SEMA issued a press release to alert the public of the proposed changes on February 9, 2016.<sup>5</sup> Within 24 hours, a petition to the White House requesting the EPA withdraw the proposal had received more than 100,000 signatures.<sup>6</sup> When the NODA was published on March 2, 2016, SEMA was disappointed to find that the EPA had not provided any explanation or analysis on the proposal relative to racing, and instead requested comments on issues raised in SEMA’s comments.<sup>7</sup> While the rulemaking has been reopened for public comment, there is no supplemental information to fulfill EPA’s obligations to provide meaningful notice that would allow the public, small businesses, the Congress and the Government Accountability Office (GAO) to have a full understanding of the changes, the costs versus the benefits of the proposal, the impact it would have on small entities or the economic impact to the economy at large. [EPA-HQ-OAR-2014-0827-1931-A1 p.2]

### New and Unreasonable Policy

The EPA’s proposal to prohibit racing vehicle conversions and the effective ban on use of parts in converted racing vehicles hinges on the EPA’s interpretation of the term “motor vehicle” in the Clean Air Act. A motor vehicle is defined in the Clean Air Act as “any self-propelled vehicle designed for

transporting persons or property on a street or highway” (emphasis added).<sup>8</sup> In 1974, the EPA issued its first regulations interpreting the term “motor vehicle” in Part 85, Subpart R – “Exclusion and Exemption of Motor Vehicles and Motor Vehicle Engines.”<sup>9</sup> The definition of “motor vehicle” that the agency ultimately adopted excludes vehicles based on certain characteristics, such as whether the vehicle “lacks features customarily associated with safe and practical street or highway use” or “exhibits features which render its use on a street or highway unsafe, impractical, or highly unlikely.”<sup>10</sup> These criteria are used to assess whether a vehicle is used on-road, and is thus a “motor vehicle,” or has undergone significant modifications such that it will no longer be used on-road, which would naturally exclude vehicles substantially modified for racing or combat operations.<sup>11</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.2]

The EPA is now proposing a change to the definition of “motor vehicle” that could significantly limit the exclusion of racing vehicles.<sup>12</sup> The change modifies the criteria used to determine whether a vehicle is excluded from the term “motor vehicle” by adding the following language as a new subparagraph (b): [EPA-HQ-OAR-2014-0827-1931-A1 p.3]

Note that, in applying the criterion in paragraph (a)(2) of this section, vehicles that are clearly intended for operation on highways are motor vehicles. Absence of a particular safety feature is relevant only when absence of that feature would prevent operation on highways.<sup>13</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.3]

This limiting language is so severe that absence of a particular feature must prevent the vehicle from being operated on the highways in order to qualify for exclusion.<sup>14</sup> This would present a stark departure from current regulatory guidance on the import of modified racing vehicles, which relies on the definition of “motor vehicle” to determine whether a modified racing vehicle qualifies for an exclusion.<sup>15</sup> The agency has failed to explain how the change would affect the continued importation and conversion of racing vehicles. [EPA-HQ-OAR-2014-0827-1931-A1 p.3]

In addition to overhauling the definition of motor vehicle that has been in place since 1974, language was inserted into various sections of the proposed rule to expressly prohibit the conversion of a motor vehicle into a nonroad vehicle or vehicle to be used solely for competition.<sup>16</sup> The EPA claims in its explanation of the changes that it is changing the language to reflect longstanding policies, such as a policy that “if a motor vehicle is covered by a certificate of conformity at any point, there is no exemption from the tampering and defeat-device prohibitions that would allow for converting the engine or vehicle for competition use.”<sup>17</sup> Essentially, the EPA is saying “once a motor vehicle, always a motor vehicle.”<sup>18</sup> However, this contradicts long-standing agency policy, which has for decades recognized that vehicles that are used solely for competition are excluded from the EPA’s regulations under the Clean Air Act because they no longer meet the definition of “motor vehicle.”<sup>19</sup> In spite of the EPA’s claims in comments to the media,<sup>20</sup> the policy prohibiting street-to-race conversions is indeed a new one. In testifying before a March 15, 2016 congressional hearing on this issue, a Congressional Research Service (CRS) section manager confirmed that “CRS was unable to find a document from EPA from before 2015 that explicitly stated that conversions of motor vehicles for racing were not eligible for an exemption.”<sup>21</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.3-4]

Within the NPRM, significant changes have also been made to Part 1068 to make it generally applicable to all light-duty vehicles and highway motorcycles. The current Part 1068 expressly excludes light-duty vehicles and highway motorcycles, so this change is notable. The implications of the change are not adequately addressed in light of its significance. Along with applying Part 1068 to all light-duty vehicles and highway motorcycles, the EPA has amended the investigatory procedures under Part 1068 to remove provisions dealing with EPA investigators securing warrants or court orders before entering a



facility. In the current Part 1068, a facility owner may deny entry to investigators who do not present a warrant or court order.<sup>22</sup> The EPA is deleting this provision such that a court order or warrant will no longer be required under the agency's rules.<sup>23</sup> These proposed changes may well serve the EPA's enforcement strategy, but legitimate businesses in good standing in their communities deserve further guidance from the agency before investigators show up unannounced and without documentation. [EPA-HQ-OAR-2014-0827-1931-A1 p.4]

#### Proposal Contradicts Other State and Federal Policies

The EPA's proposal would subject the industry to two contradictory stances on competition use only products, since they would become illegal at the federal level but permitted by the State of California.<sup>24</sup> Under section 43001 of the California Health and Safety Code, the vehicular air pollution control provisions contain the following exclusion: [EPA-HQ-OAR-2014-0827-1931-A1 p.4]

The provisions of this part shall not apply to:

(a) Racing vehicles.<sup>25</sup>

For purposes of this exclusion, "'racing vehicle' means a competition vehicle not used on public highways."<sup>26</sup> The California Air Resources Board (CARB) routinely reinforces this exclusion in settlement agreements by requiring companies to appropriately label racing products with disclaimers to inform consumers that the part is legal only for racing and can never be used on a street or highway.<sup>27</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.5]

Regulations governing the import of racing vehicles also allow for street vehicles to be converted into racing vehicles in other countries and imported into the U.S. under the racing vehicle exclusion.<sup>28</sup> To maintain this policy for imported racing vehicles that have been converted from street vehicles, but remove the ability to conduct the same activity in the U.S., would create an inconsistent and arbitrary policy. It could also lead to the absurd result of U.S. residents having to export a vehicle to be used in racing to another country to have it converted and brought back in as a racing vehicle under the EPA's import guidance. [EPA-HQ-OAR-2014-0827-1931-A1 p.5]

#### Incorrect Interpretation of Clean Air Act in Light of Legislative History

The EPA's interpretation of the term "motor vehicle" and the anti-tampering provision is not supported by the language, congressional intent or legislative history of the Clean Air Act.

The seminal case on deference to an agency's interpretations of statutory language is *Chevron v. NRDC*.<sup>29</sup> *Chevron* instructs that when Congress has left a particular issue unresolved, an agency may interpret the statute through rulemaking and courts generally give the agency's interpretations "controlling weight unless they are arbitrary, capricious, or manifestly contrary to the statute."<sup>30</sup> However, this deference is only available where a court is unable to determine Congress' intent on a particular issue.<sup>31</sup> Where congressional intent contradicts the agency's interpretation, a court will not defer to the agency.<sup>32</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.5]

In contrast to the ambiguous term "source" in *Chevron*, Congress has spoken to the meaning of "motor vehicle" as it relates to racing vehicles. Congress first addressed this issue in the Motor Vehicle Air Pollution Control Act of 1965, when it defined "motor vehicle" as "any self-propelled vehicle designed for transporting persons or property on a street or highway."<sup>33</sup> When the Clean Air Act Amendments were enacted in 1970, Congress made clear in conference committee deliberations that the term "motor

vehicle” does not extend to vehicles manufactured or modified for racing.<sup>34</sup> In 1990, Congress provided the EPA with the authority to regulate nonroad vehicles/engines. Since the term “nonroad vehicle” could easily have been interpreted to include racing vehicles, Congress added language to unequivocally exclude vehicles used solely for competition from the definition of “nonroad vehicle.”<sup>35</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.5-6]

#### Unnecessary to Accomplish EPA’s Stated Goals

Statements from the EPA suggest that the agency has proposed the changes relative to racing vehicles because it needs further enforcement authority to go after emissions defeat devices used on street vehicles.<sup>36</sup> However, the EPA already has authority to enforce against anyone who offers, sells or installs products that knowingly take a regulated motor vehicle out of compliance with emissions standards.<sup>37</sup> In fact, the EPA has successfully pursued these cases in the past. In 2007, the EPA successfully brought an enforcement action against Casper Electronics for selling defeat devices used in “‘on road’ or ‘on highway’ vehicles.”<sup>38</sup> The EPA explained that the defeat devices were marketed for “off road” use, and explained that “there is no general ‘off road’ use exemption from the pollution control requirements of the Clean Air Act.”<sup>39</sup> SEMA recognizes that there is no exemption for “off road” use because the EPA is authorized by the Clean Air Act amendments of 1990 to regulate emissions from nonroad vehicles.<sup>40</sup> However, the agency is not authorized to regulate emissions from “vehicles used solely for competition.”<sup>41</sup> The EPA again exercised its enforcement authority to regulate products for on-road use when it brought enforcement actions against Edge Products, LLC in 2013 and H&S Performance, LLC in 2015.<sup>42</sup> It is unclear why the EPA believes it is no longer able to successfully pursue these cases. By making all non-certified emissions-related parts that could be used on mass-produced vehicles illegal, the EPA would indeed make it much easier for the agency to bring cases against sellers of these parts. However, such an overbroad approach is the equivalent of killing a fly with a howitzer: it is not only completely unnecessary, it causes a great deal of collateral damage to sellers of legitimate racing products. [EPA-HQ-OAR-2014-0827-1931-A1 p.6-7]

#### Failure to Engage in Reasoned Decision Making

Despite all of the significant changes contained within the NPRM, the regulated community was not provided adequate notice prior to the close of the initial comment period and the EPA has still not provided a detailed statement of basis and purpose for the changes, all of which are required under the Administrative Procedures Act<sup>43</sup> and the Clean Air Act.<sup>44</sup> The rationale behind the changes relative to racing vehicles was inexplicably absent from the NPRM and no explanation was included in the NODA, which merely requested the public comment on issues raised in SEMA’s comments.<sup>45</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.7]

While the EPA does not disclose the specific statutory authority for the changes relative to racing vehicles, the Clean Air Act is cited as the overarching statutory authority. Certain rulemakings undertaken by the EPA under the Clean Air Act are subject to the procedures at section 307(d) of the Act.<sup>46</sup> Section 307(d) states that proposed rules “shall be accompanied by a statement of its basis and purpose...”<sup>47</sup> There are minimum requirements for the statement of basis and purpose, such as “the major legal interpretations and policy considerations underlying the proposed rule.”<sup>48</sup> Adequate notice to interested parties is required under both the procedural provisions of the Clean Air Act and the Administrative Procedure Act, which governs rulemakings conducted by federal agencies more generally.<sup>49</sup> Agencies “must provide sufficient factual detail and rationale for the rule to permit interested parties to comment meaningfully.”<sup>50</sup> In reviewing the agency’s conduct, a court determines whether the agency’s process was conducted in an arbitrary and capricious manner, including looking to whether the “agency set forth the reasons for its actions.”<sup>51</sup> Constitutional due process also demands

“notice reasonably calculated, under all the circumstances, to apprise interested parties of the pendency of the action and afford them an opportunity to present their objections.”<sup>52</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.7-8]

In attempting to regulate converted racing vehicles and parts used thereon, the EPA has failed to fulfill the basic procedural requirements found in the Clean Air Act and Administrative Procedure Act. The NPRM contains no basis for the changes or the EPA’s purpose in proposing them, only that “clarification” is needed – but clarification never comes.<sup>53</sup> Instead of offering legal interpretations and policy considerations, the EPA flatly states that, unlike the exemptions available for nonroad vehicles used for competition, “[t]here is no comparable allowance for motor vehicles.”<sup>54</sup> This bald statement does not equate to a useful explanation of the changes or the extensive impact they have on the regulated industry. In explaining its position to the public, the EPA issued statements muddying the issue further by stating that it is merely explaining the difference between “nonroad vehicles” and “motor vehicles” and indicating that it does not plan on pursuing enforcement against individual racers.<sup>55</sup> The public’s confusion is indicative of a failure on the part of the agency to adequately explain the implications of the proposed changes. SEMA would also like to take this opportunity to note that the EPA’s frequent reference to nonroad vehicles used solely for competition is an oxymoron and confusing in itself, as the statutory definition of “nonroad vehicle” explicitly excludes any “vehicle used solely for competition.”<sup>56</sup> When Congress sought to regulate nonroad vehicles, it added the exclusionary language for racing vehicles because it had not directed these vehicles to be regulated as “motor vehicles” and had no intention of having them regulated under the nonroad provisions either. [EPA-HQ-OAR-2014-0827-1931-A1 p.8]

Congress has put in place additional requirements to maintain the proper checks and balances on agency action, including the Regulatory-Flexibility Act (“Reg-Flex Act”), the Small Business Regulatory Enforcement Fairness Act and the Congressional Review Act.<sup>57</sup> The Reg-Flex Act instructs federal agencies that they must “consider the impact of their regulatory proposals on small entities, [] analyze alternatives that minimize impacts on small entities, and [] make the agencies’ analyses available for public comment.”<sup>58</sup> The Congressional Review Act requires an agency to submit reports explaining how it has complied with the Reg-Flex Act and any applicable Executive Orders, as well as any cost-benefit analyses, to Congress and the GAO.<sup>59</sup> Rules that are considered “major” are subject to greater scrutiny, with a “major rule” defined as a rule that would “likely have an annual effect on the economy of \$100 million or more... increase costs or prices for consumers, industries, or state and local governments... or have significant adverse effects on the economy.”<sup>60</sup> Given the overwhelming impact that this proposal would have on the specialty equipment aftermarket, which generates approximately \$36 billion a year and employs Americans across all 50 states, this rule certainly qualifies for enhanced scrutiny under the Congressional Review Act.<sup>61</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.8-9]

The EPA has failed to conduct an analysis of how small businesses would be impacted or any cost-benefit analysis on the race vehicle provisions as required under the Reg-Flex Act and the Congressional Review Act. For example, the EPA’s rule would prohibit the sale of racing products for vehicles that started life as street vehicles but which have been converted into racing vehicles. If this change remains in the final rule, thousands of businesses selling products for use on converted racing vehicles would be considered to be operating outside the law overnight.<sup>62</sup> Many of these businesses are small entities, and the EPA has made no attempt to explain how the benefits of the proposed changes outweigh the substantial costs and disruption to the economy. Racers that use converted street vehicles for their sport and the shops that undertake the modifications are also put out of business. Motorsports as an industry generates billions of dollars of economic activity across the nation. Many states see motorsports-related industry as a driving force of their economies, such as Indiana, which has an estimated 23,000 Indiana residents employed by motorsports companies with average salaries of

\$63,000.<sup>63</sup> In Ohio, Summit Motorsports Park sponsored by aftermarket parts supplier Summit Racing has a \$99.5 million economic impact on the surrounding community.<sup>64</sup> That translates into jobs lost as well as denying Americans the ability to enjoy the sport of racing, and an indirect hit to all the local businesses catering to the participants and spectators. The EPA has not made any attempt to explain the potential impact on motorsports, motorsport facilities, the industries that have developed around motorsports or the Americans whose livelihood depends on motorsports. Foreclosing this degree of economic activity without explaining the logic and rationale for the changes falls short of the procedural statutes and judicial precedent.<sup>65</sup> [EPA-HQ-OAR-2014-0827-1931-A1 p.9-10]

### Reliance Interests

Many individuals and businesses have also relied on previous EPA guidance issued in 2002 that provided for modifications for the purpose of converting certified vehicles into racing vehicles.<sup>66</sup> The EPA's 2002 guidance document presents the question: "May I modify a vehicle for competition?"<sup>67</sup> The EPA answers the question by explaining that modifications to vehicles not subject to EPA standards are fine and followed with: "You may also modify EPA-certified vehicles if you will use them only for competition."<sup>68</sup> While the EPA may assert it meant this guidance solely for certified dirt bikes and snowmobiles, the language is certainly susceptible to the interpretation on which many in the industry have come to rely. [EPA-HQ-OAR-2014-0827-1931-A1 p.10]

For the forgoing reasons, SEMA respectfully requests the EPA withdraw the proposed regulations prohibiting the conversion of motor vehicles into vehicles to be used solely for competition. SEMA also requests the EPA more adequately explain the other proposed regulatory changes that will impact small businesses and give further guidance to businesses on compliance with existing policies [EPA-HQ-OAR-2014-0827-1931-A1 p.10]

### Other Implications and Considerations

At least one other regulatory hurdle must be addressed if the EPA continues to pursue this new policy. Motor vehicles are regulated by both the EPA and NHTSA. Similar to the Clean Air Act's tampering prohibition, under the Motor Vehicle Safety Act it is illegal for a manufacturer, distributor, dealer, or motor vehicle repair business to knowingly make inoperative any part of a device or element of design installed on or in a motor vehicle or motor vehicle equipment in compliance with an applicable motor vehicle safety standard. See 49 U.S.C. § 30122(b) (2015). The Motor Vehicle Safety Act's "make inoperative" prohibition does not apply to a certified motor vehicle that has been modified into a vehicle used solely for competition, placing it in conflict with the EPA's proposed interpretation of the Clean Air Act's tampering prohibition. The EPA must explain how its proposed application of the Clean Air Act would harmonize with NHTSA's application of the Motor Vehicle Safety Act. [EPA-HQ-OAR-2014-0827-1469-A1, p.8]

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4 Public Comment from the Specialty Equipment Market Association, EPA-HQ-OAR-2014-0827-1469-A1 (Dec. 28, 2015).

5 Press Release, Specialty Equipment Market Association, EPA Seeks to Prohibit Conversion of Vehicles into Racecars (Feb. 8, 2016) (on file with author).

6 See EPA Petition: Keep the Momentum Going! SEMA (Feb. 11, 2016), <https://www.sema.org/sema-news/2016/06/epa-petition-keep-the-momentum-going>.

7 NODA, *supra* note 1.

8 42 U.S.C. § 7550(2) (2016).

9 Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines: Exclusion and Exemption of Motor Vehicles and Motor Vehicle Engines, 39 Fed. Reg. 32,609 (Sept. 10, 1974) (to be codified at 40 C.F.R. pt. 85).

10 40 C.F.R. § 85.1703(a)(2)-(3) (2016).

11 See Anne Wick & Jacqueline Robles-Werner, SEMA Show 2010 Presentation by EPA at slide 10 (on file with author) (“Racing vehicle: A vehicle which, in general, has been extensively modified for racing, and is incapable of safe and practical street or highway use because it lacks features associated with safe and practical street or highway use. Such features include, but are not limited to, a reverse gear (except in the case of motorcycles), a differential, or other safety features required by state and/or Federal law.”); see also 40 C.F.R. § 85.1511(e) (2016) (“Racing vehicles may be imported by any person provided the vehicles meet one or more of the exclusion criteria specified in § 85.1703.”); U.S. ENVTL. PROT. AGENCY, EPA-420-B-11-015, OVERVIEW OF EPA IMPORT REQUIREMENTS FOR VEHICLES AND ENGINES 14 (2011) (explaining the documentation that must be presented to qualify for the racing vehicle exclusion to include: “A list of racing features (features that make the vehicle a racing vehicle)... A list of street features that are lacking (features that have been moved or have never been installed that would permit safe driving on streets or highways)... and Other proof that the vehicle cannot be used on streets and highways, such as a letter from a state’s Department of Motor Vehicles (DMV) that explains the vehicle cannot be licensed for use on public roads, and explains why it cannot be licensed.”).

12 See NPRM, *supra* note 3, at 40,552.

13 *Id.*

14 *Id.*

15 See 40 C.F.R. § 85.1511(e), *supra* note 11; see also OVERVIEW OF EPA IMPORT REQUIREMENTS, *supra* note 11.

16 See NPRM, *supra* note 3, at 40,552, 40,565, 40,596, 40,650, 40,720, 40,724-25.

17 *Id.* at 40,527.

18 See NPRM, *supra* note 3, at 40,527 (“if a motor vehicle is covered by a certificate of conformity at any point, there is no exemption from the tampering and defeat device prohibitions”; “it is not permissible to remove a motor vehicle or motor vehicle engine from its certified configuration regardless of the purpose for doing so.”).

19 See SEMA Show 2010 Presentation by EPA, *supra* note 11; see also *Util. Air Regulatory Grp. v. EPA*, 134 S. Ct. 2427, 2444 (2014) (explaining that particular scrutiny should be paid to agency actions when “an agency claims to discover in a long-extant statute an unheralded power to regulate a significant portion of the American economy.”).

20 See Jeremy Korzeniewski, Update: EPA says your racecar is probably already illegal, Autoblog, Feb. 9, 2016, 4:01 PM, <http://www.autoblog.com/2016/02/09/epa-racecar-emissions-illegal-update-official/>; see also Ryan Beene, EPA, SEMA at odds over proposed racecar rule, AUTOMOTIVE NEWS, Feb. 9, 2016, 5:10 PM), <http://www.autonews.com/article/20160209/OEM10/160209811/epa-sema-at-odds-over-proposed-racecar-rule> (“An EPA spokeswoman says the new language merely clarifies a prohibition that has long been agency policy.”).

21 Racing to Regulate: EPA’s Latest Overreach on Amateur Drivers Hearing Before the H. Comm. on Sci., Space, and Tech., Subcomm. on Oversight, 114th Cong. 3 (2016) (testimony of Brent D. Yacobucci, Section Research Manager for the Congressional Research Service), available at <https://science.house.gov/sites/republicans.science.house.gov/files/documents/HHRG-114-SY21-WState-BYacobucci-20160315.pdf>.

22 40 C.F.R. § 1068.20(b) (2016) (“May EPA enter my facilities for inspections? If we come to inspect, we may or may not have a warrant or court order. If we do not have a warrant or court order, you may deny us entry. If we have a warrant or court order, you must allow us to enter the facility and carry out the activities it describes”).

23 See NPRM, *supra* note 3, at 40,715 (“227. Section 1068.20 is amended by removing paragraphs (b) and (c) and redesignating paragraphs (d) through (f) as paragraphs (b) through (d), respectively.”).

24 Cal. Health & Safety Code § 43001 (2016).

25 *Id.*

26 Cal. Health & Safety Code § 39048 (2016).

27 E.g., Settlement Agreement and Release, ARB and LeMans Corporation at 6 (Jan. 16, 2016), available at [http://www.arb.ca.gov/enf/casesett/sa/lemans\\_corp\\_sa.pdf](http://www.arb.ca.gov/enf/casesett/sa/lemans_corp_sa.pdf) (“To the extent LEMANS advertises non-exempt parts in California, it shall use one of the following disclaimers:.. C. ‘LEGAL IN CALIFORNIA ONLY FOR RACING VEHICLES WHICH MAY NEVER BE USED, OR REGISTERED OR LICENSED FOR USE, UPON A HIGHWAY,’ or D. ‘FOR CLOSED COURSE COMPETITION USE ONLY. NOT INTENDED FOR STREET USE,’ ...”).

28 See 40 C.F.R. § 85.1511(e), *supra* note 11; see also OVERVIEW OF EPA IMPORT REQUIREMENTS, *supra* note 11.

29 See *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984).

30 See *Id.* at 843-844.

31 See *Id.* at 862 (Court unable to ascertain what Congress meant by “source” in the Clean Air Act because legislative history was ambiguous on this point); see also *Util. Air Regulatory Grp.*, *supra* note 19 at 2442 (“Under *Chevron*, we presume that when an agency-administered statute is ambiguous with respect to what it prescribes, Congress has empowered the agency to resolve the ambiguity. The question for a reviewing court is whether in doing so the agency has acted reasonably and thus has ‘stayed within the bounds of its statutory authority.’”) (quoting *Arlington v. FCC*, 133 S. Ct. 1863, 1868 (2013)).

32 Id. at 843 n.9 (“The judiciary is the final authority on issues of statutory construction and must reject administrative constructions which are contrary to clear congressional intent.”).

33 Motor Vehicle Air Pollution Control Act, Pub. L. No. 89-272, 79 Stat. 993 (1965).

34 See House Consideration of the Report of the Conference Committee, Dec. 18, 1970 (reprinted in A legislative history of the Clean air amendments of 1970, together with a section-by-section index, U.S. LIBRARY OF CONGRESS, ENVIRONMENTAL POLICY DIVISION, Washington: U.S. Govt. Print. Off. Serial No. 93-18, 1974, p. 117) (Representative Nichols: “I would ask the distinguished chairman if I am correct in stating that the terms ‘vehicle’ and ‘vehicle engine’ as used in the act do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events which, of course, are held very infrequently but which utilize all types of vehicles and vehicle engines?”; Representative Staggers: “In response to the gentleman from Alabama, I would say to the gentleman they would not come under the provisions of this act, because the act deals only with automobiles used on our roads in everyday use. The act would not cover the types of racing vehicles to which the gentleman referred, and present law does not cover them either.”).

35 See 42 U.S.C. § 7550(10) (2016) (“The term ‘nonroad vehicle’ means a vehicle that is powered by a nonroad engine and that is not a motor vehicle or a vehicle used solely for competition.”).

36 See Ryan Beene, EPA: Race car proposal targets ‘defeat devices,’ not racers, AUTOMOTIVE NEWS, Feb. 15, 2016, 12:01 AM), <http://www.autonews.com/article/20160215/OEM11/302159901/epa-target-is-defeat-devices-not-racers> (quoting EPA deputy press secretary as stating: “The EPA remains primarily concerned with cases where the tampered vehicle is used on public roads, and more specifically with aftermarket manufacturers who sell devices that defeat emission-control systems on vehicles used on public roads.”).

37 See 42 U.S.C. § 7522(a)(3)(B) (2016); see also 40 C.F.R. § 86.1854-12(a)(3)(ii) (2016); 40 C.F.R. § 1068.101(b)(2) (2016).

38 See Casper’s Electronics Inc. Clean Air Act, EPA, <https://www.epa.gov/enforcement/caspers-electronics-inc-clean-air-act> (last visited April 1, 2016); see also United States v. Casper’s Electronics, Inc., Civil Action No. 1:06-cv-03542 (N.D. Ill. 2007) (Consent Decree), available at <https://www.epa.gov/sites/production/files/2013-09/documents/casper-cd.pdf>.

39 See Id.

40 See Clean Air Act Amendments, Pub. L. No. 101-549, 104 Stat. 2399 (1990).

41 See 42 U.S.C. § 7550(10)-(11) (2016) (defining “nonroad engine” as any “internal combustion engine... that is not used in a motor vehicle or a vehicle used solely for competition” and “nonroad vehicle” as any “vehicle that is powered by a nonroad engine and that is not a motor vehicle or a vehicle used solely for competition”).

42 See United States v. Edge Products, L.L.C., \_\_\_\_\_ (N.D. Utah 2013) (Consent Decree), available at <https://www.epa.gov/sites/production/files/documents/edgeproducts-cd.pdf>; see also H&S Performance, LLC, Docket No. CAA-HQ-2015-8248 (EAB 2015) (Consent Agreement), available at <https://www.epa.gov/sites/production/files/2016-01/documents/hscafo.pdf>.

43 See 5 U.S.C. § 553 (2016).

44 See 42 U.S.C. § 7607(d) (2016).

45 See NODA, *supra* note 1 (“EPA is soliciting additional comments on issues discussed in a late comment related to light-duty motor vehicles used for racing”).

46 See 42 U.S.C. § 7607(d), *supra* note 44.

47 *Id.*

48 *Id.*

49 See 5 U.S.C. § 553, *supra* note 43; see also Theodore L. Garrett and Sonya D. Winner, *Administrative Procedure and Judicial Review*, 22 ENVTL. L. J. 10313 (1992) (“the procedures established under § 307(d) in most respects parallel the APA”).

50 See *National Elec. Mfrs. Ass'n v. EPA*, 99 F.3d 1170, 1172 (D.C. Cir. 1996) (quoting *Florida Power & Light Co. v. United States*, 846 F.2d 765, 771 (D.C. Cir. 1988), cert. denied, 490 U.S. 1045 (1989)).

51 See *Northeast Md. Waste Disposal Auth. v. EPA*, 358 F.3d 936, 949 (D.C. Cir. 2004) (“A rationale buried in a document published in 1989 simply does not ‘accompany’ a rule proposed and promulgated more than a decade later. Nor can such a reference satisfy the fundamental requirement of non-arbitrary administrative decision-making: that an agency set forth the reasons for its actions.”).

52 *Mullane v. Cent. Hanover Bank & Trust Co.*, 339 U.S. 306, 314 (1950).

53 See NPRM, *supra* note 3, at 40,526 (“EPA is proposing to add a clarification that the exemption from the tampering prohibition for competition purposes does not apply to heavy-duty highway vehicles. This aligns with the statutory provisions for the racing exemption.”).

54 See NPRM, *supra* note 3, at 40,527.

55 See Bob Sorokanich, *No, the EPA Didn't Just Outlaw Your Race Car*, ROAD AND TRACK, Feb. 9, 2016, <http://www.roadandtrack.com/motorsports/news/a28135/heres-what-the-epas-track-car-proposal-actually-means/> (admitting that it “isn't clear is how the EPA's newly clarified language will affect hobby racers going forward” and quoting EPA deputy press secretary as stating: “the proposed language in the Heavy-Duty Greenhouse Gas rulemaking simply clarifies the distinction between motor vehicles and nonroad vehicles such as dirt bikes and snowmobiles”); see also Korzeniewski, *supra* note 20 (“In an attempt to clarify its position on the modification of vehicles to be used solely for competition purposes, the Environmental Protection Agency has issued a statement to Autoblog. While we appreciate the effort to clear the air (sorry... pun intended), in reality, we're left with just as many questions as we started with.”).

56 42 U.S.C. § 7550 (11) (2016).

57 See Regulatory Flexibility Act of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996, 5 U.S.C. §§ 601-612 (2016) (hereinafter the “Reg-Flex Act”); Small Business Regulatory Enforcement Fairness Act of 1996, Pub. L. No. 104-121, 110 Stat. 857 (codified as amended



in scattered sections of 5 U.S.C. and 15 U.S.C.); Congressional Review Act, 5 U.S.C. §§ 801-808 (2016).

58 RONALD E. MEISBURG ET AL., THE NEW VOCABULARY OF NLRB RULEMAKING, AMERICAN BAR ASSOCIATION SECTION OF LABOR AND EMPLOYMENT LAW 5 (2012), available at [http://www.americanbar.org/content/dam/aba/events/labor\\_law/2012/02/committee\\_on\\_practice\\_procedure\\_under\\_the\\_nlra\\_midwinter\\_meeting/mw2012pp\\_meisburg.authcheckdam.pdf](http://www.americanbar.org/content/dam/aba/events/labor_law/2012/02/committee_on_practice_procedure_under_the_nlra_midwinter_meeting/mw2012pp_meisburg.authcheckdam.pdf).

59 See MAEVE P. CAREY, CONG. RESEARCH SERV., RL32240, THE FEDERAL RULEMAKING PROCESS: AN OVERVIEW 15 (2013).

60 Meisburg, *supra* note 58, at 7-8.

61 2015 SEMA MARKET REPORT, SEMA 2 (2015).

62 Racing products alone account for an estimated \$1.4 billion in retail sales. 2015 SEMA Market Report.

63 See Rich Van Wyk, Study Shows Motorsports Impact on Indiana Economy, WTHR (Dec. 6, 2012), available at <http://www.wthr.com/story/20281896/study-shows-motorsports-impact-on-indiana-economy>; see also Drew Klacik, Estimating the Annual Economic Contributions of Indianapolis Motor Speedway, INDIANA UNIVERSITY PUBLIC POLICY INSTITUTE 3 (2013), available at [http://www.imsproject100.com/wp-content/uploads/2013/07/Report\\_Update.pdf](http://www.imsproject100.com/wp-content/uploads/2013/07/Report_Update.pdf) (explaining that the Indianapolis Motor Speedway alone contributes over \$510 million of economic activity annually in Indiana).

64 Economic impact study released: Race track generates \$99.5 million a year for other local businesses, Summit News (Feb. 28, 2013), available at <http://www.summitmotorsportspark.com/news/81-news/217-economic-impact-study-released>.

65 See *Michigan v. EPA*, 135 S.Ct. 2699, 2706 (2015) (quoting *Allentown Mack Sales & Service, Inc. v. NLRB*, 522 U.S. 359, 374 (1998)) (“Not only must an agency’s decreed result be within the scope of its lawful authority, but the process by which it reaches that result must be logical and rational.”).

66 The EPA now contends this guidance is limited to “nonroad vehicles,” but has not taken steps over the years to correct the public’s misunderstanding.

67 U.S. ENVTL. PROT. AGENCY, EPA420-F-02-045, FREQUENTLY ASKED QUESTIONS: EMISSION EXEMPTION FOR RACING MOTORCYCLES AND OTHER COMPETITION VEHICLES 3-4 (2002).

**Organization:** State Attorneys General

As the chief legal officers of our states, we write to express our concerns about a conflict with the federal Clean Air Act found within the provisions of the 629-page rule referenced above, which states: “Certified motor vehicles and motor vehicle engines and their emission control devices must remain in their certified configuration even if they are used solely for competition or if they become nonroad vehicles or engines.” [EPA-HQ-OAR-2014-0827-1897-A1 p.1]

As proposed, this rule attempts to expand the USEPA's statutory jurisdiction under the Clean Air Act to cover vehicles modified solely for racing or competition. This approach is contrary to the law and would reverse decades of practice by the USEPA. This unnecessary regulation conflicts with the expressed intent of Congress, and we urge you to remedy this problem in the final rule by deleting the provision quoted above. [EPA-HQ-OAR-2014-0827-1897-A1 p.1]

Throughout the United States, modifying and racing cars is one of our nation's pastimes. It is also a large part of our country's economy. In 2014, consumers spent \$36 billion on automotive specialty equipment parts and accessories. All over the U.S., manufacturers, retailers, and technicians represent tens of thousands of jobs and billions of dollars. This proposed rule would purport to make many of the products made, sold, and installed by those businesses illegal, dealing a heavy blow to our economy. [EPA-HQ-OAR-2014-0827-1897-A1 p.1]

While the federal Clean Air Act prohibits certain modifications to everyday motor vehicles used on public roads, statutory language and the USEPA's historic practice have made it clear that vehicles built or modified for racing purposes, and not used on public streets, are not regulated under the Clean Air Act. [EPA-HQ-OAR-2014-0827-1897-A1 p.1]

For example, 42 U.S.C. § 7550(2) limits the definition of a covered "motor vehicle" to a vehicle designed for transport "on a street or highway" as opposed to operation on a racetrack. Correspondingly, 42 U.S.C. § 7550(10) limits the term "nonroad engine" to an engine "that is not used in a motor vehicle or a vehicle used solely for competition," while 42 U.S.C. § 7550(11) makes clear that the term "nonroad vehicle" also does not apply to "a motor vehicle or a vehicle used solely for competition." [EPA-HQ-OAR-2014-0827-1897-A1 p.]2

Congress did not make these choices at random. It intended to differentiate between a vehicle covered by this sort of rule and "a vehicle used solely for competition." In fact, the House Committee on Foreign and Interstate Commerce identified and discussed this issue before passing the Clean Air Act in 1970: [EPA-HQ-OAR-2014-0827-1897-A1 p.2]

MR. NICHOLS. I would like to ask a question of the chairman, if I may. [EPA-HQ-OAR-2014-0827-1897-A1 p.2]

I am sure the distinguished chairman would recognize and agree with me, I hope, that many automobile improvements in the efficiency and safety of motor vehicles have resulted from experience gained in operating motor vehicles under demanding circumstances such as those circumstances encountered in motor racing. I refer to the tracks as Talladega in my own State, to Daytona and Indianapolis, competition. I would ask the distinguished chairman if I am correct in stating that the terms "vehicle" and "vehicle engine" as used in the act do not include vehicles or vehicle engines manufactured for, modified for or utilized in organized motorized racing events which, of course, are held very infrequently but which utilize all types of vehicles and vehicle engines? [EPA-HQ-OAR-2014-0827-1897-A1 p.2]

MR. STAGGERS. In response to the gentleman from Alabama, I would say to the gentleman they would not come under the provisions of this act, because the act deals only with automobiles used on our roads in everyday use. The act would not cover the types of racing vehicles to which the gentleman referred, and present law does not cover them either<sup>1</sup>. [EPA-HQ-OAR-2014-0827-1897-A1 p.2]

Statutory language and legislative history clearly show that vehicles used solely for competition, including a race vehicle that has been converted from a certified highway vehicle, are not regulated

under the Clean Air Act. While the USEPA is authorized to create regulations that interpret laws passed by Congress, the agency cannot rewrite statutory definitions and—as the United States Supreme Court has made clear—“must always give effect to the unambiguously expressed intent of Congress.”<sup>2</sup> [EPA-HQ-OAR-2014-0827-1897-A1 p.2]

On behalf of the undersigned states, we strongly urge the USEPA to remove the aforementioned language referencing vehicles “used solely for competition” from the final rule. Not only is this language inconsistent with the federal Clean Air Act, but any purported benefit from this change would pale in comparison to the economic damage caused by this regulation. [EPA-HQ-OAR-2014-0827-1897-A1 p.3]

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1 House Consideration of the Report of the Conference Committee, Dec. 18, 1970 (reprinted in A legislative history of the Clean air amendments of 1970, together with a section-by-section index, U.S. LIBRARY OF CONGRESS, ENVIRONMENTAL POLICY DIVISION, Washington: U.S. Govt. Print. Off. Serial No. 93-18, 1974, p. 117).

2 Utility Air Regulatory Group v. Environmental Protection Agency 573 U. S. \_\_\_\_ (2014), quoting National Assn. of Home Builders v. Defenders of Wildlife, 551 U. S. 644, 665.

**Organization:** Thomas Abbe of Englewood LLC

I may not know the full meaning of the new regulations proposed but I am in strong opposition to any conditions which intentionally or otherwise may stifle development and innovation of motor vehicles by anyone engaged in improving performance of motor vehicles. Racing and other related fields are a proving ground of inestimable value to the progress of technology. Be very careful about the consequences of the proposed rule as it affects our industry. [EPA-HQ-OAR-2014-0827-1735 p.1]

**Organization:** Specialty Equipment Market Association (SEMA)

#### Regulatory Flexibility Act

Reg-Flex Analysis: The proposed rule has the possibility of causing harm to a number of small businesses. Many companies, including small businesses, would be dramatically affected by this new rule. These companies sell hundreds of street vehicles for conversion to race vehicles, undertake the conversions, sell products for use on these vehicles and use the converted race vehicles to participate in the sport of automobile racing. The EPA has failed to conduct an analysis of how these companies would be potentially impacted, as required under the Regulatory Flexibility Act of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996. See 5U.S.C. §§ 601-612 (2015). [EPA-HQ-OAR-2014-0827-1469-A1, p.4]

The EPA has actually recognized the important role of these businesses and supported racing in a program titled “Green Racing: From the Raceway to Your Driveway.” See Green Racing: Frequently Asked Questions, GREEN RACING 2011 PRESS KIT, <http://www3.epa.gov/otaq/ld-hwy/green-racing/PDF/FAQ.pdf>, and Green Racing Factsheet, [http://www3.epa.gov/otaq/ld-hwy/green-racing/PDF/Quick\\_Facts.pdf](http://www3.epa.gov/otaq/ld-hwy/green-racing/PDF/Quick_Facts.pdf) (both attached). [See Docket Numbers EPA-HQ-OAR-2014-0827-1469-A3 and EPA-HQ-OAR-2014-0827-1469-A4 for documents.] Working in collaboration with the American Le Mans Series (ALMS), the Green Racing program promoted innovation in racing that could

be transitioned into use in on-road vehicles. The EPA recognized that this transition would be possible because “[a]ll of the race cars have direct links to production vehicles,” with some cars in the series described as “more production-based but are highly modified for racing.” See Program Announcement: Green Racing Initiative, EPA420-F-10-058 (November 2010), <http://www3.epa.gov/otaq/ld-hwy/420f10058.pdf> (attached). [See Docket Number EPA-HQ-OAR-2014-0827-1469-A2 for document.] Given this understanding on the part of the EPA, it is unclear how and when the current conflicting position was formulated, and the rulemaking materials provide no clarification. [EPA-HQ-OAR-2014-0827-1469-A1, pp.4-5]

#### Other Implications and Considerations

Beyond statutory differences, the issue has significant economic and safety implications. Competition use vehicles are modified in shops across the nation and the vehicles are outfitted with safety equipment such as five-point seat belts, roll bars, cages and safety netting. These sales and services would cease as a result of the EPA’s proposed policy. The EPA’s unilateral action would threaten auto sector jobs and stifle the production of new and innovative safety equipment due to decreased product sales. Since many of the companies associated with these products and services are small businesses, the EPA’s Regulatory Flexibility Act analysis must take this issue into consideration. [EPA-HQ-OAR-2014-0827-1469-A1, p.8]

#### **Response:**

The language in the proposal regarding vehicles used for competition was intended to clarify how the Clean Air Act requirements apply for vehicles used on public roads. EPA’s focus is not (nor has it ever been) on vehicles built or used exclusively for racing, but on companies that violate the rules by making and selling products that disable pollution controls on motor vehicles used on public roads. These unlawful defeat devices lead to harmful pollution and adverse health effects. The proposed language was not intended to represent a change in the law or in EPA’s policies or practices towards dedicated competition vehicles. Since our attempt to clarify led to confusion, EPA has decided to eliminate the proposed language from the final rule.

With respect to the detailed comments we received on this issue, EPA will continue to consider them before making any additional attempts to clarify this issue. EPA will also continue to engage with the racing industry and others regarding the concerns raised in the comments, while maintaining the Agency’s focus where it has always been: reducing pollution from the cars and trucks that travel along America’s roadways and through our neighborhoods.

## **15.8 Comments Related to Criteria Pollutants**

### **15.8.1 Comments on Engine Efficiency and NOx Tradeoff**

**Organization:** Advanced Engine System Institute (AESI)

Our members have been working with the Department of Energy's Super Truck program to demonstrate the magnitude of carbon dioxide reductions that engine and vehicle technologies can deliver while improving criteria pollution control systems. From this advanced research and development program as well as the independent investment our companies are making with EPA and the California Air Resources Board at the Southwest Research Institute, we are increasingly confident that there is a fuel economy/greenhouse gas optimization 'bonus' to be realized from integrating rapidly emerging and cost-effective NOx control strategies into heavy-duty manufacturers' engines and powertrain designs. [EPA-HQ-OAR-2014-0827-1152-A1 p.2][This comment can also be found in section 3.3 of this comment

summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.291.]]

There no longer needs to be the once evident tradeoff between engine efficiency and tailpipe NOx emissions. The presentation attached (attachment 1) illustrates many of the newest NOx and GHG reducing technologies and the continually declining NOx emissions rates of the more recent and more efficient engine certifications. Basically, as engine manufacturers have been, with the able assistance of AESI companies, certifying their engines to tighter criteria pollutant standards and simultaneously integrating carbon emissions reduction as a design priority, both categories of pollution have been dropping. However, without the appropriate policy signal, the newest and most promising NOx control technologies may not manifest on the right timescale to comport with the Phase 2 proposal and thus could leave significant fuel economy gains until a future time. [EPA-HQ-OAR-2014-0827-1152-A1 p.2][This comment can also be found in section 3.3 of this comment summary]

Because California, as well as other states, continues and will continue to have very serious ozone nonattainment problems due mainly to NOx pollution from vehicles, that state is seriously considering an additional 90% reduction in NOx emissions beyond the 2010 standards for medium and heavy duty vehicles. Should that state, states in the Ozone Transport Commission region or the Northeast, or EPA, choose to formally adopt that standard, AESI members will work very hard with our customers to ensure that that standard can be achieved and to realize the optimization 'bonus' that would make fuel economy/greenhouse gas targets easier to achieve. [EPA-HQ-OAR-2014-0827-1152-A1 p.2-3][This comment can also be found in section 3.3 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.291-292.]]

**Organization:** Caterpillar Inc., et al.

### **The regulation must recognize trade-off of NOx and CO2 reduction targets**

There is a well-established inverse relationship between carbon dioxide (CO2) and oxides of nitrogen (NOx) emissions from an engine. If engine CO2 emissions and fuel consumption are to decrease, as is the intent of Phase 2 regulations, the engine-out NOx level must increase. This means that aftertreatment systems must be designed or redesigned to reduce the net tailpipe-out NOx emissions in order for the engine to remain compliant with the criteria pollutant regulation. EPA is encouraged to consider the relationship between CO2 and NOx emissions when issuing final GHG and fuel consumption standards. Based on testimony to the Agencies, the California Air Resources Board (CARB) believes they need to revise the California criteria pollutant regulation to implement an ultra-low NOx standard to mitigate ozone issues in some parts of the state. An extremely ambitious NOx reduction target in the timeframe of the Phase 2 rule, even if applicable only in some portions of the U.S., would make compliance with stringent GHG standards even more challenging. [EPA-HQ-OAR-2014-0827-1215-A1 p.8-9]

It is understood that the proposed Phase 2 regulations from EPA and NHTSA do not include a NOx reduction requirement. Nonetheless, the setting of the engine technology stringency for Phase 2 will influence the size of the effort and the ability to attain any future lower NOx standard. Therefore, it is important to consider the relationship between CO2 and NOx in the GHG and fuel consumption rulemaking process. It should be noted that in-use NOx emissions will be inherently reduced by technologies that reduce drag or decrease rolling resistance, thanks to reduced engine work demand. A Phase 2 rule that provides flexibility to deploy vehicle technologies over engine technologies allows manufacturers to maximize this effect. [EPA-HQ-OAR-2014-0827-1215-A1 p.9]

**Organization:** Diesel Technology Forum

### **California Clean Diesel Adoption and Benefits**

With one of the largest medium and heavy duty fleets in the country, California stands to benefit the most from these proposed Phase 2 rules. Already, model year 2010 and newer engines that are found in Class 3 – 8 vehicles in the state have eliminated 120,000 tons of NO<sub>x</sub> and 580,000 tons of carbon dioxide and saved 1.4 billion barrels of crude oil between 2010 and 2014, according to our most recent research. According to the Air Resources Board, the further adoption of new and newer diesel engines in heavy-duty applications in California is expected to reduce emissions of oxides of nitrogen by fifty percent between 2012 and 2020. [EPA-HQ-OAR-2014-0827-1171-A2 p.5][This comment can also be found in section 3.4 of this comment summary]

We believe these are also important considerations for EPA in developing a final Phase 2 rules, as follows: [EPA-HQ-OAR-2014-0827-1171-A2 p.5][This comment can also be found in section 3.4 of this comment summary]

**The program must consider the longstanding trade-off between NO<sub>x</sub> and CO<sub>2</sub>.** The rule should avoid driving technologies that realize gains in fuel efficiency at the expense of NO<sub>x</sub>, reversing the huge achievements of clean diesel technology in recent years and limiting the potential for further reductions in the future. As we have stated previously, technologies developed to meet the current emission standard established for model year 2010 maximize reductions in NO<sub>x</sub> and CO<sub>2</sub>. The maximization of this trade-off may become jeopardized if pushed too far. [EPA-HQ-OAR-2014-0827-1171-A2 p.6][This comment can also be found in section 3.4 of this comment summary]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **The Relationship between NO<sub>x</sub> and CO<sub>2</sub> Emissions from the Engine**

The calibration of internal combustion engines is a delicate balance that has to deal with trade-offs to optimize performance and emissions. For example, there is an inverse relationship between PM and NO<sub>x</sub> emissions that engine manufacturers applied to meet emission standards up through the 2006 heavy-duty highway regulations. In 2007, the requirement to reduce both PM and NO<sub>x</sub> emissions caused OEMs to install particulate filters on diesel vehicles which allowed engine calibrators to optimize the combustion in the engine to meet lower NO<sub>x</sub> emissions while relying on the DPF to remediate the resulting higher PM emissions. This example of effective emission regulations provided a technology solution to overcome the traditional barriers of engine calibration. In 2010, another game changing technology was installed on most trucks in response to a further tightening of NO<sub>x</sub> limits. Selective catalytic reduction or SCR allowed calibrators to not only reduce the soot load on filters and soot regeneration as a way of improving fuel efficiency but also to take advantage of another well-known trade-off in combustion thermodynamics between fuel consumption, CO<sub>2</sub> and NO<sub>x</sub> emissions out of the engine. [EPA-HQ-OAR-2014-0827-1210-A3 p.4]

Since 2010 the predominant technology to reduce NO<sub>x</sub> from diesel engines has been SCR and every generation of SCR systems has led to improvements in catalyst conversion efficiency (a detailed discussion of SCR technology is provided below). The SCR system is just one technology option that has allowed engine and vehicle manufacturers to meet the first phase of heavy-duty GHG standards while still achieving NO<sub>x</sub> reduction targets from the engine. The portfolio of technology options that are available to reduce greenhouse gas emissions from heavy-duty trucks and engines is continually

growing in response to tighter regulations set by U.S. EPA and the California Air Resources Board. In fact, a review of heavy-duty engine certifications from 2002 to 2015 shows that once emission and efficiency technologies were required on engines, the relationship between CO<sub>2</sub> and NO<sub>x</sub> emissions at the tailpipe went from a trade-off to a benefit (see Figure 1 below). By setting stringent emission targets for both CO<sub>2</sub> and NO<sub>x</sub> through realistic regulations and expanding the calibrator's tool box from the engine to the powertrain allowed engineers to achieve both reduced NO<sub>x</sub> levels and engine efficiency improvements simultaneously. Figure 1 plots the certification level for NO<sub>x</sub> and CO<sub>2</sub> from heavy-duty engines over the last 14 years and several generations of emissions technology. [EPA-HQ-OAR-2014-0827-1210-A3 p.4-5]

[Figure 1, 'Heavy-Duty Engine Certification Levels for NO<sub>x</sub> and CO<sub>2</sub>', can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1210-A3]

### **Selective Catalytic Reduction (SCR) Catalysts for Diesel Engines**

Selective catalytic reduction (SCR), catalysts have been used to significantly reduce NO<sub>x</sub> emissions from lean combustion engines for decades. The SCR system uses a chemical reductant, usually a urea/water solution, or other ammonia sources (e.g., solid urea or metal chloride amines), to convert nitrogen oxides to molecular nitrogen and oxygen-rich exhaust streams across a suitable catalyst. Upon thermal hydrolysis and decomposition in the exhaust, urea forms CO<sub>2</sub>, water and ammonia which serves as the reductant for NO<sub>x</sub> over the catalyst. As exhaust and reductant pass over the SCR catalyst, chemical reactions occur that reduce NO<sub>x</sub> emissions to nitrogen and water. [EPA-HQ-OAR-2014-0827-1210-A3 p.5]

SCR catalyst can achieve over 98% NO<sub>x</sub> conversion in hot operation and over 70% during the cold-start portion of the heavy-duty transient test cycle. SCR catalysts are used on medium and heavy-duty engines around the world to achieve low NO<sub>x</sub> emission regulations. Applying SCR to diesel-powered engines provides simultaneous reductions of NO<sub>x</sub>, PM, and HC emissions. In addition to reductions in criteria pollutants, SCR applications on heavy-duty trucks allow engine manufacturers to further optimize and reduce fuel consumption of these engines through calibration optimization, in-turn providing important reductions in greenhouse gas emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.5-6]

SCR applications on new highway, heavy-duty trucks in both Europe and the U.S. have already been shown to allow engine manufacturers the possibilities of calibrating engines for lower fuel consumption (and lower greenhouse gas emissions), while still meeting applicable NO<sub>x</sub> emission standards. Engine manufacturers that employed SCR technologies on 2010-compliant heavy-duty, highway engines in the U.S. claimed up to 5% improvements in fuel efficiency vs. engines that did not employ SCR technology. These fuel efficiency improvements are most evident at highway speeds, however in the future, employing thermal management strategies can shorten the warm-up portion of the cold start and facilitate urea injection earlier in the test cycle and thus expand the calibration optimization window to further reduce CO<sub>2</sub> emissions. The high NO<sub>x</sub> conversion efficiencies associated with SCR catalysts enable engines to be operated at conditions that yield lower fuel consumption. Engine manufacturers are expected to continue to further optimize engine fuel consumption characteristics and SCR system designs to assist in achieving the reductions proposed by EPA under this regulation. One example of future improvements in SCR catalyst system designs on heavy-duty engines is the direct application of SCR catalysts to diesel particulate filter substrates to provide a single catalyst module that provides reductions to all four criteria pollutants: hydrocarbons, CO, NO<sub>x</sub>, and PM. By deploying the SCR catalyst onto the filter moves the catalyst closer to the engine for faster warm-up, thus allowing earlier urea dosing. These SCR coated filters are already commercialized on several light-duty diesel passenger

car models and are expected on heavy-duty highway and off-road engines in the near future. Beyond SCR, a number of other technology advances will facilitate significant criteria emission reductions, efficiency gains and reductions of short lived climate pollutants. [EPA-HQ-OAR-2014-0827-1210-A3 p.6] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.213-214.]]

One such technology that has evolved specifically to address NO<sub>x</sub> emitted at low exhaust temperatures, includes a family of new materials referred to as passive NO<sub>x</sub> adsorbers (PNA). This catalyst technology is used upstream of the traditional exhaust control system, in combination with the DOC, to trap and store NO<sub>x</sub> at temperatures below 200°C before urea can be dosed into the hot exhaust. Once the exhaust temperature is sufficient for SCR catalysts to convert NO<sub>x</sub> to nitrogen, and to allow the urea dosing system to be activated, the NO<sub>x</sub> stored on the PNA begins to desorb so it can be converted by the ammonia reductant over the SCR catalyst. This emerging technology will be one of the strategies available to engine and vehicle manufacturers to achieve lower cold-start tailpipe NO<sub>x</sub> levels. [EPA-HQ-OAR-2014-0827-1210-A3 p.6]

The Advanced Collaborative Emissions Study (ACES) Phase 2 report published in 2012 showed that modern heavy-duty engines are achieving PM and NO<sub>x</sub> levels well below the federal standards. Recognizing the capability of technologies to deliver complimentary reductions of NO<sub>x</sub> and GHGs, California has adopted voluntary low NO<sub>x</sub> standards to incentivize development of state-of-the-art engines and emission controls to achieve NO<sub>x</sub> levels as low as 0.02 g/bhp-hr which is equivalent to a 90% reduction from EPA's 2010 highway, heavy-duty engine standards. Certification of cleaner engines ahead of proposing mandatory standards opens up opportunities for the state to direct incentive funds toward the development of cleaner engines. To support their regulatory efforts, ARB is funding a technology demonstration test program at Southwest Research Institute to demonstrate the feasibility to further reduce NO<sub>x</sub> emissions from heavy-duty engines. Advanced emission technologies like SCR coated filters and passive NO<sub>x</sub> adsorbers are included in this demonstration test program. EPA is monitoring this important test program as a member of the program's advisory committee. [EPA-HQ-OAR-2014-0827-1210-A3 p.6-7] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.214.]]

The engine certification levels for criteria pollutants and CO<sub>2</sub> since 2010 demonstrate that these fuel-efficient powertrain designs, combined with appropriate emission controls and efficiency technologies, can be optimized to improve overall CO<sub>2</sub> emissions of the vehicle while also achieving ultra-low NO<sub>x</sub> and other criteria pollutant emissions. This optimization extends beyond carbon dioxide emissions to include other significant greenhouse gases such as methane and nitrous oxide. [EPA-HQ-OAR-2014-0827-1210-A3 p.14]

**Organization:** National Association of Manufacturers (NAM)

The NAM also encourages the EPA and NHTSA to carefully examine the interaction between fuel efficiency and nitrogen oxides (NO<sub>x</sub>) reductions. This week, the EPA finalized new standards for ground-level ozone, for which compliance will require reductions in NO<sub>x</sub> across multiple sectors, including medium- and heavy-duty vehicles. NO<sub>x</sub> reducing technologies have typically reduced fuel efficiency. With new federal and perhaps even state NO<sub>x</sub> emissions standards on the immediate horizon, the EPA and NHTSA should carefully examine the interaction between reducing NO<sub>x</sub> from medium- and heavy-duty vehicles and improving fuel efficiency. [EPA-HQ-OAR-2014-0827-1323-A2 p.2]

**Organization:** Navistar, Inc.



It is well known that a trade-off exists for heavy duty diesel engines between NO<sub>x</sub> and CO<sub>2</sub>. For example, certain technologies for NO<sub>x</sub> control involve lower in-cylinder temperature which controls NO<sub>x</sub> but can lower the efficiency of the engine. In addition, other technologies, such as SCR catalysts, require higher exhaust temperatures to reduce NO<sub>x</sub> and may use fuel to increase the catalyst temperature. In both cases, NO<sub>x</sub> is reduced while CO<sub>2</sub> is increased due to either increased fuel use or decreased engine efficiency. In this regard, we fully agree with EMA. [EPA-HQ-OAR-2014-0827-1199-A1 p.10]

Navistar strongly believes that the feasibility of this Proposed Rule, assuming all other issues discussed are corrected, is very heavily dependent on NO<sub>x</sub> emissions levels for new engines remaining at their present levels. In addition, the costs of attempting to lower NO<sub>x</sub> while also lowering GHG emissions would be substantially higher than the costs of lowering GHG emissions alone while keeping NO<sub>x</sub> at its present levels. [EPA-HQ-OAR-2014-0827-1199-A1 p.10]

The agencies must consider the cumulative impacts of the Proposed Rule. We again have to stress that the feasibility of the Proposed Rule is dependent, among other things, on other emissions, particularly NO<sub>x</sub>, remaining at the same levels. Similarly, the adoption of the emission standards proposed would have a significant impact on the feasibility of future NO<sub>x</sub> regulation. Navistar strongly believes that this Proposed Rule and the technologies that will be necessary to meet it will impact the feasibility of any future regulation for NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1199-A1 p.20-21]

A little background is appropriate here. The upcoming MY2017 standard from Phase 1 is technology-forcing for the tractor engine, as opposed to other elements of Phase 1. The second step of the Phase 1 regulations for the tractor engines is currently driving a significant improvement in engines and represents a 3.3% improvement from MY2014, a magnitude which was expected to and has proven to be technology forcing (primarily for air systems and fuel systems). As proposed, the Phase 2 standard for tractor represents yet another technology-forcing step in emissions in the 2024MY phase which requires a 3.5% improvement over the 2017MY engines (see Table 1 in the Attachment A). This appears at face value to include relatively long lead time. However, when the CO<sub>2</sub> emission standard is considered with other portions of the proposed Phase 2 regulation the CO<sub>2</sub> standard is actually more stringent and occurs earlier. This is due to the N<sub>2</sub>O proposal and the fuel map margins, which effectively add stringency earlier to the engine standard. [EPA-HQ-OAR-2014-0827-1199-A1 p.21]

These cumulative impacts, if they are not corrected, would render the CO<sub>2</sub> standard infeasible if they are not corrected. Either the emission standard should be revised, or each of these issues must be corrected. Otherwise, the CO<sub>2</sub> standard will not be achievable in the time frame allowed. [EPA-HQ-OAR-2014-0827-1199-A1 p.21]

The major concerns with the technology projections and penetrations for both vocational and tractor engine standards include: [EPA-HQ-OAR-2014-0827-1199-A1 p.21]

- For combustion improvements, the primary mechanism is increased injection pressure, a set of technologies that can put upward pressure on engine-out NO<sub>x</sub>

**Organization:** PACCAR, Inc.

### **Relationship between NO<sub>x</sub> and CO<sub>2</sub> emissions**

Complying with more stringent NO<sub>x</sub> standards would require significant investment in engine and aftertreatment technologies and would not be conducive to improving fuel consumption and lowering

CO<sub>2</sub>. As is documented and known, there is a trade-off between fuel consumption and engine-out NO<sub>x</sub> for a current certified Heavy Heavy-Duty (HHD) diesel engine. The negative impact on fuel consumption from reduced engine-out NO<sub>x</sub> levels is clearly understood. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

As part of an ongoing feasibility study of 0.02 g/bhp-hr NO<sub>x</sub> tailpipe compliance, Southwest Research Institute is exploring a variety of measures aimed at reducing engine-out NO<sub>x</sub>. The results from an August 20, 2015 report-out suggest a 12% fuel consumption penalty for a 6-fold reduction in engine-out NO<sub>x</sub>. The proposed tailpipe levels would likely require still more aggressive reductions in engine-out NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Potential NO<sub>x</sub> and N<sub>2</sub>O Reductions

Several stakeholders are pressuring EPA to adopt lower NO<sub>x</sub> emission limits for heavy-duty vehicles. That pressure is likely to increase in light of the Agencies' adoption of a lower NAAQS for ozone. Regardless, this rulemaking is not the regulatory vehicle for the consideration of any potential additional low-NO<sub>x</sub> standards. In fact, given the inherent emissions trade-off between GHG emissions and NO<sub>x</sub> emissions (which, unlike GHG emissions, favor lower combustion temperature regimes), any additional NO<sub>x</sub> reductions will require extremely careful and thorough analysis. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

**Organization:** Truck Renting and Leasing Association

However, TRALA has several concerns about the Proposed Standards, which we have set forth below: (4) the trade-off between NO<sub>x</sub> emissions and engine efficiency could lead to impaired air quality [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

#### **The Trade Off Between NO<sub>x</sub> Emissions and Engine Efficiency Could Lead to Negative Air Quality Impacts**

The agencies have not fully taken into consideration the trade-off between NO<sub>x</sub> emissions and engine efficiency. Technology that reduces the engine work, such as improved aerodynamics or reduced rolling resistance, inherently results in a proportionate reduction in total NO<sub>x</sub> output. However, this is not the case with engine efficiency improvement, where there is a well-documented trade-off between NO<sub>x</sub> reduction and engine efficiency (and thus GHG emissions, as well). Excessive demands for stand-alone engine efficiency would limit the potential for NO<sub>x</sub> reduction, especially in urban duty cycles where NO<sub>x</sub> emissions reductions are most critical. [EPA-HQ-OAR-2014-0827-1140-A1 p.6]

**Organization:** Volvo Group

Fortunately, technologies aimed at reducing vehicle power demand, such as improving aerodynamics and reducing rolling resistance, result in less total work needed from the engine to complete the mission of moving cargo from point A to point B, and therefore proportionately less total NO<sub>x</sub> is emitted. This is not the case, however, when it comes to technologies focused on improving *engine* efficiency. Here, the NO<sub>x</sub>/efficiency trade-off typically results in precisely the opposite effect. The most logical thing EPA and NHTSA could do to avoid forcing this trade-off is to eliminate the separate engine standards in the proposal. At minimum, they should maintain the proposed engine stringency levels to mitigate undue

risk of unintended consequences. This would permit manufacturers to focus their development efforts on efficiency technologies that capitalize on synergistic GHG-NOx reduction opportunities, rather than those engine technologies that complicate and frustrate future NOx reductions. [EPA-HQ-OAR-2014-0827-1290-A1 p.60][This comment can also be found in section 3.3 of this comment summary]

That unique opportunity aside, EPA and NHTSA should give greater consideration to NOx implications of technologies when setting efficiency targets. EPA should calculate the NOx impact of individual engine technologies they propose. For example, hybrid technology can yield overall net increases in NOx if the engine aftertreatment temperature is compromised due to intermittent engine operation. Is the projected 23 to 25% efficiency gain of “strong hybrid” compromised by a more NOx-conscious control scheme? The stringency assessments that manufacturers are attempting to make in the review of the Phase 2 rule, especially in the extended timeframe of this rule, are meaningless if new NOx requirements are required in the same timeframe. [EPA-HQ-OAR-2014-0827-1290-A1 p.60]

The NOx reduction challenge to decrease ambient ozone levels will soon be upon us; the technical interplay with GHG emissions is far too great to ignore. It is appropriate and necessary that EPA and NHTSA structure a rule that allows manufacturers to achieve GHG-NOx synergies *whenever* possible, and that does not impede the ability to achieve further NOx reductions required in the future. [EPA-HQ-OAR-2014-0827-1290-A1 p.60]

**Organization:** Allison Transmission, Inc.

### **Onboard Diagnostic Requirements and NOx Testing of Hybrids Must Not Impede Adoption of Hybrid Technology**

#### **Higher NOx Emissions Are Not Attributable to Any Inherent Deficiency In Hybrid Technology**

As part of the Phase 1 regulations, EPA adopted provisions to delay onboard diagnostics (“OBD”) requirements for heavy-duty powertrains. As the Agency properly determined, for multiple reasons, imposing full OBD requirements for hybrids in order to meet criteria pollution limits would create a substantial impediment for the adoption of such systems. Within this rulemaking, EPA and NHTSA are requesting comment on a letter received from the California Air Resources Board (“CARB”) requesting consideration of supplemental NOx testing of hybrids. [EPA-HQ-OAR-2014-0827-1284-A1 p.54]

Allison does not believe that higher NOx production is caused by any inherent deficiency in hybrid systems. Instead, Allison believes that this phenomenon has occurred because hybrid systems tend to run the diesel engine at lower engine speeds than the equivalent conventional non-hybrid powertrain. In the case of an Allison hybrid, the engine may run the majority of its time in the 1200-1500 rpm speed range. That same engine in a conventional powertrain may run the majority of its time in the 1800-2600 rpm speed range. Since selective catalytic reduction (“SCR”) systems are configured to be most efficient in the conventional powertrain speed range, different emission profiles can occur. [EPA-HQ-OAR-2014-0827-1284-A1 p.54]

If the engine were optimized for emissions in the hybrid speed range, Allison believes that NOx production would be on par with the conventional systems. This optimization would likely require sizing of the SCR catalyst for the lower exhaust gas flow rate experienced with the hybrid system. Additionally, however, test duty cycles for hybrids must create adequate opportunity for the SCR catalyst to reach proper operating temperatures that are necessary to effectively convert the NOx passing through the catalyst. [EPA-HQ-OAR-2014-0827-1284-A1 p.54]

Allison believes that testing to certify NO<sub>x</sub> levels should be performed on a cycle that would be representative of the speed ranges that the hybrid system will command. We believe that there is a risk that requiring special testing and potentially special after-treatment devices may result in dramatically increased costs for the engine supplier. This, in turn, could affect decisions by manufacturers whether to invest in this specialty vehicle segment. [EPA-HQ-OAR-2014-0827-1284-A1 p.54]

**Organization:** California Air Resources Board (CARB)

CARB previously submitted to U.S. EPA comments requesting a supplemental NO<sub>x</sub> check to safeguard against NO<sub>x</sub> increases from improperly designed heavy-duty hybrid systems; the current proposal does not address this issue or incorporate CARB's recommendations. At a minimum, CARB recommends that the proposal specify the consequences for NO<sub>x</sub> emission increases identified during powertrain testing of hybrid systems, such as prohibiting manufacturers from counting high-NO<sub>x</sub> hybrid vehicles towards Phase 2 fleet averages. [EPA-HQ-OAR-2014-0827-1265-A1 p.4]

### **Comment – Hybrid powertrain test/potential hybrid NO<sub>x</sub> increases**

The NPRM is proposing to allow a single powertrain test for hybrid vehicles. Instead of A to B testing as required for hybrids in Phase 1, manufacturers would be required to conduct powertrain testing solely on the hybrid system and the test results would be used as inputs for GEM for simulation. CARB staff has significant concerns on the possible NO<sub>x</sub> increases of improperly designed heavy-duty hybrid systems, especially in light of U.S. EPA and NHTSA's current proposed provisions allowing the use of downsized engines and non-road engines in on-road heavy-duty hybrid vehicles. [EPA-HQ-OAR-2014-0827-1265-A1 p.88]

The NPRM requests comment on CARB's letter recommending that U.S. EPA consider including supplemental NO<sub>x</sub> testing of hybrids. The published version of the Phase 2 proposal does not contain the supplemental check for NO<sub>x</sub> emissions as recommended in the aforementioned CARB letter. Literature data point to possible increases in NO<sub>x</sub> emissions from heavy-duty hybrid vehicles if the hybrid system wasn't properly designed and integrated and/or if the hybrid vehicles were placed in vocations with mismatched duty cycles. As an example, a recent NREL study of hybrid trucks (funded by CARB) shows the average NO<sub>x</sub> emissions level from a hybrid class 5 parcel delivery step van was 111 percent higher than the NO<sub>x</sub> emissions from a similar conventional step van when tested on a chassis dynamometer.<sup>38</sup> CARB staff continues to believe that this is an important issue for heavy-duty hybrid vehicles and should not be ignored, and continues to support requiring supplemental NO<sub>x</sub> testing of hybrids. [EPA-HQ-OAR-2014-0827-1265-A1 p.88-89]

Although the Phase 2 proposal requires hybrid powertrain testing to record NO<sub>x</sub> emissions from the hybrid system, there are no provisions for addressing situations where the results show elevated NO<sub>x</sub> emissions levels. Since no penalties are specified for such a situation, manufacturers may have incentive to exploit a CO<sub>2</sub>/NO<sub>x</sub> trade-off and optimize the hybrid system for fuel economy at the detriment of NO<sub>x</sub> emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.89]

At a minimum, if the recommended supplemental check for NO<sub>x</sub> emissions is not required for every hybrid, CARB staff recommends that U.S. EPA and NHTSA specify in the Phase 2 standards the consequence for elevated NO<sub>x</sub> detected during the required hybrid powertrain testing. Possible consequences could include not allowing hybrid systems with elevated NO<sub>x</sub> to be certified under Phase 2 and/or requiring follow-up supplemental A to B testing if powertrain testing indicates elevated NO<sub>x</sub> emissions. CARB staff would be happy to work with U.S. EPA to develop the appropriate NO<sub>x</sub>

emissions thresholds for hybrid powertrain testing to identify elevated NOx emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.89]

If U.S. EPA and NHTSA ultimately decline to include the recommended supplemental check for NOx emissions (as described above) in the final Phase 2 rulemaking, CARB staff recommends an alternative approach. As an option, U.S. EPA and NHTSA could offer advanced technology credits to encourage manufacturers to perform the supplemental check for NOx emissions. Such credits could be offered to manufacturers who submit data showing hybrid NOx levels the same or lower than a conventional vehicle using supplemental A to B testing. CARB staff believes that these extra credits would provide incentives for hybrid manufacturers to produce hybrids without elevated NOx emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.89]

**Organization:** Daimler Trucks North America LLC

**Hybrids and the ARB's request to increase testing burden on hybrids by requiring NOx testing with GHG testing** - The agencies note that the ARB has created an impediment to the adoption of hybrid systems in that hybrid OBD certification is very difficult. 80 FR 40298. The agencies note, however, that the ARB requests a further increase to certification burden through the additional requirement of NOx testing in certification of hybrid GHG benefits. We recommend against any increased certification burden. Hybrid certification costs (i.e., the cost of testing on a chassis dynamometer and of certifying hybrid OBD systems) are already so high and sales volumes so low that any increased certification burden just worsens hybrids' cost-benefit position. We understand that ARB's concern about hybrids' NOx emissions, but we think that the agencies cannot both seek to increase hybrid penetrations into the market and increase regulatory obstacles to their deployment. [EPA-HQ-OAR-2014-0827-1164-A1 p.95-96]

**Response:**

Commenters on this topic tended to fall into two groups: one group that believes there to be an inherent tradeoff between NOx and fuel consumption, and another group that believes the tradeoff no longer exists. However, both groups over-simplify this issue by neglecting differences in technologies. For some technologies, there is little or no tradeoff. For example, technologies that reduce brake-specific fuel consumption by increasing the amount of usable work from the engine (such as friction reduction or waste heat recovery) can also reduce brake-specific criteria pollutants. On the other hand, technologies that reduce fuel consumption by increasing peak cylinder pressure would generally increase engine-out NOx emissions. Interactions with SCR further complicates the potential tradeoffs.

EPA has considered these potential effects in developing the engine standards, and agrees they would also need to be considered in any effort to develop lower NOx standards. However, we also see viable pathways to reduce NOx emissions with aftertreatment improvements or better off-cycle controls.

With respect to NOx emissions from hybrids, EPA believes this would more appropriately be addressed in a separate rulemaking focused on NOx emissions.

### **15.8.2 Comments on Future HD NOx Standards**

**Organization:** American Lung Association

The American Lung Association offers the following recommendations to strengthen the stringency and timing of the proposal and address several key elements of California's commitment to protecting public health and air quality. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.143-144.]]

Second, the American Lung Association urges the US EPA to immediately begin a national rulemaking to set standards requiring lower emissions of nitrogen oxides (NOx) from these engines and vehicles. EPA should begin work on a concurrent low-NOx standard to ensure that all trucks working in California are held to the standards we need to protect our citizens from near-road exposures of NOx and from ozone pollution. California's clean air progress must be protected against ongoing inter-state truck traffic with higher emissions. Under a stronger ozone standard, a national low-NOx standard of 0.02 grams per brake horsepower hour will help all regions with attainment, but this is especially true for Southern California. [NHTSA-2014-0132-0087-A1 p.2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.144-145.]]

**Organization:** American Trucking Associations (ATA)

### **Further Evaluation and Demonstration is Needed Before Committing to a Low-NOx Engine Standard**

Having gone through three rounds of reducing tailpipe NOx emissions in 2004, 2007, and again in 2010, the lessons learned from these prior regulatory actions remain fresh in the minds of the industry. Fuel economy penalties, increases in greenhouse gas emissions, reliability issues, and vehicle pre-buys and low-buys were among the significant unintended consequences. Another major factor was the cost of compliance. The cumulative vehicle surcharge for all three rounds was in excess of \$21,000, more than four times EPA's projected cost of compliance.<sup>17</sup> Given EPA expects fleets to pay an additional \$14,000 for a new tractor-trailer combination meeting the Phase 2 standards, the agencies must be sensitive to the cost impacts additional regulatory pursuits will have on the trucking industry. [EPA-HQ-OAR-2014-0827-1243-A1 p.20]

Although CARB recently certified an 8.9 liter natural gas engine to an optional NOx standard of 0.02 g/bhp-hr, the ability to transfer this technology into the Class 8 truck sector remains unproven.<sup>18</sup> The prospect of a commercially viable diesel engine meeting a NOx standard that is as much as 90% below the current standard should not be a foregone conclusion. [EPA-HQ-OAR-2014-0827-1243-A1 p.20]

If system designers push the NH3 to NOx ratio higher to try and achieve the maximum possible NOx reduction, it could increase N2O emissions. If EPA were to adopt a very low NOx standard (e.g., 0.02 g/bhp-hr) over existing test cycles, some reductions would be needed throughout the hot portion of the cycle (although most of the reductions would have to come from the cold start portion of the test cycle).... An increase in NH3 to NOx ratio could also further reduce NOx emissions: however this would also adversely affect NH3 slip and N2O formation. [EPA-HQ-OAR-2014-0827-1243-A1 p.21]

ATA is aware of the CARB-led research taking place at Southwest Research Institute to investigate the feasibility of achieving lower NOx emissions.<sup>20</sup> While this evaluation is scheduled to be completed in late 2016, additional time will be needed to further develop and demonstrate any resulting technologies. In addition to the need to demonstrate the technical feasibility of meeting lower NOx emissions in the Class 8 sector, while at the same time achieving increasingly stringent GHG emission limits, the in-use performance of such an engine must be carefully evaluated to ensure it meets the reliability, performance and cost criteria of the purchaser. Otherwise, this pursuit will result in buyer avoidance and an increase in the overall age of the fleet. ATA recommends that EPA carefully evaluate the cost,

timing, and market readiness of emerging low-NOx technologies when considering requests for a low-NOx engine standard. [EPA-HQ-OAR-2014-0827-1243-A1 p.21]

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17 Calpin, Patrick & Esteban Plaza-Jennings, A Look Back at EPA's Cost and Other Impact Projections for MY 2004-2010 Heavy-Duty Truck Emissions Standards, American Truck Dealers (February 2012).

18 CARB Webpage: Heavy-Duty Engines and Vehicles, including Urban Buses, and Engines Used in Diesel or Incomplete Medium-Duty Vehicles of 8501-14000 Pound GVWR Executive Orders – 2016, <http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/2016.php>

20 CARB webpage: Evaluating Technologies and Methods to Lower Nitrogen Oxide Emissions from Heavy-Duty Vehicles, <http://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm>.

**Organization:** California Air Resources Board (CARB)

### **5. Commit to future NOx control**

California needs dramatic further reductions in NOx emissions beyond what our current programs will achieve by 2031 to attain health-based standards for ozone and fine particulate matter. Reaching these attainment levels in California's South Coast Air Basin will require an approximate 70 percent reduction in NOx from today's levels by 2023, and an overall 80 percent reduction in NOx by 2031. CARB expected the proposal to include a commitment from U.S. EPA to begin efforts to develop lower, mandatory NOx standards for heavy-duty engines and vehicles. Federal action is especially needed for the largest heavy-duty trucks that frequently cross state lines and therefore cannot be effectively regulated by California alone. CARB will begin development of lower, mandatory NOx engine standards in 2017, and will also petition U.S. EPA to establish lower, federal NOx engine standards. If U.S. EPA fails to initiate a timely rulemaking, CARB will continue with its efforts to establish a California-only standard. [EPA-HQ-OAR-2014-0827-1265-A1 p.4] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.25.]]

### **Comment – NOx reductions from heavy-duty vehicles are crucial to California's air quality goals**

In the NPRM, U.S. EPA and NHTSA rightly noted California's unique challenge to attain the ozone and PM NAAQS in many regions of the state. In particular, California's South Coast Air Basin and San Joaquin Valley Air Basin, the nation's only two "Extreme" ozone non-attainment areas, require significant reductions in NOx and volatile organic gases to reach state air quality goals. Since heavy-duty vehicles currently emit approximately one-third of the state's NOx emissions, measures to reduce emissions from such vehicles are crucial for California. California needs dramatic further reductions in NOx emissions beyond what our current programs will achieve by 2031 to attain health-based standards for ozone and fine PM. Reaching these attainment levels in California's South Coast Air Basin will require an approximate 70 percent reduction in NOx from today's levels by 2023, and an overall 80 percent reduction in NOx by 2031. To make matters more challenging, U.S. EPA and NHTSA are revising the NAAQSs (due to be finalized by December, 2015). These new NAAQSs, which are more stringent than existing ones, will require even greater NOx emission reductions. This means that heavy-duty NOx emission reduction strategies must begin now and in parallel with GHG emission reduction strategies. [EPA-HQ-OAR-2014-0827-1265-A1 p.174]

California's compelling need for emission reductions necessitates further actions now, despite the past significant achievements of U.S. EPA and CARB efforts to reduce heavy-duty vehicle emissions.

CARB's *Sustainable Freight Pathways to Zero and Near-Zero Discussion Document* (Discussion Document)<sup>69</sup> describes actions to identify and prioritize potential immediate and near-term measures and strategies to reduce criteria pollutants and GHG emissions from all vehicle/equipment sectors that move freight in California to assist in meeting both the State's air quality attainment and climate needs. [EPA-HQ-OAR-2014-0827-1265-A1 p.174-175]

For the trucking sector, these strategies and measures include expanded enforcement efforts and financial incentive opportunities, reduced opacity limits for filter-equipped trucks, enhanced certification and warranty requirements to ensure low in-use emissions, increased flexibility for manufacturers in certifying advanced innovative truck engine and vehicle systems, and California Phase 2 GHG requirements, which may be more stringent than federal Phase 2 requirements, depending on the stringency of the final federal rule. The Discussion Document also calls for CARB to petition U.S. EPA to develop mandatory, NOx standards (which is discussed in more detail later in this comment). [EPA-HQ-OAR-2014-0827-1265-A1 p.175]

The CAA gives California independent authority to adopt its own heavy-duty vehicle and engine standards, which it has utilized on numerous occasions to achieve additional emission reductions as compared to the federal standards. However, the regulated industry has consistently preferred a single, national program, rather than a more stringent California-only standard. California recognizes this, and is committed to working with U.S. EPA and NHTSA to address heavy-duty truck NOx emissions. This is especially important for out of state trucks; of the one million heavy-duty vehicles that operate in California, approximately 60 percent of trucks operating in California were originally purchased in states outside of California. CARB is prepared to utilize its authority to develop California-only mandatory, lower NOx standards if U.S. EPA fails to take timely action in developing federal standards. [EPA-HQ-OAR-2014-0827-1265-A1 p.17.5]

Although the NPRM claims some reductions in NOx emissions are expected due to the Phase 2 program (due to use of APUs instead of idling),<sup>70</sup> CARB staff believes these emission reductions are overstated. Because nearly all of today's engines already meet clean idle requirements which limit NOx at idle to 30 grams/hour, switching to APU use is not expected to appreciably reduce NOx emissions and hence Phase 2 is not expected to significantly reduce tailpipe NOx emissions. Instead, because the NPRM does not incorporate CARB's recommendation for a supplemental NOx check for heavy-duty hybrids<sup>71</sup> and proposes overly broad use of dirtier off-road engines in on-road vehicles, CARB staff instead is concerned that Phase 2 may result in overall NOx emissions to increase; recent work at NREL funded by CARB shows that heavy-duty hybrids can have NOx emissions more than three times those of comparable diesel vehicles.<sup>72</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.175-176]

As CARB staff has worked with U.S. EPA and NHTSA over the past several years on the Phase 2 program, we have repeatedly requested that U.S. EPA and NHTSA consider opportunities in the Phase 2 rulemaking to encourage further NOx emission reductions, prevent inadvertent NOx increases, and lay the groundwork for swift federal action to reduce NOx from heavy-duty trucks. However, these requests have not been addressed in the NPRM. [EPA-HQ-OAR-2014-0827-1265-A1 p.176]

CARB staff was anticipating the inclusion in the NPRM of a discussion on the need for federal action on future NOx control and a commitment from U.S. EPA and NHTSA to begin development on lower, mandatory NOx standards for heavy-duty engines and vehicles. Unfortunately, the proposal included no such commitment. [EPA-HQ-OAR-2014-0827-1265-A1 p.176]

In parallel with completion of the Phase 2 rulemaking, CARB staff recommends that U.S. EPA and NHTSA pursue a joint rulemaking effort to reduce the NOx emission standard for heavy-duty engine



certification. The current emission standards for heavy-duty engines, the 2010 emission standards, were promulgated in 2001, which was 14 years ago. Since that time, engine manufacturers have made significant progress in improving the conversion efficiency of NOx aftertreatment technologies and in reducing emissions from engines. The next phase of NOx emission standards may be achieved with advanced engine controls and advanced aftertreatment technologies, leading to a significantly lower NOx emission standard than the 2010 standards.<sup>73</sup> [EPA-HQ-OAR-2014-0827-1265-A1 p.176]

CARB staff will begin development of lower, mandatory NOx engine standards in 2017, and also plans to petition U.S. EPA to establish lower, federal NOx engine standards. If U.S. EPA fails to initiate its rulemaking by 2017, CARB will continue with its efforts to establish a California-only standard. A lower NOx standard that reduces emissions from all trucks operating in California is critical to meeting 2031 air quality goals. [EPA-HQ-OAR-2014-0827-1265-A1 p.176]

CARB staff has already begun work to lay the technical foundation for a lower NOx emission standard for new heavy-duty engines. CARB has funded SwRI for a \$1.6 million project to investigate advanced technologies to reduce NOx emissions by 90 percent from today's U.S. EPA and CARB heavy-duty engine standards. The engine technology package must continue to meet all applicable standards for hydrocarbons, carbon monoxide, and PM, including, and GHG emissions. [EPA-HQ-OAR-2014-0827-1265-A1 p.177]

In this research contract, SwRI is evaluating enhanced aftertreatment technology choices, aftertreatment configurations, catalyst optimizations, urea dosing strategies, engine tuning, and engine management practices for two heavy-duty engines: one natural gas engine with a three-way catalyst; and one diesel engine with a DPF and SCR. The target NOx emission rate for this project over the heavy-duty FTP is 0.02 g/bhp-hr. [EPA-HQ-OAR-2014-0827-1265-A1 p.177]

SwRI will characterize the emission performance of the two stock engines using procedures following Title 40, Code of Federal Regulations, Part 1065, determine stock engine characteristics for cold starts, hot starts, normal operation, and low-load-low-temperature operation, and will determine possible engine control strategies. Based on the engine performance and possible engine control strategies, SwRI will select candidate aftertreatment technologies and engine control strategies for screening. The candidate emission reduction strategies will be screened using low-cost exhaust emission sources and test benches. The best performing technology packages and strategies will be identified and their performance will be measured on engine dynamometer over the heavy-duty FTP, World Harmonized Transient Cycle, ramped mode cycle, extended Idle, and three low-load-low-temperature cycles derived from the Orange County Transit Authority bus cycle, New York bus cycle, and CARB Creep cycle. [EPA-HQ-OAR-2014-0827-1265-A1 p.177]

The screening process is currently progressing and it is showing promising results towards achieving the 0.02 g/bhp-hour NOx for both natural gas and diesel engines.<sup>74</sup> This research contract is expected to be completed by the end of 2016. [EPA-HQ-OAR-2014-0827-1265-A1 p.177]

To further reduce NOx emissions, CARB also adopted optional low-NOx standards in late 2013 that are 50 percent, 75 percent, and 90 percent lower than the current NOx standard of 0.20 g/bhp-hr. The optional low-NOx standards were developed to encourage engine manufacturers to develop new technologies and also to provide them have been updated to include incentives to encourage the development and certification of lower NOx heavy-duty engines. In response to these actions, Cummins Westport Inc. (CWI) announced in May 2015 that it achieved a 0.02 g/bhp-hr NOx emission level on its 8.9 liter ISL G spark-ignited natural gas engine, and was starting field testing in California. In September 2015, CARB issued Executive Orders for the 8.9 liter ISL engine certified to the 0.02

g/bhp-hr optional NOx standard for use in medium heavy-duty and urban bus applications. [EPA-HQ-OAR-2014-0827-1265-A1 P.177-178]

As discussed previously on California's need for GHG reductions, another consideration for the adoption of lower NOx emission standards is its simultaneous implementation with the proposed Phase 2 GHG standards. The proposed Phase 2 Alternative 3 does not become fully implemented until the 2027 MY. A more stringent Alternative 4 would be fully implemented by the 2024 MY, which would allow earlier action on NOx, without the need for manufacturers to implement both rulemakings simultaneously. As a result, the need for timely NOx reductions lends additional support for U.S. EPA and NHTSA to choose Alternative 4 over Alternative 3. [EPA-HQ-OAR-2014-0827-1265-A1 P.178]

In light of California's and certain other states' pressing needs for NOx emission reductions to achieve the proposed more stringent NAAQS standards, CARB staff urges U.S. EPA and NHTSA to thoroughly describe the need for lower federal NOx emission standards for new heavy-duty engines in the Phase 2 rulemaking package and to initiate a parallel effort to adopt such standards as quickly as possible. [EPA-HQ-OAR-2014-0827-1265-A1 P.178]

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69 (CARB, 2015b) California Air Resources Board, "Sustainable Freight – Pathway to Zero and Near-Zero Emissions," April 2015, <<http://www.arb.ca.gov/gmp/sfti/sustainable-freight-pathways-to-zero-and-near-zero-emissions-discussion-document.pdf>>.

<sup>70</sup> Table VIII-20 in the Phase 2 Proposed Rule estimates 426,610 tons/yr downstream NOx reductions nationwide in 2050 due to Phase 2.

<sup>71</sup> See <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2014-0827-0036> for our comment regarding the need for a supplemental NOx check for hybrids.

<sup>72</sup> (NREL, 2015b) National Renewable Energy Laboratory, "Data Collection, Testing, and Analysis of Hybrid Electric Trucks and Buses Operating in California Fleets - Final Report," June 2015, <<http://www.nrel.gov/docs/fy15osti/62009.pdf>>.

<sup>73</sup> (CARB, 2015e) California Air Resources Board, "Draft Technology Assessment: Lower NOx Heavy-Duty Diesel Engines," September 2015, <[http://www.arb.ca.gov/msprog/tech/techreport/diesel\\_tech\\_report.pdf](http://www.arb.ca.gov/msprog/tech/techreport/diesel_tech_report.pdf)>.

<sup>74</sup> See Attachment 8 for Southwest Research Institute, ARB Low NOx Program Advisory Group Update, August 2015; and see <http://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm> for more information of this study.

[Attachment 8 can be found on p.40 of docket number EPA-HQ-OAR-2014-0827-1268-A1]

**Organization:** California Interfaith Power and Light

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p.104.]

We also support other organizations, such as the South Coast Air Quality Management District, in their call for a tightening of the NOx standards.

**Organization:** Clean Energy

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 249-250.]

We understand that some stakeholders will be asking that the EPA and NHTSA consider establishing a low-NOx standard for engines within the final rulemaking, much like the one being proposed by the California Air Resources Board.

While Clean Energy does not currently have a formal position on this proposed addition to the rule, we are very proud of our industry's tradition in delivering optional low-NOx performance well in advance of competing combustion technologies. Specifically, Cummins Westport has recently announced its plans to deliver a nine-liter engine available to the market that meets a .02-gram per brake horsepower hour limit as early as quarter 1 of 2016. Further, Cummins Westport believes that it would deliver similar missions performance for its 12 and 6.7-liter product line as early as Q2 2017 if they receive onboard diagnostic flexibility from the Air Resources Board and additional R&D funding from local and state agencies.

**Organization:** Coalition for Clean Air/California Cleaner Freight Coalition

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 217-218.]

We cannot reach attainment of federal standards in Los Angeles region or the San Joaquin Valley without a .02 brake horsepower hour NOx heavy-duty standard.

And it should also initiate a separate rulemaking to lower the NOx standards.

**Organization:** Environmental Defense Fund (EDF)

### **EPA should commit to strengthen NOx standards for heavy-duty trucks**

Ozone pollution continues to threaten the health of millions Americans – 4 in 10 people live in areas with unhealthy levels of ozone.<sup>221</sup> Reducing emissions of nitrogen oxides (NOx) and volatile organic compound (VOC) – the precursors to ozone – is critical to providing cleaner air for communities and families across the nation. NOx emissions standards for heavy-duty vehicles were last issued in 2001 and implementation was completed in 2010. Those standards achieved significant reductions in NOx and particulate emissions through innovative technology and ingenuity by manufacturers. [EPA-HQ-OAR-2014-0827-1312-A1 p.53]

It has been nearly 15 years since the last standards were promulgated, and technology has continued to advance. It is also clear that additional reductions in ozone forming NOx are needed from the heavy-duty sector. In places like California – where much of the state is hard hit by ozone pollution – heavy-duty trucks still make up 33% of statewide NOx emissions.<sup>222</sup> Developing technologies, together with the improvement of existing emissions controls can provide additional cost-effective, meaningful NOx reductions from the nation's heavy-duty fleet.<sup>223</sup> California has already begun research on the

technologies needed to reduce NOx by another 90 percent.<sup>224</sup> EPA should collaborate with ARB to investigate the pathways to making NOx reductions. [EPA-HQ-OAR-2014-0827-1312-A1 p.53]

We urge EPA, in the final rulemaking, to commit to strengthen NOx standards for heavy-duty trucks as soon as possible. By initiating a NOx rulemaking immediately, manufacturers will be able to integrate the planning and the technology for CO2 and NOx reductions, helping to ensure that one benefit is not traded for the other. [EPA-HQ-OAR-2014-0827-1312-A1 p.53]

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211 Preamble at 40332.

221 American Lung Association, State of the Air 2015, Key Findings, available at <http://www.stateoftheair.org/2015/key-findings/> (last accessed September 14, 2015).

222 CARB presentation at Board Hearing, “Update on the Proposed Federal Phase 2

GHG and Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles,” Sacramento, (July 23, 2015), available at <http://www.arb.ca.gov/board/books/2015/072315/15-6-6pres.pdf>.

223 CARB, upcoming “Draft Technology Assessment: Lower NOx Heavy-Duty Diesel Engines.”

224 Southwest Research Institute, “ARB Low NOx Program Advisory Group Update,” (August 2015), available at <http://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm>.

**Organization:** Manufacturers of Emission Controls Association (MECA)

The Advanced Collaborative Emissions Study (ACES) Phase 2 report published in 2012 showed that modern heavy-duty engines are achieving PM and NOx levels well below the federal standards. Recognizing the capability of technologies to deliver complimentary reductions of NOx and GHGs, California has adopted voluntary low NOx standards to incentivize development of state-of-the-art engines and emission controls to achieve NOx levels as low as 0.02 g/bhp-hr which is equivalent to a 90% reduction from EPA’s 2010 highway, heavy-duty engine standards. Certification of cleaner engines ahead of proposing mandatory standards opens up opportunities for the state to direct incentive funds toward the development of cleaner engines. To support their regulatory efforts, ARB is funding a technology demonstration test program at Southwest Research Institute to demonstrate the feasibility to further reduce NOx emissions from heavy-duty engines. Advanced emission technologies like SCR coated filters and passive NOx adsorbers are included in this demonstration test program. EPA is monitoring this important test program as a member of the program’s advisory committee. [EPA-HQ-OAR-2014-0827-1210-A3 p.6-7] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.214.]]

To estimate the achievable level of NOx inventory reduction through the deployment of technologies capable of achieving a 90% NOx reduction below 2010 levels in the lower 47 states (excluding California), MECA funded an independent emission inventory forecast study, at ENVIRON. This analysis relied on EPA’s MOVES2014 emissions inventory model for on-road vehicle emissions to estimate the future NOx reduction potential of a 0.02 g/bhp-hr heavy-duty NOx standard under a federal program. By-model-year emissions were determined for on-road vehicles to develop emissions estimates with and without new potential future emission standards. The model was run to generate

emission inventories of NO<sub>x</sub>, VOC, CO and PM for on-road heavy-duty sources for calendar years 2025, 2030, 2040, and 2050. [EPA-HQ-OAR-2014-0827-1210-A3 p.7] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.214.]]

When fully implemented, the achievable reductions from tighter NO<sub>x</sub> regulations on the heavy-duty on-road sector are estimated to be 266,000 tons per year or 730 tons per day in 2050 across the 47 contiguous United States and D.C., excluding California. We believe that these heavy-duty control measures represent the largest opportunity for achieving NO<sub>x</sub> reductions from the mobile sector going forward. We estimated the incremental cost of the types of additional emission controls that would be necessary to achieve the target reductions from heavy-duty trucks, beyond the exhaust controls already being used to meet current 2010 heavy-duty on-road standards at approximately \$500 per vehicle averaged over the medium and heavy-duty highway fleet. Based on the results of our analysis, we estimate that heavy-duty trucks can deliver NO<sub>x</sub> reductions at a cost of approximately \$3,000-\$4,000 per ton. The very cost-effective NO<sub>x</sub> reductions available from the heavy-duty highway sector reflect the continued evolution of diesel exhaust emission controls. It has been more than 15 years since EPA closely examined diesel emission technologies as part of finalizing their 2007-2010 heavy-duty highway engine standards. Manufacturers of these technologies have and continue to improve the base technologies used to control NO<sub>x</sub> and PM from diesel engines. Significant experience has been provided by commercial roll-out of heavy-duty engines equipped with DPFs and SCR catalyst systems in this sector since 2007. These evolutionary improvements provide the pathway to achieving additional significant, cost-effective NO<sub>x</sub> reductions from this sector. [EPA-HQ-OAR-2014-0827-1210-A3 p.7] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.214-215.]]

MECA believes that further reductions in NO<sub>x</sub> emissions from new heavy-duty on-road and off-road diesel engines beyond the 2010 on-road and Tier 4 off-road requirements will be possible through the combinations of more advanced diesel engines with advanced diesel exhaust emission control technologies. Much of the system development necessary to meet lower NO<sub>x</sub> emissions will be focused on the initial cold-start portion of the heavy-duty transient FTP test cycle representing approximately 70% of the total NO<sub>x</sub> emissions over the entire cycle. The types of future evolutionary technologies deployed, to achieve a future lower NO<sub>x</sub> standard, will likely include advanced substrates, improved SCR catalysts, more efficient SCR reductant delivery technologies and algorithms, and/or passive NO<sub>x</sub> adsorber catalysts. Substrate mounting materials have also evolved through newer technology generations including innovative, insulating intumescent canning materials that retain heat in the catalyst during periods of engine shutdown. The emission reduction benefits achieved through the deployment of cold start technologies such as advanced thermal management strategies, close-coupled catalysts, low thermal mass materials, improved ammonia dosing strategies among others will extend to increased conversion during low temperature duty-cycle operations. Already in several commercial light-duty diesel applications, higher porosity within the ceramic filter walls has allowed SCR catalyst to be deposited directly onto the DPF and thereby effectively moving the SCR closer to the turbocharger outlet in a more close-coupled position. Faster heat-up of the SCR catalyst has allowed earlier ammonia injection and NO<sub>x</sub> reduction. The sooner the SCR catalyst is activated in the test cycle, engine calibrators can optimize combustion for reduced CO<sub>2</sub> emissions. Furthermore, these cold-start technologies will allow vehicle manufacturers to deploy hybrid systems, stop-start technologies and waste heat recovery to improve vehicle efficiency while still meeting tighter NO<sub>x</sub> limits. [EPA-HQ-OAR-2014-0827-1210-A3 p.7-8] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.213-214.]]

MECA believes the time is right for EPA to begin a rulemaking effort aimed at further significant reductions in NO<sub>x</sub> emissions from heavy-duty highway engines. Improved NO<sub>x</sub> reduction technologies are available today to deliver ultra-low NO<sub>x</sub> emissions from these engines. Existing and future ozone

non-attainment regions will need these cost-effective NO<sub>x</sub> reductions to support attainment plans. Engine manufacturers can combine these advanced NO<sub>x</sub> emission controls with other efficiency technologies to optimize future truck performance to deliver both lower NO<sub>x</sub> emissions and improved fuel efficiency. [EPA-HQ-OAR-2014-0827-1210-A3 p.8]

Ground level ozone also has a strong linkage to climate change. EPA needs to continue its efforts to review and adjust criteria pollutant programs for all mobile sources going forward to not only provide needed health benefits from technology-forcing emission standards but also the co-benefits these emission standards have on climate change. In particular for heavy-duty highway engines, MECA urges EPA to begin a rulemaking effort as soon as possible aimed at further NO<sub>x</sub> reductions from heavy-duty engines. [EPA-HQ-OAR-2014-0827-1210-A3 p.14] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.215.]]

**Organization:** Moving Forward Network

*EPA and NHSTA need an advanced NO<sub>x</sub> standard* – Many of our communities live in areas with high levels of ozone pollution. It is vital that this regulation create requirements to reduce the amount of harmful NO<sub>x</sub> pollution coming from these trucks. [EPA-HQ-OAR-2014-0827-1130-A2 p.2]

**Organization:** National Association of Clean Air Agencies (NACAA)

Our March 18, 2015 letter also included a recommendation that EPA articulate in the proposal the need for significantly lower national heavy-duty NO<sub>x</sub> standards beyond the current 2010 onroad heavy-duty NO<sub>x</sub> exhaust emission standards and nonroad heavy-duty engine exhaust emission standards. We are very disappointed that EPA has not included such a discussion in this proposal. Although there is the potential for ancillary NO<sub>x</sub> reductions from the Phase 2 rule, the achievement of these reductions is not certain (we note that predicted ancillary benefits of Phase 1 did not occur). Moreover, even if ancillary NO<sub>x</sub> benefits do accrue under the Phase 2 rule, they will not be nearly sufficient given the challenges state and local agencies face in attaining and maintaining current and upcoming ozone and fine PM standards and protecting against visibility impairment and eutrophication of water bodies. [EPA-HQ-OAR-2014-0827-1157-A1 p.4] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.54.]]

In addition to early climate benefits, federal action on our recommendation to adopt Alternative 4 (full implementation by 2024) would also provide manufacturers the ability to incorporate technologies to significantly reduce NO<sub>x</sub> emissions from heavy-duty vehicles in a more timely manner. While already crucial for a number of areas, NO<sub>x</sub> reductions from the heavy-duty sector will become increasingly important to additional areas under strengthened National Ambient Air Quality Standards for ozone, which are expected imminently. We urge that EPA include in the final Phase 2 rule a clear and comprehensive discussion of the need for very substantial additional NO<sub>x</sub> reductions from heavy-duty vehicles and engines and, even more critically, an explicit commitment to begin immediately a separate rulemaking initiative to capture those reductions. [EPA-HQ-OAR-2014-0827-1157-A1 p.4][[This comment can also be found in section 1.5 of this comment summary] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.54.]]

**Organization:** National Automobile Dealers Association (NADA)

NADA/ATD is categorically opposed to the imposition of any new NO<sub>x</sub> standards during the duration of the Phase 2 program. The prospect of significantly lower NO<sub>x</sub> standards is just now the subject of

cutting edge research and it will be many years before the technology sufficient to meet any such standards can be developed and demonstrated to the demanding performance, reliability, and cost requirements of new commercial vehicle customers. [EPA-HQ-OAR-2014-0827-1309-A1 p.10]

**Organization:** Navistar, Inc.

Navistar strongly believes that this Proposed Rule and the technologies that will be necessary to meet it will impact the feasibility of any future regulation for NOx. [EPA-HQ-OAR-2014-0827-1199-A1 p.20-21]]

**Organization:** North American Repower

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 308.]

You have asked very specifically about .2 versus .02 grams per horsepower hour NOx. There are disclosures in place that I can't say exactly who we are working with. We have the technology. We have already shown it in the test cell, to our satisfaction. We can get to .02 NOx with natural gas engines with our technology. Do I push for that? No. Why? Because we have seen where we have pushed too quickly with new technologies and it has adversely affected the population.

**Organization:** Northeast States for Coordinated Air Use Management (NESCAUM)

In addition, our states remain concerned about emissions of nitrogen oxides (NOx) from this sector, and urge EPA to begin rulemaking to require further reductions in NOx from heavy-duty trucks at the earliest possible date. Below we discuss several specific areas in which the rule can and should be strengthened. [EPA-HQ-OAR-2014-0827-1221-A1 p.1-2] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.136.]]

**EPA should address the potential for further NOx reductions at the earliest possible date.**

Heavy-duty trucks represent the second largest source of NOx emissions in the NESCAUM region, and our states remain very concerned about the need to further control NOx emissions from this sector. We thank the agencies for acknowledging the challenge that states continue to face in this regard, and we urge EPA to begin a rulemaking without delay to ensure that the next generation of trucks is not only more fuel efficient but also much less of a contributor to states' air quality and public health problems. [EPA-HQ-OAR-2014-0827-1221-A1 p.3] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, pp.137-138.]]

The NESCAUM region, home to over 42 million people, is subject to episodes of poor air quality resulting from ground-level ozone and fine particle pollution. During severe events, the scale of the problem can extend beyond NESCAUM's borders and include over 200,000 square miles across the eastern United States. Local and regional sources as well as air pollution transported hundreds of miles from distant sources outside the region contribute to elevated ozone and fine particle concentrations in the region. [EPA-HQ-OAR-2014-0827-1221-A1 p.3]

NOx emissions contribute to a number of adverse public health and environmental outcomes. NOx is the most important contributor to nitrogen dioxide and ground-level ozone pollution, and an important precursor to fine particulate matter formation. These pollutants are responsible for tens of thousands of

premature deaths, hospital admissions, and lost work and school days in the U.S. annually. NO<sub>x</sub> is also a key factor in a number of environmental problems that affect the Northeast. Table 1 summarizes the major adverse impacts of NO<sub>x</sub> emissions in the NESCAUM region. [EPA-HQ-OAR-2014-0827-1221-A1 p.4]

[Table 1 can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1221-A1]

Additional NO<sub>x</sub> reductions would benefit air quality and public health in the Northeast by: (1) lowering the “ozone reservoir” that forms in the eastern U.S., and (2) reducing the amount of low-level NO<sub>x</sub> emissions and pollutants derived from NO<sub>x</sub> that are transported into the Northeast/Mid-Atlantic region. [EPA-HQ-OAR-2014-0827-1221-A1 p.4]

### **Ozone**

Ozone remains a persistent pollution problem in parts of the NESCAUM region during warm weather months. The evolution of severe ozone episodes often begins with the passage of a large high pressure area from the Midwest to the middle or southern Atlantic states. Three primary pollution transport pathways affect air quality in the region: long-range, mid-level, and near-surface. During severe ozone episodes associated with high-pressure systems, these pathways converge on the Mid-Atlantic area, where sea and bay breezes act as a barrier and funnel ozone and other air pollutants up the Northeast Corridor. [EPA-HQ-OAR-2014-0827-1221-A1 p.4-5]]

Collectively, NO<sub>x</sub> emissions and ambient ozone concentrations in the region have dropped significantly since 1997, along with the frequency and magnitude of exceedances of the health-based ozone national ambient air quality standard (NAAQS).<sup>5</sup> Despite this demonstrated progress, some of the most populous areas of the region continue to violate the 2008 0.075 ppm ozone NAAQS. Attaining the standard in these areas will require significant additional NO<sub>x</sub> reductions within the Northeast and in upwind areas. Looking toward the future, additional NO<sub>x</sub> reductions will be critical to ozone attainment in order to meet the recently revised 0.070 ppm ozone NAAQS, which EPA projects will continue to be exceeded in our region in 2025. [EPA-HQ-OAR-2014-0827-1221-A1 p.5]

### **Particulate Matter**

Scientific evidence has established a solid link between cardiac and respiratory health risks and transient exposure to ambient fine particle pollution that is capable of penetrating deep into the lungs.<sup>6</sup> Exceedances of the fine particle NAAQS can occur at any time of the year, with some of the highest levels often reached in the winter. There are important differences in the chemical species responsible for high fine particle levels during summer and winter in the Northeast. Regional fine particle formation in the eastern United States is primarily due to SO<sub>2</sub>, but NO<sub>x</sub> is also important because of its influence on the chemical equilibrium between sulfate and nitrate particles during winter when nitrates can be a relatively greater contributor to urban PM<sub>2.5</sub> levels. [EPA-HQ-OAR-2014-0827-1221-A1 p.5]

The agencies, however, should strengthen certain provisions to maximize the benefits from this important program. In addition, EPA should ensure that emissions of other pollutants do not increase as a result of the rule, and should commence rulemaking to reduce NO<sub>x</sub> from heavy-duty vehicles at the earliest possible date. [EPA-HQ-OAR-2014-0827-1221-A1 p.7]



5 NESCAUM. 2010. The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description, prepared for the Ozone Transport Commission by NESCAUM, Boston, MA (August 2010). Available at: [http://www.nescaum.org/documents/2010\\_o3\\_conceptual\\_model\\_final\\_revised\\_20100810.pdf](http://www.nescaum.org/documents/2010_o3_conceptual_model_final_revised_20100810.pdf).

6 U.S. EPA. 2005. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, USEPA OAQPS Staff Paper, EPA-452/R-05-005a (December 2005).

**Organization:** Ozone Transport Commission (OTC)

Air quality in our region does not meet the current ozone National Ambient Air Quality Standards (NAAQS) and is not expected to meet the proposed 2015 NAAQS without substantial not yet on the books decreases in Oxides of Nitrogen (NO<sub>x</sub>) emissions. Mobile sources, particularly heavy-duty vehicles, are a significant contributor of NO<sub>x</sub> emissions in the region. USEPA has the authority and responsibility to provide these remission reductions. The OTC calls on the USEPA to evaluate and deliver additional NO<sub>x</sub> reductions from medium- and heavy-duty vehicles in a time frame to assist the attainment of the 2008 and expected 2015 Ozone NAAQS. [EPA-HQ-OAR-2014-0827-1211-A2 p.1]

Background on Ozone

Ground-level ozone is a significant health threat. It is known to cause respiratory illnesses, exacerbate or trigger asthma related episodes, increase respiratory-related emergency room and hospital admissions, and compromise the immune system leading to increased incidents of other respiratory illnesses, including pneumonia and bronchitis, and to cause premature death. Ozone is formed when Volatile Organic Compounds (VOCs) and NO<sub>x</sub> mix and interact with sunlight. [EPA-HQ-OAR-2014-0827-1211-A2 p.1]

Research has shown that ozone formation in the OTR is predominately driven by regional NO<sub>x</sub> emissions from mobile sources. [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Importance of Diesel Trucks in Formation of Ground Level Ozone

Recent modeling and inventory analyses OTC completed to plan for meeting both the 2008 and expected 2015 Ozone NAAQS, has shown that diesel trucks are a large contributor of NO<sub>x</sub> emissions which lead to ground level ozone pollution. National runs of the USEPA MOVES model show that heavy-duty diesel trucks alone make up greater than 60% of the onroad mobile NO<sub>x</sub> emissions in the mid 2020's and when applied to our preliminary predictions of the anthropogenic NO<sub>x</sub> emissions inventory, make up 10% of the overall emissions. NO<sub>x</sub> emissions from diesel truck emissions need to be reduced substantially in order for the states in the OTR to meet the 2015 ozone NAAQS. [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Technologies and CARB

The California Air Resources Board (CARB) has a voluntary program for heavy-duty diesel manufacturers to certify that their vehicles meet lower NO<sub>x</sub> standards. Testing is also underway by CARB and members of industry to further demonstrate the technologies necessary to meet lower NO<sub>x</sub> standards for diesel vehicles. Some examples of the technologies available to meet lower NO<sub>x</sub> standards are: [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Thermal management [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Selective catalytic reduction (SCR) positioning improvements [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Advanced high porosity substrates [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Low temperature catalyst activity [EPA-HQ-OAR-2014-0827-1211-A2 p.2]

Passive NOx adsorber catalysts [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

Improved urea dosing strategies [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

These technologies allow diesel trucks to meet lower NOx standards and need to be implemented relatively quickly in order for the states in the OTR to attain the 2008 and expected 2015 Ozone NAAQS. Early action is needed given that the heavy-duty diesel fleet sector turnover is significantly slower than that seen in light-duty vehicle turnover. If standards began by 2020, OTC's analysis found that a 10% reduction in NOx could be achieved by the mid 2020s. [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

#### Implications of a Lower 2015 Ozone NAAQS on the OTR

USEPA is under a court order to revise the Ozone NAAQS in October of 2015. USEPA has proposed a revision to the Ozone NAAQS in the range of 65 — 70 ppb and as low as 60 ppb, whereas the current NAAQS is set to 75 ppb. Several states in the OTR do not meet the 75 ppb standard and if currently complete ambient air quality data is examined, all but two states in the OTR would be in at least marginal nonattainment for a 70 ppb NAAQS, and all but one state in the OTR would be in at least marginal nonattainment for a 65 ppb NAAQS. Furthermore, at the 65 ppb level, over half of the jurisdictions in the region are facing moderate nonattainment. The timeline legislated in the Clean Air Act would require states to begin achieving the ozone NAAQS in 2023. [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

In the RIA, USEPA also found that 23% and 43% of the NOx controls needed in the OTR to meet the 70 ppb and 65 ppb NAAQS respectively were 'unknown.' These controls will need to come from mobile sources and need to be on the way by 2023 and is further evidence supporting the need for greater NOx reductions from heavy-duty diesel trucks. [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

#### Implications of 2018 Regional Haze Planning

States are required to submit regional haze SIPs demonstrating improvement in regional haze by 2028. The latest science and analyses of emission trends show an increasing impact of nitrates and secondary organic aerosols on regional haze, both of which are impacted by NOx emissions. Reducing NOx emissions from heavy-duty diesel emissions through lower emission standards would assist states in meeting the Clean Air Act required regional haze goals. [EPA-HQ-OAR-2014-0827-1211-A2 p.3]

#### Work with Manufacturers

USEPA needs to send signals now to the manufacturers that additional NOx emission reductions will be required. Such an action would allow manufacturers to holistically develop engine and emission control

systems. This early signal to manufacturers could help reduce the costs of such systems and avoid the need for incremental designs, where manufacturers first implement technologies to meet the lower greenhouse gas standards and then, several years down the road, needing to address reduced NO<sub>x</sub> emission standards. USEPA needs to take a multi-pollutant approach with mobile source standards and finalize a rule that deals with all of the pollution that needs to be reduced from diesel trucks. Furthermore, if this does not occur, it is highly likely that additional NO<sub>x</sub> reductions needed from the sector will not occur in a timeframe necessary for the OTC states to meet their ozone nonattainment obligations and upwind states to meet their good neighbor contributions. [EPA-HQ-OAR-2014-0827-1211-A2 p.3-4]

**Organization:** PACCAR, Inc.

### **EPA Should Not Adopt Significantly More Stringent NO<sub>x</sub> Requirements that Would Complicate Compliance with the GHG Standards, Nor Should EPA Approve any such California Requirements**

PACCAR also urges EPA to consider the relationship between carbon dioxide (CO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>) emissions when issuing final standards. PACCAR is committed to working with EPA and the California Air Resources Board (ARB) to achieve significant NO<sub>x</sub> reductions over time. However, an accelerated and extremely ambitious NO<sub>x</sub> reduction target, even in only some portions of the U.S., would make compliance with more stringent GHG standards even more challenging. A patchwork regulatory scheme would undermine EPA's GHG program, pose enormous compliance challenges, and could make the movement of goods more expensive. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

### **Relationship between NO<sub>x</sub> and CO<sub>2</sub> emissions**

Complying with more stringent NO<sub>x</sub> standards would require significant investment in engine and aftertreatment technologies and would not be conducive to improving fuel consumption and lowering CO<sub>2</sub>. As is documented and known, there is a trade-off between fuel consumption and engine-out NO<sub>x</sub> for a current certified Heavy Heavy-Duty (HHD) diesel engine. The negative impact on fuel consumption from reduced engine-out NO<sub>x</sub> levels is clearly understood. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

As part of an ongoing feasibility study of 0.02 g/bhp-hr NO<sub>x</sub> tailpipe compliance, Southwest Research Institute is exploring a variety of measures aimed at reducing engine-out NO<sub>x</sub>. The results from an August 20, 2015 report-out suggest a 12% fuel consumption penalty for a 6-fold reduction in engine-out NO<sub>x</sub>. The proposed tailpipe levels would likely require still more aggressive reductions in engine-out NO<sub>x</sub>. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

### **Permitting California to Set More Stringent NO<sub>x</sub> Standards Would Adversely Affect the Movement of Goods Throughout the U.S.**

PACCAR strongly believes that a 50-state, nationwide regulation for Phase 2 is imperative to the success of this next step in GHG and fuel consumption reductions. GHG emission reduction is being driven by global climate change, not local impacts. As such, there is no benefit to an individual state to have a GHG reduction regulation that is not the same as that of EPA. [EPA-HQ-OAR-2014-0827-1204-A1 p.5]

The State of California has indicated that it will develop its own Phase 2 GHG emissions rule in late 2016 or 2017, after a final federal rule is promulgated. Under Section 209(b) of the Clean Air Act

(CAA), California has the unique authority to seek a waiver of CAA preemption to enforce its own vehicle and engine standards that are at least as protective as comparable federal rules. California was granted a 209(d) waiver for its own Phase 1 program in 2014 but ultimately harmonized these standards with the federal rule. While the state has been working with EPA and NHTSA in the development of the federal Phase 2 standards, ARB has recently indicated that the state may pursue more stringent Phase 2 GHG and NO<sub>x</sub> controls to ensure that California meets federal air quality targets and its long-term climate goals. [EPA-HQ-OAR-2014-0827-1204-A1 p.5-6]

The CAA permits states to adopt and enforce standards that are identical to California's standards in lieu of the national standard. Five states—Maine, Massachusetts, New Jersey, Pennsylvania, and Georgia—have done so for heavy duty vehicles and engines. The remaining states require the sale of federally-certified vehicles. If California adopts separate standards and seeks and is granted a waiver for its own Phase 2 standards, other states with air quality problems may adopt identical requirements, undermining a single national standard for heavy duty trucks and raising cross-border regulatory issues not seen in Phase 1 of the rule. [EPA-HQ-OAR-2014-0827-1204-A1 p.6]

As EPA is aware, vehicles certified to federal standards may not be sold in states that require California-certified vehicles, and vehicles only certified for sale in California may not be sold in states that have not adopted California standards or are not contiguous to such states. However, “50-State Vehicles” conforming to U.S. EPA regulations and California regulations may be sold in any state, and EPA’s Cross-Border Sales Policy permits the sale of California-certified vehicles or engines in states bordering a state that has adopted the California standards. This complicated regulatory landscape will make it extremely difficult for Original Equipment Manufacturers (OEMs) to comply with both the national EPA standards and with more stringent California standards, or will require manufacturers to certify all vehicles and engines to the California program at a higher cost. [EPA-HQ-OAR-2014-0827-1204-A1 p.6]

PACCAR and other OEMs would be faced with the choice of not selling trucks and engines into California, which would dramatically affect our business and undermine our commitment to our dealers and shareholders. The other, also unappealing, option would be to certify the majority of our vehicles to the more stringent “50-State” standards to avoid the compliance issues associated with different standards in place in different states. This option would come with substantial costs and effort to develop, test, and certify products that meet more stringent standards. This would effectively turn the California standards into national standards, without the program undergoing evaluation and assessment by EPA, NHTSA, the Small Business Administration (SBA), regulated parties and customers for these engines and vehicles. EPA should not allow California to force the heavy-duty truck and engine industry to comply with that state’s more stringent requirements across the nation. [EPA-HQ-OAR-2014-0827-1204-A1 p.6]

**Organization:** South Coast Air Quality Management District (SCAQMD)

Given the challenges facing the South Coast Air Basin and other regions that are in nonattainment of the national ambient air quality standards for ozone and fine particulate matter, the proposed Phase 2 standards have the potential to not only further reduce greenhouse gas emissions from medium- and heavy-duty engines and vehicles, but more critically and urgently needed reduction in oxides of nitrogen (NO<sub>x</sub>) emissions that significantly contribute to the ozone and fine particulate air quality in the South Coast Air Basin. As you are aware, the South Coast Air Basin is designated as an “extreme” nonattainment area for the 1997 and 2008 federal 8-hour ozone ambient air quality standard and must attain the standards by 2024 and 2032. In order to meet these air quality standards, around 50 to 65 percent reduction in NO<sub>x</sub> emissions must be achieved by the applicable dates. As acknowledged in the

notice of proposed rulemaking, California has adopted tighter on-road heavy-duty engine emission standards to reduce NO<sub>x</sub> and greenhouse gas emissions (80FR40149). However, given the significant NO<sub>x</sub> emission reductions needed to attain federal ambient air quality standards (80FR40149), it is critical that every opportunity to reduce NO<sub>x</sub> emissions be afforded to the region. *As such, we strongly urge U.S. EPA to adopt new on-road heavy-duty engine NO<sub>x</sub> emission standards that ultimately achieve a 90 percent cleaner emissions level compared to the current 2010 on-road heavy-duty engine standard.* This action will enhance the production of such vehicles nationwide since a significant number of heavy-duty vehicles are purchased outside of the California market. [EPA-HQ-OAR-2014-0827-1181-A1 p.1-2]

**Need for New National Low-NO<sub>x</sub> On-Road Heavy-Duty Engine Emissions Standard** The South Coast Air Basin and many other areas that are in nonattainment of the federal ozone ambient air quality standards will face significant challenges in meeting the standards without assistance from the U.S. EPA. This will be especially true when U.S. EPA promulgates another more stringent ozone standard in the near future. While U.S. EPA believes that many of these areas will meet current and future ozone air quality standards within the applicable deadlines, many areas must assess the need to reduce emissions from stationary and industrial sources to meet these standards. In addition to meeting existing and future air quality standards, regions designated nonattainment for ozone air quality standards that have been revoked must continue to show progress in meeting those standards. Such is the case with the 1990 national ambient air quality standard for the 1-hour ozone, which the South Coast Air Basin must achieve by 2022. Clearly, without new federal regulations to establish tighter emissions standards from not only on-road heavy-duty engines, but also non-road engines including locomotives, marine vessels, and aircraft, mobile source emissions will increase due to increased activity and economic growth. Establishing new criteria pollutant exhaust emission standards will provide assurance that cleaner combustion engines will be commercially available to help meet not only existing federal ambient air quality standards, but also tighter future air quality standards. [EPA-HQ-OAR-2014-0827-1181-A1 p.3]

The South Coast Air Basin not only has to attain the national ambient air quality standard for ozone, but must also attain new fine particulate ambient air quality standards in the early 2020 timeframe. As the SCAQMD and CARB develop the 2016 State Implementation Plan (SIP) to meet the various national ambient air quality standards, we find that the predominant contributors to the ozone and fine particulate air quality are from on-road and non-road mobile sources as shown in Figure 1. Figure 1 shows the NO<sub>x</sub> emissions historically in 2012 and projected NO<sub>x</sub> emissions in 2023 and 2031 assuming full implementation of current regulations. The primary path to meeting both ozone and fine particulate air quality standards requires significant reductions in oxides of nitrogen (NO<sub>x</sub>) emissions. [EPA-HQ-OAR-2014-0827-1181-A1 p.3]

[Figure 1 can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1181-A1]

Figure 2 shows the top NO<sub>x</sub> emissions sources in the South Coast Air Basin for 2023 and 2031, the two years required to demonstrate attainment of the 1997 and 2008 ozone air quality standards. As shown in Figure 2, mobile sources are among the largest emission sources with on-road heavy-duty trucks as the number one contributor to the region's air quality problem. As the SCAQMD continues to implement controls on stationary sources, the mobile source emission contributions are the largest contributors to the NO<sub>x</sub> emissions in the region. [EPA-HQ-OAR-2014-0827-1181-A1 p.4]

[Figure 2 can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1181-A1]

In preparing the 2016 SIP, the SCAQMD and CARB are projecting that the region must further reduce NO<sub>x</sub> emissions by around 50 and 65 percent to meet the federal 8-hour ozone air quality standards by

2024 and 2032, respectively. Figure 3 illustrates the NOx reductions needed to achieve the two air quality standards with the emission sources from Figure 2 rearranged by mobile and stationary sources. As shown in Figure 3, if there were no stationary sources contributing to the NOx emissions in 2023, mobile source emission contributions alone will result in ozone levels greater than the targeted 50 and 65 percent NOx reduction needed for attainment. Thus, it is vitally important that mobile sources reduce their NOx emissions as early as possible. Many of these sources are the primary responsibility of the U.S. EPA and/or international regulations. The region cannot attain mandated federal air quality standards without critical actions from the U.S. EPA and international organizations governing these sources. *As such, we urge the U.S. EPA to begin immediate actions to adopt new low-NOx heavy-duty engine emissions standard at 0.02 g/bhp-hr. These actions do not necessarily need to be part of the current proposed greenhouse gas emissions rulemaking. However, a combined rulemaking would allow engine manufacturers to develop control technologies that will reduce both NOx and greenhouse gas emissions. Regardless, such rulemaking must begin immediately to help the region attain air quality standards.* [EPA-HQ-OAR-2014-0827-1181-A1 p.6]

[Figure 3 can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1181-A1]

Relative to timing for the need for a new low-NOx emissions standard, CARB has conducted an analysis on the need for a national on-road heavy-duty engine NOx emissions standard compared to a California only standard. Figure 4 shows the difference in having a California only standard compared to a national standard. Since on-road trucks are mostly purchased out-of-state, there will be significantly more NOx emission reductions with a national standard. In addition, based on CARB's analysis, it will take almost 15 years for fleets to turnover to the new low-NOx engines. The SCAQMD staff and CARB recognize the need to incentivize the accelerated deployment of such engines as early as possible. As such, immediate action by U.S. EPA will provide certainty for the commercialization of such engines and enable the region and the state to develop programs to accelerate the deployment of such engines. [EPA-HQ-OAR-2014-0827-1181-A1 p.7]

[Figure 4 can be found on p.7 of docket number EPA-HQ-OAR-2014-0827-1181-A1]

The SCAQMD and CARB have initiated efforts to conduct research and demonstration of on-road heavy-duty engines to meet NOx emissions levels at 0.02 g/bhp-hr as early as possible. Relative to the SCAQMD efforts, the SCAQMD along with the California Energy Commission, and the Southern California Gas Company, are co-sponsoring the development of on-road heavy-duty natural gas engines that are at 0.02 g/bhp-hr with the goal of having these engines commercially available within the next few years. Cummins Westport, Inc. is one of the manufacturers participating in this effort. Cummins Westport recently received a California certification of its 8.9 liter natural gas engine at the 0.02 g/bhp-hr level. The CARB Executive Order for this engine is provided in Attachment 2. As you are aware, this engine can be used in several classes of on-road heavy-duty vehicles, primarily in transit buses and solid waste collection vehicles. In addition, we are encouraging the use of biomethane as the primary source of fuel rather than fossil based natural gas to further reduce greenhouse gas emissions. Cummins Westport has indicated its intent to expand commercialization of two additional natural gas engines at the 0.02 g/bhp-hr level, the 11.9 liter and 6.7 liter engines. The 11.9 liter engine is a preference by many operators of over-the-road Class 7 and 8 trucks, while the 6.7 liter engines are used in medium-duty and light-heavy duty vehicles in the Class 4 through 7 range. *We strongly believe that the initiative taken by Cummins Westport will spur other engine manufacturers to begin the development of the next generation of on-road heavy-duty engines meeting the 0.02 g/bhp-hr. However, commercialization of such engines requires setting a national emissions standard to provide a benchmark for all engine manufacturers to meet.* [EPA-HQ-OAR-2014-0827-1181-A1 p.7-8]

[Attachment 2 can be found on p.15 of this docket]

More importantly, in order for the South Coast Air Basin and other areas in nonattainment of national ambient air quality standards, U.S. EPA must act immediately to adopt new, tighter engine exhaust standards to further reduce NO<sub>x</sub> and fine particulate emissions. As discussed above, such rulemaking need not be part of the proposed Phase 2 rulemaking. However, work must begin in parallel to finalizing the Phase 2 rulemaking with the goal of adopting the low-NO<sub>x</sub> engine emission standards by the end of 2017. [EPA-HQ-OAR-2014-0827-1181-A1 p.8]

**Organization:** Truck & Engine Manufacturers Association (EMA)

#### Potential NO<sub>x</sub> and N<sub>2</sub>O Reductions

Several stakeholders are pressuring EPA to adopt lower NO<sub>x</sub> emission limits for heavy-duty vehicles. That pressure is likely to increase in light of the Agencies' adoption of a lower NAAQS for ozone. Regardless, this rulemaking is not the regulatory vehicle for the consideration of any potential additional low-NO<sub>x</sub> standards. In fact, given the inherent emissions trade-off between GHG emissions and NO<sub>x</sub> emissions (which, unlike GHG emissions, favor lower combustion temperature regimes), any additional NO<sub>x</sub> reductions will require extremely careful and thorough analysis. [EPA-HQ-OAR-2014-0827-1269-A1 p.64]

**Organization:** Truck Renting and Leasing Association

For example, we appreciate that the agencies have discussed the need for national uniformity of relevant standards with the California Air Resources Board (CARB). It will be imperative for the EPA in particular to work with CARB going forward to ensure that California regulators do not stray from this approach by, for example, targeting additional NO<sub>x</sub> reductions that would upset the careful balances struck in this rulemaking. [EPA-HQ-OAR-2014-0827-1140-A1 p.2]

**Organization:** Union of Concerned Scientists (UCS)

#### FURTHER REDUCTIONS IN NO<sub>x</sub> EMISSIONS

Advances in criteria pollution emission controls, driven by tailpipe emissions standards set by EPA and California, have led to major reductions pollution from heavy-duty trucks and reduced health risks (Propper et al. 2015). However, contributions of nitrogen oxides (NO<sub>x</sub>) from heavy-duty trucks and other diesel sources continue to be a major source of air pollution and contribute to regional challenges in meet health-based federal air quality standards. Analysis by California air regulators shows a need to dramatically reduce levels of NO<sub>x</sub> emissions, on the order of 90 percent, to meet the existing 75 part per billion ozone standard by 2032 (CARB 2015). NO<sub>x</sub> emissions from heavy-duty trucks are also of a concern in states outside of CA, particularly in meeting lower ambient ozone standards necessary to protect public health and soon to be finalized by EPA (NESCAUM 2015). Moving forward with fuel economy and greenhouse gas emissions, as proposed in this rulemaking, and making further reductions in NO<sub>x</sub> emissions in a future rulemaking is critical for meeting air quality standards as well as meeting climate and oil savings goals. Improvements in emissions control technologies and engine combustion, application of vehicle technologies, and deployment of advanced technologies including plug-in and fuel cell technologies in the heavy-duty sector will allow continued advances in lowering both NO<sub>x</sub> and global warming emissions (Figure 3).

[Figure 3, 'Reducing criteria pollution and global warming emissions from diesel engines', can be found on p.11 of docket number EPA-HQ-OAR-2014-0827-1329-A2]

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Propper, R., P. Wong, S. Bui, J. Austin, W. Vance, A. Alvarado, B. Croes, and D. Luo. Ambient and emission trends of toxic air contaminants in California. *Environmental Science and Technology*, September 4. Online at <http://pubs.acs.org/doi/abs/10.1021/acs.est.5b02766>.

CARB (California Air Resources Board). 2015. Draft heavy-duty technology and fuels assessment: Overview. Online at [http://www.arb.ca.gov/msprog/tech/techreport/ta\\_overview\\_v\\_4\\_3\\_2015\\_final\\_pdfpdf](http://www.arb.ca.gov/msprog/tech/techreport/ta_overview_v_4_3_2015_final_pdfpdf).

NESCAUM (Northeast States for Coordinated Air Use Management). 2015. Comments on greenhouse gas emissions standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2. Submitted to docket ID No. EPA-HQ-OAK-2014-0827.

**Organization:** US Hybrid Corporation

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 304-306.]

I believe they missed the major goal of achieving a stringent NOx reduction required to meet our future environmental target. These rules will not drive the NOx level down low enough to improve the health of residents in nonattainment areas.

As has been published and as stated by engine manufacturers, the NOx reduction and fuel economy improvement contradicts the engine controller strategy.

**Organization:** Volvo Group

### **Future NOx and CARB GHG Regulation**

The timeframe of this rule, as proposed, stretches 15 years into the future. EPA and NHTSA are thereby shaping the technology development and deployment plans of medium and heavy-duty manufacturers according to these aggressive efficiency standards for many years to come. In the meantime, there is considerable discussion in California and elsewhere concerning persistent elevated ozone levels in urban areas and the associated health risks. Many states include large cities that are not currently expected to meet federal ambient ozone limits according to their regulated deadlines, the most extreme example being broad areas of California, not only due to the many square miles of heavily populated urban areas, but also due to difficult geographical and topological circumstances. So challenging is the problem in California that the Air Resources Board is currently on a path to promulgating NOx emissions standards more stringent than the federal standards. [EPA-HQ-OAR-2014-0827-1290-A1 p.59]

On top of these challenges, EPA is expected to soon announce a reduction in the National Ambient Air Quality Standard for Ozone. This is expected to significantly increase the number of counties in non-attainment status, which will increase the pressure to impose tighter limits on NOx emissions sources *nationally*, including heavy-duty trucks. Signals are emerging that EPA will initiate a rulemaking to further reduce HD NOx emissions after the Phase 2 regulation is finalized. For various reasons, CARB would prefer to see new standards set at the *national level*, and is expected to petition EPA to



promulgate lower NOx standards. Nonetheless, whether considering GHG or NOx emissions, CARB has been quite clear that they are motivated to pass stricter standards than those set by EPA if they feel it's necessary to meet the State of California's goals. [EPA-HQ-OAR-2014-0827-1290-A1 p.59]

Despite this backdrop of growing pressure to further regulate NOx emissions from medium and heavy-duty vehicles, there has been little consideration given to this anticipated demand in the Phase 2 notice. This is a considerable oversight, given not only the well documented inverse relationship between NOx and CO2 emission for internal combustion engines<sup>10</sup>, but also considering the impact to manufacturers' resource demands if they must develop an even broader array of technologies to simultaneously reduce NOx. [EPA-HQ-OAR-2014-0827-1290-A1 p.59]

The development necessary to meet the proposed GHG standards should not be taken lightly. In many ways, we're embarking into a new era. The development work to meet the NOx and PM reduction challenges required by EPA's 2004/2007/2010 standards was based on widespread deployment of mostly singular technologies – first Exhaust Gas Recirculation, then Diesel Particulate Filters, and finally Selective Catalytic Reduction. In this Phase 2 GHG regulation, however, EPA and NHTSA are counting on manufacturers to develop a series of technologies, each targeting a subset of applications. Manufacturers lack the development capacity to meet the multiple, parallel development demands for Phase 2. Waste-heat recovery, stop-start, hybrids in widely different vocational applications, engine/transmission control integration, etc. – all of these are major engineering challenges. On top of this is the strong possibility that this will be complicated by, and supplemented with, additional development to address NOx reductions is not even considered in the NPRM. There are limitations to the capabilities of manufacturers to deliver on all fronts. Overstressed delivery demands lead to product launches with poor reliability and delayed purchases, which undermine all stakeholders' goals. [EPA-HQ-OAR-2014-0827-1290-A1 p.59-60]

**Response:**

Because EPA did not propose to establish new NOx standards beyond the existing 2010 standards in this rulemaking, these comments are somewhat out of scope. Nevertheless, we understand why commenters supporting more stringent NOx standards included such comments. EPA has added a section to the FRM Preamble describing our current position with respect to future NOx standards for heavy-duty engines. Please see Preamble Section I.F.

## **15.9 Comments on the NHTSA DEIS**

**Organization:** Michelin North America, Inc.

The DOT draft Environmental Impact Statement (EIS) states '... the literature review did not identify HD vehicle LCA studies that examined impacts from other stages of the tire life cycle, including manufacturing, retreading, and end-of-life management specific to LRR and WBS tires...'. [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

In terms of a life cycle analysis (LCA), see the attached summary chart from the Quantis 2013 Truck Tires Life Cycle Analysis Project and attributes summary chart. [EPA-HQ-OAR-2014-0827-1286-A1 p.4]

[Graphs, 'Tire system comparison at endpoint' and 'NGWBS Summary of Attributes', can be found on p.6 of docket number EPA-HQ-OAR-2014-0827-1286-A1]

**Response:**

NHTSA received many written and oral comments to the NPRM and the DEIS. NHTSA reviewed, analyzed, and considered all relevant comments it received during the public comment period. The agency then updated and revised the DEIS to prepare the FEIS, which is being released concurrently with this final rule and ROD. For a more detailed discussion of the comments NHTSA received, including the agency's responses to those comments, see Chapter 9 of the FEIS.

**Organization:** National Biodiesel Board

5) Comments on the Draft Environmental Impact Statement. [EPA-HQ-OAR-2014-0827-1240-A1 p.11]

Although the agencies do not focus on lifecycle GHG emissions, NHTSA does address lifecycle emissions of biodiesel in the Phase 2 Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles Draft EIS (DEIS) (NHTSA-2014-0074-0034 at 6-15 to 6-16). NHTSA appropriately recognizes that “[w]hen used as a fuel in on-road vehicles, biodiesel offers significant GHG emission advantages over conventional petroleum diesel.” DEIS at 6-15. It also references a more recent study showing lifecycle emissions can be decreased by up to 52 percent when using biodiesel as a replacement for petroleum diesel, which is based on soybean oil. The DEIS also references, however, the potential for land use changes. NBB continues to dispute the inclusion of land use impacts in the analysis as there is still no real-world evidence that the increased production of biodiesel has resulted in significant land use changes and the modeling that has been used remains inappropriate for measuring actual emissions. Moreover, the U.S. remains a sink for GHG emissions regarding the land use sector. While NHTSA references an analysis by Searchinger, as NHTSA also recognizes, the Searchinger article was disputed by the Department of Energy and should not be considered as a valid scientific analysis. Indeed, there are numerous factors that influence decisions regarding land use, and it would be too speculative to attempt to identify what emissions can be attributed to biofuel production. Further, as noted above, the industry has increased use of waste feedstocks, which has greater GHG emissions reductions. In any event, even considering such impacts, EPA still found lifecycle GHG emission reductions compared to petroleum to be above 50 percent (and as high as 86 percent). [EPA-HQ-OAR-2014-0827-1240-A1 p.11-12]

NBB also requests that NHTSA make certain corrections to the discussion on use of biodiesel blends in diesel equipment in the DEIS at 6-15. NBB agrees that vehicles on the road today are compatible with higher blends of biodiesel. No detrimental effects have been seen with blends up to B20. NBB disagrees, however, with the notion that engines are only “warrantied” (or not warrantied) for certain fuels. OEMs generally identify the fuels they recommend for use in the owner’s manuals, but we believe this is unrelated to any warranties provided on the engines themselves. OEMs generally do not warranty fuel at all, no matter if that fuel is biodiesel, diesel, gasoline or otherwise. Rather, the OEMs only warrant the actual parts and workmanship of the vehicle or engine that they themselves produce, and they simply provide recommendations for the types of fuel, lubricants, etc. that are suggested for use in those vehicles.<sup>14</sup> [EPA-HQ-OAR-2014-0827-1240-A1 p.12]

In addition, NHTSA states that “[b]iodiesel performance improves in cold temperatures as the blend is reduced.” DEIS at 6-15. But, additional measures taken by the industry such as cold-flow additives, blending with #1 diesel fuel, and heated tanks/lines have demonstrated the ability to use blends up to B20 even in the coldest months and regions of the country. [EPA-HQ-OAR-2014-0827-1240-A1 p.12]

## **15.10 Comments Unrelated to the Proposed Rule**

### **15.10.1 General Comments 2100**

**Organization:** Avista Oil AG et al.

As companies engaged in the collection, processing, refining and sale of used motor oil, we recommend allowing the manufacturers of MHDD vehicles to obtain credit for the significant greenhouse gas benefits associated with re-refined engine oil when it is supplied and used as initial factory fill in the engines of new vehicles subject to the rule and/or when re-refined oil is sold by these manufactures to be used by vehicle owners in service or preventative maintenance fill. Both methods of use could be easily tracked and verified, and the GHG emission reduction benefits could be credited toward the proposed target reductions and OEMs. [EPA-HQ-OAR-2014-0827-1266-A2 p.1]

Overview: Re-refining used engine oil generates significant environmental and energy benefits, and has been deemed by federal agencies and national research laboratories as the highest and best use of this valuable commodity.<sup>1</sup> Among these benefits is a significant overall life cycle reduction in greenhouse gas emissions when compared to incinerating used oil for energy and replacing it with lubricants made from virgin crude oil. Re-refined oil meets American Petroleum Institute performance classifications; has been deemed suitable for use by major manufactures of gas and diesel engines; and is used successfully by government, commercial and local transit fleets, among others.<sup>2</sup> In addition, re-refined oil is comparably priced to oil made from virgin crude and widely available in the U.S., particularly for large fleets and OEMs. [EPA-HQ-OAR-2014-0827-1266-A2 p.1]

Premise: Allowing Greenhouse Gas Emission reduction credits as part of the Phase 2 Rule, when re-refined engine oil is utilized in medium- and heavy-duty engines, as opposed to engine oil made from virgin crude oil, will significantly reduce the amount of GHG emissions over the lifespan of the engines, while encouraging the expansion of used motor oil recycling in the United States. [EPA-HQ-OAR-2014-0827-1266-A2 p.2]

Key Metrics on the Management of Used Motor Oil in the United States: Used Motor Oil (UMO) can be redefined almost limitlessly into API-Certified Lubricant stocks, thereby reducing GHG emissions, compared to oil made from virgin crude. If OEMs are allowed to use re-refined oil to obtain GHG emissions credits, it would increase demand and production of this oil technology that reduces GHG emissions. The most recent EPA data (1995) indicates that the U.S. generates approximately 1.4 billion gallons per year (B usg/yr) of UMO. Of that, we “recycled” about 945M usg/yr. In this context, recycling included re-refining into base oil which is then manufactured into finished lubricants. In 1995, this was estimated to be 200M usg/yr. but is likely closer to 300M usg/yr. today. Burning for energy recovery was and still is treated by regulation as recycling and, in 1995, included about 745M usg/yr. While burning for energy recovery does reclaim the energy value, it results in destruction of a valuable resource which could otherwise be reused indefinitely. Also, within the category of used oil burned for energy recovery, an estimated 113M usg/yr was used oil burned in space heaters approved for use in garages, greenhouses and other locations. These heaters are often in small workplaces proximate to workers, and have no emission controls for the harmful pollutants in the used oil that can include arsenic, chromium, cadmium, lead, and even PCBs. Significantly, the data from 1995 indicated that the remaining 455M usg/yr was being indiscriminately disposed into the environment – either by discarding into landfills or, worse yet, simply draining into sewers and spilling on the ground. To put this into perspective, this volume of UMO being improperly discarded annually in 1995 was 39 times the quantity of oil spilled in the Exxon Valdez oil spill and about double the amount of crude oil spilled as a result of the Deepwater Horizon spill. [EPA-HQ-OAR-2014-0827-1266-A2 p.2]

Today, we estimate that more oil is being responsibly recycled than in 1995 but the amount of oil being responsibly reused is still far less than other developed and some developing countries. The 2006 DOE study (which relied on 1995 data) indicated that countries like France and Germany had much higher

collection rates (78% and 94%, respectively) and also that they favored re-refining over other reuse options, resulting in re-refining rates that are three to four times higher than the 1995 data indicated for the U.S. (12% in the U.S. versus 42% in France and 41% in Germany. The EU continues to favor re-refining over other uses and continues to promote re-refining using a variety of governmental policies. More current data for Germany suggests that re-refining rates have essentially doubled and that in 2012-2013, Germany re-refined 82% of the used oil available for re-refining. [EPA-HQ-OAR-2014-0827-1266-A2 p.2]

Existing Legislation and Executive Orders about Re-refined Oil: There are some policies in place at the Federal and state level that encourage recycling of used oil and also the use of re-refined oil by the Federal government. For example, section 2 of the Federal Used Oil Recycling Act of 1980 (P.L. 96-463) declares that it is “in the national interest to recycle used oil in a manner which does not constitute a threat to public health and environment and which conserves energy and materials.” This legislation is generally codified at 43 USC 3014 and requires that EPA set recycling and performance standards for used oil to protect public health and the environment. The Act authorizes the Administrator of the EPA to make grants to States with approved or proposed solid waste plans which: (1) encourages the use of recycled oil; (2) discourages uses hazardous to the protection of the public health and environment; (3) calls for informing the public of the uses of recycled oil; and (4) establishes a program for the collection and disposal of oil in a safe manner. Also, the Act authorizes the Administrator to provide technical assistance to States in removing impediments to the recycling of used oil. [EPA-HQ-OAR-2014-0827-1266-A2 p.2-3]

Further, Executive Order (EO) 13101 approved by President Clinton on September 14, 1998, “Greening the Government through Waste Prevention, Recycling, and Federal Acquisition,” strengthened and expanded the Federal government’s commitment to recycling, waste prevention, and buying recycled content and environmentally preferable products and services, including lubricants made from re-refined oils. A key objective of this EO is to implement green procurement initiatives to foster development of markets for recovered materials through modifications to Federal purchasing rules, regulations and guidelines. As a result of EO 13101, the Department of Defense and other Federal agencies instituted new guidelines fostering use of re-refined engine oil in Federal vehicles including heavy equipment fleet such as HUMVEES used in battle. This program has proven to be highly successful and continues to provide the “Greening of the Government through Waste Prevention and Re-cycling” as the major market for re-refined lubricants. [EPA-HQ-OAR-2014-0827-1266-A2 p.3]

Environmental Cost-Benefit Analysis: Re-refined oil is comparable in cost to oil from virgin crude for initial factory fill or maintenance. Both are API certified and of comparable quality. According to peer reviewed life cycle analyses by the State of California<sup>3</sup> and Safety-Kleen<sup>4</sup>, re-refining used motor oil reduces up to 80% of GHGs, when end of life emissions are included, compared to manufacturing lubricants from virgin crude. This means that use of re-refined engine oil reduces GHG emissions by .003363 MT of CO<sub>2</sub>e for each gallon of re-refined oil used, based on a typical ratio of 85% re-refined base oil and 15% additives. While this GHG emissions reduction may appear small when compared to total fuel burned by the MHDD fleet, it is truly significant in the aggregate. Further, re-refined oil is available in adequate supply to cover demand, at a cost comparable to that for oil made from virgin crude. For example, the GHG savings from 50M gallons of re-refined oil is approximately 168,000 metric tons of CO<sub>2</sub>e. The GHGs reduced are equivalent to the emissions from 15M/usg of #2 fuel oil. These benefits are significant enough to warrant providing some incentive for the use of re-refined oil as part of the Phase 2 rulemaking. Allowing some GHG emissions offset credit will incentivize the re-use of a precious natural resource, while encouraging more collection and re-refining of used motor oil that escapes into the environment through mismanagement. [EPA-HQ-OAR-2014-0827-1266-A2 p.3]

More on Greenhouse Gas Emission Reductions: Attached is a summary of the methodology and results of the GHG benefits of re-refining provided by Environ International, Inc., one of the leading and most respected environmental consulting firms in the world. Their analysis, based on a comprehensive peer reviewed life cycle analysis done in 2009, but updated for these comments, indicate that production of re-refined engine oil generates approximately 70% fewer GHG emissions than production of oil from virgin stock, and up to 80%, when end of life emissions are considered. [EPA-HQ-OAR-2014-0827-1266-A2 p.3-4]

When GHG emissions tied only to production and transport are calculated and ancillary carbon impacts are included, the total GHG benefits are slightly reduced because of the higher transportation emissions associated with collection and transport to re-refining facilities. However, even with those ancillary benefits included, the total life cycle benefits show a total reduction of 56 percent over production from virgin crude for the production of lubricating oil of equal or better quality. [EPA-HQ-OAR-2014-0827-1266-A2 p.4]

Further, re-refining means the used oil is not released into the environment through illegal dumping or burned in unregulated incinerators without emission controls as a cheap, high carbon source of energy, thereby resulting in further GHG reductions even when a substitute energy source (natural gas) is factored in. While these additional carbon reduction benefits can be significant (as much as an 80 percent total reduction of GHG in some cases), they depend on the substitute fuel used; therefore, we are not including those benefits in this analysis. [EPA-HQ-OAR-2014-0827-1266-A2 p.4]

**Suggested Addition to Phase 2 Standards that Will Further Reduce GHG Emissions:** The proposed standard should be expanded to allow for an opportunity to encourage the use of re-refined oil as a way to reduce greenhouse gas emissions, while ensuring the use of methodologies and technologies that have a solid basis to reduce emissions and can be easily and accurately tracked and verified. Specifically, we recommend expanding the Phase 2 standards to allow OEMs of vehicles under the rules to obtain “Early Action Credits” beginning with Model Year (MY) 2017 and recurring GHG credits throughout the life of the Phase 2 rules, when OEMs use re-refined engine oil for factory or preventative maintenance service fills, instead of engine oil derived from virgin crude used. Re-refined engine oil should be defined as a gallon of engine oil that contains 100% base oil. That’s equal to about 85% of the blended gallon of engine oil, as about 15% of the volume is the additive package. The GHG emissions examples and calculations provided in this document are based on this same ratio. At this ratio, a gallon of re-refined engine oil reduces GHG emissions by .003363 MT of CO<sub>2</sub>e/usg of re-refined oil used. Every 3 gallons of re-refined oil used results in avoidance of the emissions equivalent of burning a gallon of diesel fuel. The projected GHG emissions reduced by using re-refined engine oil across the projected sales of Class2b-8 Phase 2 vehicles is estimated as follows, including estimates of gallon volumes and adoption rates in the chart and footnotes on the next page. [EPA-HQ-OAR-2014-0827-1266-A2 p.4]

[Table can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1266-A2]

These GHG emissions credits could be held by the OEMs, until EPA/NHSTA determines that it is practical to trade them under the ABT provisions of the Phase 2 standards. [EPA-HQ-OAR-2014-0827-1266-A2 p.5]

Initially, we recommend only providing GHG credits for the re-refined oil gallons used or sold by OEMs for factory or service fill, as it could be more complicated to track and verify use through other distribution channels and sources. However, if a reliable process to report and verify use by other sources could be devised, we hope the Agencies would be open to expanding the use of credits for

service fills performed by other vendors provided adequate documentation and verifications systems are in place. [EPA-HQ-OAR-2014-0827-1266-A2 p.5]

It would be rather simple and reliable to track and verify use of re-refined oil for initial factory fill or preventative maintenance service fills as follows: [EPA-HQ-OAR-2014-0827-1266-A2 p.5]

[Chart can be found on p.5 of docket number EPA-HQ-OAR-2014-0827-1266-A2]

Vehicle and engine OEMs that wish to obtain GHG credits for use of re-refined engine oil would submit information on gallons used and the agreed upon calculation for GHG reduction (CO<sub>2</sub>e/usg). The rule would indicate how the Agencies require OEMs to stipulate projected and actual usage, along with documents needed to verify amount of use. It could be validated using copies of invoices and documentation from the re-refined oil manufacture that stipulates the amount of re-refined oil content. [EPA-HQ-OAR-2014-0827-1266-A2 p.5]

In our discussions with OEMs, we have come to believe that they are interested in this tool and have said they could easily implement it if given some “credit” by EPA. In the beginning of a model year, the OEM could submit a projection of the gallons of engine oil to be used for initial factory and service fill, along with value of GHG emissions reduction at .003363 MT of CO<sub>2</sub>e/usg of re-refined oil multiplied by the anticipated gallons used. The OEM could later submit the actual gallons used or sold in their end of year report to the agencies and adjust the credits received. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

Allowing GHG emissions credit for use of re-refined motor oil will increase demand and production of re-refined engine oil. It will not just be a shifting of re-refined oil gallons that would otherwise be sold in other channels. This can be verified by the growth in total production capacity and sales of rerefined oil. This would be incremental volume sold to these OEMs. Thus, it would increase demand for and use of re-refined oil and reduce total emissions of GHGs. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

It will also provide these other benefits: [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

- continue to foster environmental stewardship;
- reinforce congressional and Executive Office mandates to recycle used motor oil into its highest and best use;
- allow engine lubricants to be continuously recovered and re-refined becoming a truly “renewable” and sustainable resource; and,
- reduce GHG emissions, at no additional cost to the regulated community. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

**Other Considerations to Further Reduce GHG Emissions:** While not relevant to these Phase 2 standards for MHDD vehicles, we want to point out that re-refined engine oil and industrial lubricants can be used to reduce GHG emissions in the following additional applications. We believe that the EPA’S objective to reduce GHG emissions from multiple sources would be significantly furthered by a discussion of expanded use of re-refined oil in other policies and standards. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

- **Railroad Diesel Engine Oil (RREO)** – A re-refined product can be produced that could reduce GHGs. Already a re-refined product is available and used by some railroads because the quality and cost is comparable to oil made from virgin crude. However, the lack of policies or standards does not encourage railroads to prefer it. The railroad industry consumes over 15M usg/yr of

RREO in the U.S. If 15M usg/yr were converted to re-refined RREO it would reduce GHG emission by 50,452MT (CO<sub>2</sub>e) per year. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]

- **Passenger Car Lubricants** – According to some estimates, OEMs buy over 125M usg/yr for factory and service fill under their brands. If 125M usg/yr were converted to re-refined oil, it could reduce GHG emission by 420,431MT (CO<sub>2</sub>e) per year. [EPA-HQ-OAR-2014-0827-1266-A2 p.6]
- **Industrial Lubricants** – Similarly, re-refined oils are available for the broad array of products in manufacturing that include hydraulic oil, way oil, spindle oil and other industrial lubricant that can be made from re-refined oil. Over 200M usg/yr is consumed in the U.S. If 200M usg/yr were converted to re-refined products, it could reduce GHG emission by more than 672,690MT CO<sub>2</sub>e per year. The re-refining industry would need to increase blending capacity to make this much industrial oil, instead of selling it as just base oil. But, it would also drive toward consuming some of the 600M+ usg/yr that is burned or indiscriminately disposed into the environment. Already re-refined industrial lubricants are available and used by many manufacturers, including the big three automakers in their plants in the U.S., but, more could be done, if policies and standards were created to encourage usage. [EPA-HQ-OAR-2014-0827-1266-A2 p.6-7]

In summation, for all the reasons enumerated above, we further believe that the EPA’s consideration of this proposal is consistent with a more global strategic approach to dealing with the interconnected components of internal combustion engines that contribute to the emission of GHGs. This is an opportunity to treat that engine system holistically without the need, cost and complication of adding a new gadget, and thereby achieve a coherent and cohesive regulatory regimen that synergistically produces even greater environmental and energy benefits. [EPA-HQ-OAR-2014-0827-1266-A2 p.7]

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<sup>1</sup> Lawrence Livermore National Laboratory report “Improving Used Oil Recycling in California” (2008) p. 1; Department of Energy report “Used Oil Rerefining Study to Address Energy Policy Act of 2005 Section 1838” (2006) p. 15.

<sup>2</sup> Defense Logistics Agency Program Manual

<sup>3</sup> “Life Cycle Assessment of Used Oil Management in California,” CA Department of Resources Recycling and Recovery (CalRecycle), (2014)

<sup>4</sup> “Life Cycle Footprint of Re-refined versus Base Oil that is Not Re-refined,” **ACS Sustainable Chemistry & Engineering**, (2013) See PDF provided. Or a link [here](#) to publication’s website.

**Response:**

We find this comment to be outside the scope of this rulemaking, but we thank you for the information on re-refined engine oil.

**Organization:** CALSTART

Development and Demonstration Funding Tied to Goals

While we realize it is outside the scope and provision of this rule making, we strongly encourage the Agencies’ to actively work with other segments in the federal government, including other agencies in

the Department of Transportation, the Department of Energy, the Department of Defense, the Department of Commerce, and others, to align federal development, incentive and deployment funds around supporting and commercializing technologies to achieve Phase 2 and later success. The breakthroughs highlighted from the Supertruck program make clear what the value can be of a consistent, long-term and aligned public funding program linked with private industry investment. The heavy-duty industry can achieve the fuel economy and carbon goals of the program, but a joint effort with the public sector around common goals will better leverage and focus industry capabilities and resources, and better prime the pump for the additional solutions needed beyond this rule timeline. We have seen the growing success of this strategy in California, which is directing significant funding from cap and trade revenues back into low carbon transportation development with industry. We would encourage a comparable funding target at the federal level. [EPA-HQ-OAR-2014-0827-1190-A1 p.9]

**Response:**

We agree that this comment is outside the scope of this rulemaking, but we thank you for the suggestion.

**Organization:** Climate 911

In addition, because diesel trucks last for up to 30 years, fleet turnover will be slow. It is important that, in addition to setting standards for new vehicles, EPA mandate retrofits of existing ones. [EPA-HQ-OAR-2014-0827-1179-A1 p.1]

**Response:**

We find this comment to be outside the scope of this rulemaking.

**Organization:** Innovus Enterprise LLC

Additionally, it does not go unnoticed that whenever CARB comes forward with a new waiver request, as was the case when they were issued a waiver for OBD, EPA treats these waivers as so-called ‘waiver decisions’ and not ‘rules’ thereby avoiding review by the Office of Management and Budget; avoiding the Regulatory Flexibility Act mandates; and avoiding the Small Business Regulatory Enforcement Fairness Act. Let it be known; we are emphatically opposed to how the EPA sees this as an honest administrative procedure with the public at large. We ask the EPA to review this waiver process and reaffirm to the public how they truly feel they are meeting the spirit and intent of these Congressional Acts, especially for making ‘decisions’ which do in fact have major impact on large numbers of small businesses. [EPA-HQ-OAR-2014-0827-1116-A1 p.8]

**Response:**

We find this comment to be outside the scope of this rulemaking. As a general matter, EPA evaluates waiver requests consistent with Clean Air Act section 209.

**Organization:** PACCAR, Inc.

Likewise, PACCAR requests EPA’s support to limit any actions by ARB regarding new onboard diagnostic (OBD) requirements, which will allow manufacturers to focus on the technology development and implementation of these GHG and fuel consumption reducing technologies. The



imposition of additional OBD requirements while manufacturers are focusing on Phase 2 implementation will stretch PACCAR's and other OEM's engineering and development resources and significantly risk Phase 2 compliance achievement. [EPA-HQ-OAR-2014-0827-1204-A1 p.6-7]

**Response:**

We find this comment to be outside the scope of this rulemaking.

**15.10.2 Comments on Other Means of Reducing GHGs**

**Organization:** Center for Neighborhood Technology

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 125-128.]

One reason is the fact that heavy duty trucks are now the leading -- the most rapidly growing source of mobile emissions in the country. We've seen a pattern since the recession in which car driving automobile VMT has been declining. It's flattened out in the last few years. It's now going into a slight decline. At the same time, truck use has been increasing more or less in proportion to the rise in GNP. So as this pattern continues, what we can expect to see is a greater need to regulate the amount of emissions that's being generated by heavy trucks.

The other reason that we think is significant is for lowering the emissions of heavy trucks is the impact that it has on other forms of economic development, particularly mode shift to rail, and the development of businesses, industrial and logistics businesses, distribution businesses, around intermodal freight terminals. If we had the best possible methods of reducing emissions from trucks, we would still find it desirable to have a major mode shift in freight movement between -- from truck to rail. We're all familiar with the data for that, which indicates that depending on three to seven times more efficient per ton mile movement of freight when moving the freight by rail.

And intermodal freight had made significant gains in reducing and generating savings through mode shift. The amount of volume of containers that's moving by intermodal has risen from a little than six million to over 13 million just over the last 20-year period. And as this has happened, intermodal terminals have been built in 64 different regions and created thousands of jobs that have the basic advantage of lowering transportation costs for the manufacturing and distribution companies that are locating there.

Today new technologies are making it possible to reduce the pollution that occurs from terminal operations and from rail operations. And we can talk about potential for zero emission ports, zero emission intermodal terminals despite the fact that the railroads still have a long way to go to improve their operations.

But the major impediment to the development -- further development of businesses co-located with intermodal freight terminals is the amount of truck traffic that's associated with those kinds of facilities. Because of the environmental risk involved in having several hundred, several thousand trucks a day coming to one location, this is serious impediment to locating these kinds of facilities in place where there's already an existing industrial base, places where workers can get to.

And consequently, these facilities are often relocated in exurban locations, which creates a whole cascade of other problems, long interregional truck trays, problems with people getting to work, longer commutes for workers.

**Organization:** Diesel Technology Forum

**Expand Efficiency Consideration Beyond New Engine and Vehicle Standards:**

There are also significant opportunities for efficiency improvements through adoption of other policies that impact vehicle operations and in turn fuel use and emissions, and these should be an increasing part of policy consideration. For example, heavy-duty trucks and passenger vehicles are estimated to have wasted 2.9 billion gallons of fuel due to traffic congestion. Efforts to better maintain and modernize freight-related transportation infrastructure will also contribute to fuel savings alongside the latest truck technologies. [EPA-HQ-OAR-2014-0827-1171-A2 p.4-5]

**Organization:** FedEx Corporation

Adopt Complimentary Policies: Other governmental policies must promote research, development and deployment of efficient technologies in the heavy duty and vocational vehicle space. Financial and other incentives – including investment tax credits; accelerated depreciation of new capital investment; increased highway infrastructure spending – can accelerate the deployment of new, more fuel efficient trucks and assist in rapid fleet turnover. [EPA-HQ-OAR-2014-0827-1302-A1 p.3]

**Organization:** Green Transportation Solutions

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 234-236.]

So beyond the costly vehicle upgrades and modifications that are being discussed here today, it is rather difficult for some of these drivers to purchase some of these things. We usually actually recommend three simple and inexpensive ways to reduce petroleum consumption, and, thus, greenhouse gas emissions with our clients.

So the second is to promote and enforce an idle reduction policy.

It does get zero miles per gallon, such as the hybrid vehicles. They're somewhat more expensive, and they do have payback, but you can reduce your idle time without a hybrid through management. So that would just come down to enforcing really because there is an idling law in Illinois already, and if you walk around the city it's not necessarily followed all the time or enforced for a variety of reasons. So if there could be stronger enforcement near communities, particularly schools and parks, as the parts per million for particulate matter go way up for young children with smaller lungs.

**Organization:** Midwest Truckers Association

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 266.]

May we suggest, though, also that other measures should be considered in the big picture, especially here in the Chicago area. There are other ways to make transportation more efficient for trucks, and thereby reduce congestion, unnecessary emissions due to idling and traffic jams, and what have you. Here in the Chicago area, we're working with transportation specialists at the University of Illinois-Chicago to encourage off peak delivery schedules for trucks. In these types of situations, trucks could run more efficiently and reduce traffic on the highways right now if we would encourage more nighttime and weekend deliveries.

This would require the cooperation of shippers, trucker, and government bodies that would encourage off peak deliveries and maybe encourage a reduction in tolls on the tollway, maybe a change in the hours of service regulations to encourage truckers to operate at night. And also it would improve truck access.

**Organization:** PepsiCo

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 43-44.]

As in the past, PepsiCo believes that it is important to complement these standards with financial incentives to help organizations implement new technologies and alternate fuel strategies.

For example, previous incentives help our Frito Lay North America division build one of the largest private electric fleets in the United States. We believe that additional financial incentives will spur future opportunities and increase implementation and innovation of fuel-saving technologies.

**Organization:** Volvo Group

Environmental care is one of Volvo Group's core values, together with product safety and quality. We share a strong concern about the effects of greenhouse gas (GHG) emissions on the global climate and the unsustainability of continued reliance by commercial transportation on petroleum-based fuel. While continued vehicle efficiency improvements are critical to addressing these concerns, we also note that there are many cost-effective opportunities for improving freight efficiency that are beyond the reach of individual vehicle technology, including: platooning, routing, and trip planning enabled by vehicle to vehicle communications; congestion mitigation; smart highway systems; permitting longer and heavier combination vehicles; improved shipping logistics; and packaging. Such infrastructure improvements and market incentives to enhance shipping efficiency should be considered in addition to vehicle regulations. [EPA-HQ-OAR-2014-0827-1290-A1 p.2]

**Response:**

The agencies agree that today's standards are but one part of a broader effort to address fuel consumption and greenhouse gas emissions. We are supportive of a wide range of complementary measures to further these goals. The SmartWay Transportation program and the Diesel Emission Reduction Act (DERA) programs are but two examples of incentive programs that complement the standards we are adopting today. We appreciate the commenters' concerns and suggestions with respect to infrastructure improvements, intermodal freight transport, and other policies that could lead to GHG reductions. However, we find these comments to be outside of the regulatory framework of this HD Phase 2 program. The agencies thank the commenters for the information provided.

However, we find these comments to be beyond the scope of this rulemaking.

### **15.10.3 Fuel-Related Comments**

**Organization:** Diesel Technology Forum

#### **Advanced renewable biofuels offer significant reductions in greenhouse gas emissions**

While this proposed rule focuses on vehicle and engine standards, in the context of efficiency and reducing greenhouse gas emissions, we believe that it is important to also note the benefits from changes to fuels. The diesel platform is most unique in its ability to operate on a wide range of renewable low-carbon biofuels. Today, most heavy-duty diesel engines are approved to operate on blends of biodiesel up to twenty percent. Renewable diesel fuels made from renewable bio-feedstocks are now also commercially available. These “drop-in” replacement fuels couple even greater carbon reduction with further emission reduction. Studies by the California Air Resources Board indicate that such fuels can reduce by 70 percent the greenhouse gas emissions over conventional diesel fuel. [EPA-HQ-OAR-2014-0827-1171-A2 p.4] [[These comments can also be found in Docket Number EPA-HQ-OAR-2014-0827-1420, p.112.]]

Recently, the City of San Francisco announced that renewable diesel fuel will power all city owned diesel vehicles and equipment by years’ end.<sup>2</sup> Still yet, UPS, the world’s largest package delivery service, recently announced that it plans to consume 46 million gallons of renewable diesel fuel over the next three years.<sup>3</sup> [EPA-HQ-OAR-2014-0827-1171-A2 p.4]

**Organization:** Green Transportation Solutions

[The following comments were submitted as testimony at the Chicago, Illinois public hearing on August 6, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1372, p. 234-236.]

So beyond the costly vehicle upgrades and modifications that are being discussed here today, it is rather difficult for some of these drivers to purchase some of these things. We usually actually recommend three simple and inexpensive ways to reduce petroleum consumption, and, thus, greenhouse gas emissions with our clients.

The first is to increase the use and availability of biodiesel fuels in trucks. Most trucks only use a blend of five percent when they're capable of using upwards towards 20 percent. So that comes down to the availability and their choice at the pump. Often enough they don't have that choice, and if they did more often they would choose it.

As most people know, increasing biodiesel blends will automatically reduce petroleum consumption because you're using five percent, 10 percent, or 20 percent less petroleum, and also providing rural economic benefits domestically, plus a significant reduction in greenhouse gases by -- at the molecular structure having an oxygen piece component to that.

**Organization:** National Biodiesel Board

The National Biodiesel Board (NBB) is the trade association for the U.S. biodiesel industry. Made from a diverse mix of resources such as recycled cooking oil, soybean oil and animal fats, biodiesel is a renewable, clean-burning diesel replacement, and is the first and only commercial-scale fuel produced

across the United States to meet EPA's definition of an Advanced Biofuel. We appreciate the opportunity to provide these comments on the proposed rule entitled "Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2." The proposed rule seeks to reduce greenhouse gas (GHG) emissions from medium- and heavy-duty engines and vehicles. Also important, however, is the goal of promoting this country's energy security—a key purpose of the Administration's Climate Action Plan<sup>1</sup>—by reducing this country's reliance on foreign oil and by diversifying the mix of energy sources. We believe biodiesel is a viable part of the solution, and its use must be promoted to meet these goals. NBB submits these comments, because it does not believe that the proposal provides any real incentives to ensure increased use of biodiesel in diesel engines and vehicles. [EPA-HQ-OAR-2014-0827-1240-A1 p.1-2]

NBB believes the proposal should encourage use of fuels from renewable sources, not just continue down the path of using alternative forms of fossil fuels. The following comments propose an option to include credits under the new Phase 2 GHG emissions reduction and fuel economy standards for those Original Equipment Manufacturers (OEMs) who have chosen to support and employ the use of B20 or higher biodiesel blends in their diesel vehicles and engines as one of the technological pathways they are pursuing to meet these standards and improve their environmental profile. We believe increased use of biodiesel presents a cost effective means for achieving emissions reductions from the transportation sector, particularly as the use of diesel fuel is estimated to continue to increase to meet the demands of the medium- and heavy-duty vehicle industry. [EPA-HQ-OAR-2014-0827-1240-A1 p.2]

1) Increasing Biodiesel Use is Key to Meeting the Administration's Climate Change Objectives. [EPA-HQ-OAR-2014-0827-1240-A1 p.2]

The Obama Administration has made climate change a top priority, outlining a Climate Action Plan to address U.S. GHG emissions. See White House, Climate Change and President Obama's Action Plan, <https://www.whitehouse.gov/climatechange> (last visited Oct. 1, 2015). The transportation sector is estimated to be the second largest contributor (28 percent) to U.S. GHG emissions behind electricity (32 percent). *Id.* As part of the Action Plan, the Administration committed to "support the Renewable Fuel Standard and invest in research and development to help bring next generation biofuels on line." *Id.* "Heavy-duty vehicles (commercial trucks, vans, and buses) are currently the second largest source of greenhouse gas pollution within the transportation sector." *Id.* The Phase 2 program for medium- and heavy duty engines and vehicles is intended to be in response to the Action Plan, seeking to reduce fuel consumption and GHG emissions. See EPA Fact Sheet, Cutting Carbon Pollution, Improving Fuel Efficiency, Saving Money, and Supporting Innovation for Trucks, EPA-420-F-15-900 (June 2015), available at [www.epa.gov/otaq/climate/documents/420f15900.pdf](http://www.epa.gov/otaq/climate/documents/420f15900.pdf). [EPA-HQ-OAR-2014-0827-1240-A1 p.2]

Diesel fuel is a growing part of the transportation fuel sector. "Distillates continue to be seen as the predominant growth category" for long-term oil demand to 2040. Organization of the Petroleum Exporting Countries, 2014 World Oil Outlook, at 217, 218 (2014), available at [http://www.opec.org/opec\\_web/static\\_files\\_project/media/downloads/publications/WOO\\_2014.pdf](http://www.opec.org/opec_web/static_files_project/media/downloads/publications/WOO_2014.pdf). "Commercial transportation needs will continue to grow despite efficiency gains, and will drive up U.S. demand for diesel and jet fuel." ExxonMobil, The Outlook for Energy: A View to 2040, U.S. Edition, at 12 (2015), available at <http://cdn.exxonmobil.com/~media/global/files/outlook-for-energy/2015/2015-outlook-for-energy-us-version.pdf>; see also Energy Information Administration (EIA), Annual Energy Outlook 2015 with Projections to 2040, at 19 (Apr. 2015), available at [http://www.eia.gov/forecasts/aeo/pdf/0383\(2015\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf) (noting anticipated increase in diesel fuel production). "Reducing GHGs and fuel consumption from [the heavy-duty] sector will be vital toward addressing climate change and energy security." Karl Simon, EPA, Moving to a More Efficient Future,

HTUF Meeting, Sept. 23, 2014, slide 20, available at [http://www.calstart.org/Libraries/HTUF\\_2014\\_National\\_Meeting\\_Documents/KSimon\\_Keynote\\_9\\_23\\_14.sflb.ashx](http://www.calstart.org/Libraries/HTUF_2014_National_Meeting_Documents/KSimon_Keynote_9_23_14.sflb.ashx); see also id. at slide 6 (noting heavy-duty vehicle energy demand is estimated to grow by 65% over next 30 years and to constitute 40% of all transportation energy). [EPA-HQ-OAR-2014-0827-1240-A1 p.2-3]

The United States has seen substantial growth in the availability of diesel vehicle options, which can also operate on biodiesel blends. With 47 new clean diesel car, truck and SUV models available in the 2015 model year, automotive industry experts have predicted that consumers will have more than 62 diesel vehicle models to choose from in North America by 2017. Add to that the more than 27 other automotive brands supplying numerous diesel engines and over 115 different diesel models for the medium- and heavy-duty truck, bus and RV markets, and there is tremendous potential for biodiesel blends to make a positive impact in reducing GHG emissions on the roadways. Industry experts predict that diesel vehicles will make up to 10 to 15 percent of the U.S. market by the year 2025, up from just over 3 percent in 2014. Because diesel-fueled vehicles deliver up to 40 percent better real-world fuel economy than their gasoline counterparts do, more and more automakers have turned to diesel vehicle platforms to help them meet the aggressive new U.S. Corporate Average Fuel Economy (CAFE) standards, which mandate a fleet average of 54.5 MPG by 2025. [EPA-HQ-OAR-2014-0827-1240-A1 p.3]

While providing improved efficiency compared to gasoline, diesel fuel also has greater carbon emissions. The EIA estimates that diesel fuel and heating oil emit 22.4 pounds of carbon dioxide (CO<sub>2</sub>) per gallon compared to 19.6 pounds for gasoline. EIA, Carbon Dioxide Emissions Coefficients, (Feb. 14, 2013), [http://www.eia.gov/environment/emissions/co2\\_vol\\_mass.cfm](http://www.eia.gov/environment/emissions/co2_vol_mass.cfm). EIA also has reported increasing CO<sub>2</sub> emissions from energy consumption associated with distillate fuel oil since 2012. EIA, Table 12.5 Carbon Dioxide Emissions from Energy Consumption: Transportation Sector (Sept. 2015), available at [www.eia.gov/totalenergy/data/monthly/pdf/sec12\\_8.pdf](http://www.eia.gov/totalenergy/data/monthly/pdf/sec12_8.pdf). Moreover, upstream GHG emissions from diesel are increasing as more diesel is refined from heavier crude oils or marginal sources, such as tar sands. [EPA-HQ-OAR-2014-0827-1240-A1 p.3]

Biodiesel offers “considerable greenhouse gas emissions benefits over conventional gasoline and diesel fuel.” Department of Energy (DOE) Energy Efficiency & Renewable Energy, Alternative Fuels Data Center - Biodiesel Vehicle Emissions, [http://www.afdc.energy.gov/vehicles/diesels\\_emissions.html](http://www.afdc.energy.gov/vehicles/diesels_emissions.html) (last updated Jan. 15, 2015). EIA estimates that B20 reduces the CO<sub>2</sub> emissions from burning one gallon of diesel fuel from 22.38 pounds of CO<sub>2</sub> to 17.90 pounds. EIA, Frequently Asked Questions: How much carbon dioxide is produced by burning gasoline and diesel fuel?, [www.eia.gov/tools/faqs/faq.cfm?id=307&t=11](http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11) (last updated July 7, 2015).<sup>2</sup> The National Highway Traffic Safety Administration (NHTSA) has recognized that “B20 has been shown to reduce . . . carbon dioxide emissions by 15 percent” compared with petroleum diesel. See NHTSA, Review and Analysis of Potential Safety Impacts of and Regulatory Barriers to Fuel Efficiency Technologies and Alternative Fuels in Medium- and Heavy-Duty Vehicles, DOT HS 812159, at 34 (June 2015), available at <http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cale/812159-RevSafetyImpactsRegulatoryFuelEfficiencyTechMDHD.pdf> (herein after “NHTSA Safety Study”). NHTSA identified no regulatory impediments to use of biodiesel. [EPA-HQ-OAR-2014-0827-1240-A1 p.3-4]

In addition to the GHG benefits, biodiesel is “nontoxic and contains no hazardous materials.” NHTSA Safety Study at 35. Biodiesel has lower carbon content than petroleum diesel and higher oxygen content, which allows it to burn more completely. Most volumes of biodiesel also have lower sulfur content than even ultra-low sulfur diesel (ULSD). As such, use of biodiesel also provides for reduced

non-GHG emissions, including hydrocarbons (HC), particulate matter (PM), carbon monoxide (CO), and air toxics.<sup>3</sup> See *id.* at 34. These “reductions increase as the amount of biodiesel blended into diesel fuel increases.” *Id.* A recent study of bus fleets found that use of B20 reduces PM emissions from buses by 17 percent compared to ULSD. See Mineta National Transit Research Consortium, *Combustion Chemistry of Biodiesel for Use in Urban Transport Buses: Experiment and Modeling* (Oct. 2014), available at <http://transweb.sjsu.edu/PDFs/research/1146-biodiesel-bus-fuel-combustion-chemistry.pdf>. This study also confirmed that lower emissions of CO and CO<sub>2</sub> are related to lower ratios of carbon to oxygen in biodiesel fuels compared to ULSD. *Id.* at 53. The improved lubricity with using biodiesel may also mean less wear on engine parts and less maintenance. Moreover, the substantial emissions reductions and other benefits associated with increased use of biodiesel are achieved cost-effectively. The overall total cost of ownership for operating a diesel vehicle on biodiesel blends is less than promoting new vehicles and fueling infrastructure to accommodate other alternative fuels such as natural gas—a fossil fuel—and electric power—largely generated by fossil fuels. [EPA-HQ-OAR-2014-0827-1240-A1 p.4-5]

2) Congress has Recognized the Importance of Biodiesel for Energy Independence [EPA-HQ-OAR-2014-0827-1240-A1 p.5]

The Energy Independence and Security Act of 2007 (EISA) sought to move this country toward greater energy independence and security and “to increase the production of clean renewable fuels.” Pub. L. No. 110-140, 121 Stat. 1492 (2007). EISA included the Ten-in-Ten Fuel Economy Act, which, among other things, required a fuel economy standard for commercial medium- and heavy-duty on-highway vehicles and work trucks and extended the flexible fuel credit program to include vehicles using B20. Pub. L. No. 110-140, Title I, Subtitle A, §§ 102(b), 103(a)(4), 109(b), 121 Stat. 1500-1501, 1506. [EPA-HQ-OAR-2014-0827-1240-A1 p.5]

EISA also expanded the Renewable Fuel Standard (RFS) Program. When first enacted, Congress provided for “appropriate amount of credits for biodiesel” under the RFS program. Pub. L. No. 109-58, § 1501(a), 119 Stat. 1071 (2005). Congress then established “advanced biofuel” and “biomass-based diesel” categories, which include biodiesel. 42 U.S.C. § 7545(o). [EPA-HQ-OAR-2014-0827-1240-A1 p.5]

Through EISA, therefore, Congress sought to promote the use of biodiesel, including increasing the amount present in blends to at least B20. The RFS program indicates that Congress intended these amounts to be even higher. [EPA-HQ-OAR-2014-0827-1240-A1 p.5]

In fact, the biodiesel industry has epitomized the benefits envisioned by Congress in seeking to promote use of biodiesel under these various programs. The growth and expansion of the U.S. biodiesel industry in recent years represents a tremendous success story for fleets and individual consumers all across the United States. Today, nearly 2 billion gallons of biodiesel and renewable diesel displace an equivalent amount of petroleum diesel, helping to protect our domestic energy security while creating millions of dollars in economic impact here in the United States. Biodiesel is produced in nearly every state in the country and is supporting more than 62,000 American jobs. Using EPA’s own estimates regarding GHG emissions, biodiesel has cut carbon pollution by 75.5 million metric tons with nearly 8.2 billion gallons used from 2005 to 2014—the same impact as removing more than 15.9 million passenger vehicles from America’s roadways. [EPA-HQ-OAR-2014-0827-1240-A1 p.5]

3) EPA’s and NHTSA’s Rules Should Support Increased Use of Biodiesel in Vehicles. [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

In the Phase 1 rule for medium- and heavy-duty vehicles, which the agencies propose to continue under the Phase 2 program, 80 Fed. Reg. at 40,158, the agencies purport to have implemented a uniform approach to fuels, despite recognizing that “this uniform approach to fuels may not take advantage of potential additional energy and national security benefits of increasing fleet percentages of alternative-fueled vehicles.” 77 Fed. Reg. 51,499, 51,502 (Aug. 24, 2012). “More alternative-fueled vehicles on the road would arguably displace petroleum-fueled vehicles, and thereby increase both U.S. energy and national security by reducing the nation’s dependence on foreign oil.” *Id.*; see also 76 Fed. Reg. 57,106, 57,124-57,125 (Sept. 15, 2011). While treating fuel consumption and GHG emissions on a one-to-one basis, the agencies also noted that they would consider proposing standards that would more fully consider the reduction in use of petroleum-based fuels. 76 Fed. Reg. at 57,125. Indeed, EPA’s credits appear to incentivize continued fossil fuel use over renewable resources, focusing on natural gas and electricity, which may be from coal-based power plants. Assuming a uniform approach may have made sense for Phase 1, it no longer continues to make sense. [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

a) Biodiesel is a drop-in alternative fuel from renewable sources, and is technically and economically feasible to use to reduce GHG emissions and increase energy security. [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

Biodiesel is essentially a drop-in fuel to current technologies for diesel fuel. Blends up to B5 are considered fungible with diesel fuel and do not require additional labeling. NHTSA has noted that “[b]lends up to B20 can be used in existing equipment without modification.” NHTSA Safety Study at 33. NHTSA further noted that “most engines made after 1994 have been constructed with gaskets and seals that are generally biodiesel resistant.” *Id.* at 36. NHTSA concluded: [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

Biodiesel is a drop-in alternative fuel that can support MD/HDV progress toward GHG and criteria pollutant reductions without major capital investment or infrastructure barriers. There is a minor decrease in fuel efficiency due to the 8 percent lower energy density of biodiesel versus petroleum diesel, but the magnitude of the emissions decrease is substantially larger. [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

As for any bi-fueled vehicles, the potential for refueling with petroleum diesel reduces potential safety risks associated with vehicle stranding due to fuel supply shortage or refueling infrastructure limitations. [EPA-HQ-OAR-2014-0827-1240-A1 p.6]

In conclusion, the literature reviewed and DOE/AFDC resources indicate that biodiesel, as a viable drop-in alternative fuel, has both safety and environmental benefits. [EPA-HQ-OAR-2014-0827-1240-A1 p.7]

*Id.* at 36 (emphasis added). While EPA and NHTSA contend that the medium- and heavy-duty vehicle and engine program provides sufficient incentive to use alternative fuels, it does not adequately explain how the proposal promotes biodiesel use, which, as noted above, was contemplated by EISA and provides feasible and economic GHG emission reductions. [EPA-HQ-OAR-2014-0827-1240-A1 p.7]

In 2011, the agencies contended that the fuel consumption measurements under the medium- and heavy-duty vehicle and engine rule provide incentives for alternative fuels. 76 Fed. Reg. at 57,124. The agencies assert this method shows a benefit of approximately 1 to 3 percent for biodiesel and ethanol blends. *Id.*; see also EPA, Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles: EPA Response to Comments Document for Joint Rulemaking, EPA-420-R-11-004, at 16-148 (Aug. 2011) (EPA-HQ-OAR-2010-0162-3635)



(“Furthermore, the agencies believe that the fuel consumption benefits that FFVs will obtain in engine test cycles accurately reflects their energy benefits and thus provides sufficient incentives for these vehicles.”).<sup>4</sup> While NBB agrees that biodiesel use provides greater GHG emissions reductions from the tailpipe, this ignores the distinction between CO<sub>2</sub> emissions from renewable resources compared to fossil fuels. [EPA-HQ-OAR-2014-0827-1240-A1 p.7]

The regulations also appear to focus on natural gas, electricity, and E85 as alternative fuels, not vehicles that are approved to use B20 or higher blends. Cf. 40 C.F.R. §§ 1036.801 (defining “alcohol-fueled engine”), 1037.801 (defining “alcohol-fueled vehicle”). EPA’s regulations also note that “[t]here can be multiple grades within a single fuel type,” referencing gasoline and E10. 40 C.F.R. § 1036.801; see also 40 C.F.R. § 1037.801. EPA recognizes that “[o]nly where the vehicle or engine technology inherently demands a certain type of fuel do the standards account for that fuel use, by specifying the calculation procedure used to determine tailpipe emissions.” 77 Fed. Reg. at 51,705. Moreover, unlike the light-duty rule, EPA does not require that the fuel actually be used, limiting the usefulness of the incentives purportedly provided under the rule.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1240-A1 p.7]

The agencies also indicated that they would not provide additional incentives similar to the light-duty rule because “the HD sector does not have the incentives mandated in EISA for light-duty FFVs, and so has not relied on the existence of such credits in devising compliance strategies for the early model years of this program.” 76 Fed. Reg. at 57,123. Again, the agencies focused on E85 and natural gas in this discussion. *Id.* But, the agencies have ignored the reliance the biodiesel industry has made on Congress’ and this Administration’s promises. The U.S. biodiesel industry has worked to address fuel quality concerns, and has moved to increase production and diversify feedstocks. They continue to innovate by reducing their energy consumption, while expanding their production capacity. [EPA-HQ-OAR-2014-0827-1240-A1 p.7-8]

In addition, the vast majority of OEMs of medium- and heavy-duty engines have found that blends up to B20 are compatible with their engines. Nearly 80 percent of U.S. manufacturers support B20 or higher blends in at least some of their equipment, and nearly 90 percent of medium-duty and heavy-duty truck models support B20. See NBB, Biodiesel Industry Overview & Technical Update, Slide 34 (Sept. 2015), available at <http://biodiesel.org/docs/default-source/ffs-basics/biodiesel-industry-and-technical-overview.pdf?sfvrsn=14>; see also NBB, OEM Support (Jan. 2015), available at [http://biodiesel.org/docs/default-source/ffs-engine\\_manufacturers/oem-support-summary.pdf?sfvrsn=16](http://biodiesel.org/docs/default-source/ffs-engine_manufacturers/oem-support-summary.pdf?sfvrsn=16). But, without adequate incentives, these OEMs may limit the vehicles that are approved for B20, despite the clear benefits as noted above. Moreover, there is little incentive to ensure their future vehicles and engines will continue to be compatible with higher biodiesel blends.<sup>6</sup> Indeed, certain OEMs have been reluctant to list B20 as an approved fuel for use or have declined to consider higher biodiesel blends as part of their engine and vehicle designs.<sup>7</sup> [EPA-HQ-OAR-2014-0827-1240-A1 p.8]

EISA defined B20 as an alternative fuel eligible for flexible fuel vehicle credits under the CAFE program. Vehicles approved to utilize B20 should receive credit, incentivizing the entire new fleet to be approved for at least B20. Approval for higher biodiesel blends above B20 can receive increased credits. Indeed, EISA requires that NHTSA establish a program “designed to achieve the maximum feasible improvement.” 49 U.S.C. § 32902(k). Diesel engines also are increasingly being used in the light-duty sector, and the agencies should consider similar means to further incentivize alternative fuel use in passenger vehicles.<sup>8</sup> To ensure the benefits of using biodiesel are realized, the agencies also can include a requirement that biodiesel actually be used in the U.S. marketplace, as indicated by annual U.S. biodiesel consumption figures. [EPA-HQ-OAR-2014-0827-1240-A1 p.8]

b) Credits could include a multiplier that reflects the biodiesel blend content approved for use by the OEM. [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

We propose that credits for OEMs supporting the use of B20 or higher biodiesel blends should apply to four of the five regulatory categories being guided by the proposed standards, namely: [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

1. Combination Tractors;
2. Heavy-Duty Pickup Trucks and Vans;
3. Vocational Vehicles which include all other heavy-duty vehicles such as buses, refuse trucks, and concrete mixers; and
4. Engines that power combination tractors and vocational vehicles. [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

There is no perceived involvement for biodiesel credits in regards to the fifth category of regulated vehicles under the proposed Phase 2 rule—Trailers Pulled by Combination Tractors. [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

Biodiesel is defined as meeting the ASTM International Standard D6751. Biodiesel blends up to B5 are essentially ubiquitous with diesel fuel in the market today. B20 is an optimal level for biodiesel blend acceptance by OEMs today as it provides a balance between vehicle performance, maintenance and emissions reductions, and proven industry specifications. Providing additional credits for higher biodiesel blends recognizes current use in niche market applications as well as helping to promote future technological developments. [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

These credits could be provided to OEMs which support the use of B20 or higher biodiesel blends as publicly stated in their Owners Manuals or other official documentation. A multiplier such as the MY2012-2015 light-duty incentive for dedicated alternative fueled vehicles and dual-fueled vehicles could be applied, but based on the level of biodiesel blend approved for use.<sup>9</sup> For example, for vehicles that the OEM has indicated can be run on B20, one gallon of fuel would be treated as 0.80 gallon to account for the 20 percent biodiesel.<sup>10</sup> [EPA-HQ-OAR-2014-0827-1240-A1 p.9]

c) EPA cannot rely on the RFS program to contend no additional incentives are necessary. [EPA-HQ-OAR-2014-0827-1240-A1 p.10]

Although the agencies previously declined to provide certain credits for alternative fuels, they should reassess this position. EPA limited the incentives for alternative fuels in the light-duty rule stating “[t]he RFS is a standalone program designed to increase the use of renewable fuels and to achieve GHG emission reductions primarily through upstream emission reductions.” 77 Fed. Reg. at 62,823. In the Phase 1 medium- and heavy-duty rule, EPA stated that “[f]or the fuels covered by the Renewable Fuels Standard additional incentives are not needed in this regulation given the large volume increases required under the Renewable Fuel Standard.” 76 Fed. Reg. at 57,124. Since then, however, EPA has proposed to reduce the statutory volumes and, moreover, to limit its proposed increases for biomass-based diesel. See generally Renewable Fuel Standard Program: Standards for 2014, 2015, and 2016 and Biomass-Based Diesel Volume for 2017, 80 Fed. Reg. 33,100 (June 10, 2015). In short, EPA is not fully implementing the RFS program. NBB has opposed this proposal and requested EPA reassess the advanced biofuel and biomass-based diesel volumes.<sup>11</sup> Even if EPA revises these volumes, however,

these programs can and should work in conjunction with one another. [EPA-HQ-OAR-2014-0827-1240-A1 p.10]

Rather, EPA has cited to limitations on getting the fuel to consumers as rationale for reducing the statutory volumes under the RFS program.<sup>12</sup> See generally 80 Fed. Reg. at 33,101. EPA's proposal focused on the so-called "E10 blendwall," noting that there were insufficient numbers of FFVs and "an even smaller number of FFVs that have ready access to an E85 retail outlet." Id. at 33,114. Unlike ethanol, any blend of biodiesel is authorized for use in motor vehicles. Nonetheless, EPA also references B2/B5 blends in its RFS proposal, noting the "efforts" underway to continue to expand product offerings. Id. at 33,116. To avoid similar purported "constraints" or "limitations" in the future, EPA should reward those in the industry that are moving forward with respect to higher biodiesel blends as intended by Congress, rather than resort to its limited authority under the RFS waiver provisions as it is attempting to do with ethanol today. [EPA-HQ-OAR-2014-0827-1240-A1 p.10]

Although the CAFE program had a special provision for light-duty vehicles, the agencies have indicated that this does not limit their authority. See, e.g., 77 Fed. Reg. at 62,831. NBB agrees. Thus, EPA and NHTSA should consider additional means of supporting those OEMs that have approved B20 and providing incentives for use of higher blends. As noted above, one possible alternative is to give OEMs approving B20 or higher blends some credit for the benefits associated with the reduced GHG emissions and greater energy security benefits. To the extent EPA continues to believe, notwithstanding its current proposal for the 2014-2016 RFS and 2017 biomass-based diesel volume, the RFS provides adequate incentives, EPA can include requirements to establish that the fuel is being used (similar to its approach for MY2016 and later light-duty vehicles) and adjust the required volumes (and thereby available credits) to apply only to those above the minimum amounts required by the RFS. [EPA-HQ-OAR-2014-0827-1240-A1 p.10-11]

NBB appreciates the opportunity to submit these comments. We believe that EISA and this Administration's policy requires promotion of increased use of biodiesel to help meet the goals of the GHG and Fuel Efficiency Standards, and we look forward to working with both EPA and NHTSA on this important issue. [EPA-HQ-OAR-2014-0827-1240-A1 p.12]

**Organization:** Plant Oil Powered Diesel Fuel Systems

Although the two agencies have approved POP Diesel's retrofitting of select diesel engines to run on 100 percent jatropha plant oil based on POP Diesel's evidence that such engines and renewable fuel do not produce higher criteria emissions than baseline petroleum diesel, the Truck Rule 2 automatically disqualifies a new diesel engine that is equipped to run on 100 percent plant oil from ever winning certification compliance running on such fuel, a requisite for sale of such a new engine to the U.S. market. The reason is two-fold. First, the two agencies measure both fuel consumption (as an incorrect proxy for fuel efficiency) and GHG emissions by tailpipe carbon emissions. Second, the presence of oxygen atoms in the plant hydrocarbon molecule, as depicted in the vegetable oil molecule in Exhibit 2 [exhibit 2 can be found on p.18 of docket number EPA-HQ-OAR-2014-0827-1125-A1], that are absent from petroleum hydrocarbon oil give plant oil lower energy content than petroleum diesel and therefore cause a compression ignition (diesel) engine running on ordinary plant oil to consume more of this fuel by mass or volume and produce more carbon emissions from the tailpipe than if the engine were running on baseline petroleum diesel fuel. However, as set forth in the attached declaration of Dr. Paul T. Henderson, a diesel engine will consume the same amount of energy per unit of work performed, whether running on 100 percent plant oil or petroleum diesel fuel. Exhibit 3 [exhibit 3 can be found on p.20 of docket number EPA-HQ-OAR-2014-0827-1125-A1]. [EPA-HQ-OAR-2014-0827-1125-A1 p.5]

In addition, plant oil fuel running in such an engine has net, life cycle greenhouse gas emissions that are far lower than baseline petroleum and such alternative fuels processed from plant oil as biodiesel and so-called 'renewable diesel' (hydro-processed esters and fatty acids, or HEFA's). [EPA-HQ-OAR-2014-0827-1125-A1 p.5]

In the alternative that the agencies do not adopt the remedy proposed in section 3 above, POP Diesel seeks a waiver or 15 percent variance from the measurements of fuel consumption and tailpipe GHG emissions under the proposed Standards for a new, plant oil-enabled compression ignition engine for the time period of any test protocol under which the engine is operating on plant oil fuel. [EPA-HQ-OAR-2014-0827-1125-A1 p.5-6]

#### **D. A Waiver or 15% Variance Is Required If Plant Oil Powered Truck Engines Are to Win Certification, If the Proposed Truck Rule 2 Remains Unchanged**

If the two agencies do not revamp the Truck Rule 2 according to the foregoing comments, then POP Diesel appeals to them to adopt a waiver from emissions testing for an engine equipped with a dual tank fuel system and running on 100% jatropha plant oil, or a permissible variance of 15% for the portion of any certification test protocol on which an engine equipped with a dual tank fuel system operates on 100% jatropha plant oil. [EPA-HQ-OAR-2014-0827-1125-A1 p.13]

There is sufficient evidence submitted with these comments, based on the arguments presented herein, for the two agencies to issue a rule granting a simple waiver from the GHG Emissions and Fuel Efficiency Standards for an engine specially equipped to run on 100% jatropha plant oil to run on such fuel. The engine would still have to pass these Standards and be certified to run on No. 2 petroleum-based diesel fuel. [EPA-HQ-OAR-2014-0827-1125-A1 p.13]

In the alternative, a variance of 15% from the fuel consumption emissions levels permitted under the GHG Emissions and Fuel Efficiency Standards is warranted for that time portion of a certification test protocol that a new engine specially equipped to run on 100% jatropha plant oil runs on such fuel.<sup>8</sup> A variance of 15% is justified on the following grounds. [EPA-HQ-OAR-2014-0827-1125-A1 p.13]

As is set forth in Exhibit 11 [exhibit 11 can be found on p.106 of docket number EPA-HQ-OAR-2014-0827-1125-A1], which is a Final Report from West Virginia University's Center for Alternative Fuels, Engines & Emissions comparing stationary point dynamometer emissions testing of a diesel engine running on 100% No. 2 diesel and 100% jatropha plant oil, the overall conclusion, reported in the Final Report in Table 22 on page 395, was that across five of six modes of engine operation, as measured by the Tailpipe Rule, fuel consumption of 100 percent plant oil was a total of around 18 percent more than of petroleum diesel while the engine was performing the same amount of work. Similarly, as reported in the Draft Final Report, Exhibit 12 [exhibit 12 can be found on p.108 of docket number EPA-HQ-OAR-2014-0827-1125-A1], the comparison of carbon dioxide (CO<sub>2</sub>) readings from baseline testing on petroleum diesel, appearing on page 294 of the Draft Final Report, are significantly lower than the CO<sub>2</sub> results for the same engine with POP Diesel's Fuel System activated and running on 100 percent jatropha plant oil, appearing on the very next page, page 295 of the Draft Final Report, for each and every of the six engine modes of operation (engine speed and torque settings) tested. [EPA-HQ-OAR-2014-0827-1125-A1 p.13-14]

POP Diesel believes that, if the two agencies adopt a variance for its engines as proposed above, the variance should be on the order of 15%. As stated above, stationary point testing showed that fuel consumption was around 18% higher for the engine running on 100% jatropha plant oil as when it was running on No. 2 diesel. Jatropha plant hydrocarbon oil requires an engine to consume more fuel per

unit of work performed because it has 10% lower energy content than petroleum diesel (due, as stated above, to the presence of oxygen atoms that are absent from petroleum hydrocarbon). Evidence for this 10% difference in energy content appears on the face of the very last page of the Final Emissions Report, Exhibit 11, stating that the BTU content for 100% jatropha plant oil is 116,613 BTU's per gallon. This compares with energy content of petroleum diesel, on average, of 10% more, 129,240 BTU's per gallon (the point at which most diesel engines equipped to run on No. 2 petroleum-based diesel are calibrated), as stated in course materials from ASTM International's Petroleum Products Committee, which are Exhibit 13 [exhibit 13 can be found on p.14 of docket number EPA-HQ-OAR-2014-0827-1125-A1]. The presence ion jatropha plant oil of oxygen atoms lending lower energy content, compelling the diesel engine to command more fuel consumption, and producing greater tailpipe carbon emissions will produce variable results in fuel consumed and carbon emitted from the tailpipe, according to engine load and torque and other operating conditions. Therefore, since POP Diesel is proposing that this variance only apply to the portion of the test protocol on which the engine is supplied by 100% jatropha plant oil, some leeway is required. POP Diesel proposes that a 15% variance should be sufficient. [EPA-HQ-OAR-2014-0827-1125-A1 p.14]

[The following comments are from a supplemental comment with a correction to the original comments in docket number EPA-HQ-OAR-2014-0827-1125-A1]

I write on behalf of the above-named corporation, which goes by the short name POP Diesel, to make one correction and amplify one point for your consideration in addition to the comments submitted on September 11, 2015 ("Comments"). These supplemental and amended comments give details on and concern matters that your two agencies have not heretofore considered. Because of the novelty and profundity of its Comments, POP Diesel had been unable to formulate these details by the deadline of its September 11 submission. Therefore, I respectfully request that the agencies give this statement full consideration at this time. [EPA-HQ-OAR-2014-0827-1467-A2 p.1]

The correction is to the amount stated in Part III, Section (D) of the Comments as the variance that POP Diesel requests as an alternative solution to your two agencies' either (i) revising the Standards to accord fully with measuring fuel efficiency by the amount of energy input to the engine per unit of work performed and greenhouse gas emissions by net life cycle emissions or (ii) adopting a waiver from these Standards for truck engines equipped to run on 100 percent jatropha plant oil while they are running on this fuel. The Comments, at page 13, suggested that a variance from the Standards "on the order of" 15 percent would suffice. However, POP Diesel's call for a 15 percent variance was in error. POP Diesel hereby amends its Comments to request a 20 percent variance, for the following reason. [EPA-HQ-OAR-2014-0827-1467-A2 p.1-2]

The data submitted in Exhibits 11 and 12 to the Comments are that a diesel engine running on 100 percent jatropha plant oil generates approximately 18 percent more fuel consumption and tailpipe carbon emissions, versus when the engine operates on petroleum diesel fuel. Other than POP Diesel's mistaken request for a 15 percent variance, there is no reason for the two agencies to hold a POP Diesel-equipped engine to a variance of 15 percent that, from the start, establishes odds against this engine's being certified, which is the only conclusion that can be drawn from the evidence submitted. [EPA-HQ-OAR-2014-0827-1467-A2 p.2]

Therefore, POP Diesel requests a variance, if the agencies' consideration of its Comments lead them to adopt a variance, of at least 20 percent. The 18 percent variation evident in Exhibits 11 and 12 is an approximate average. Tailpipe plant oil carbon emissions results involving some models of diesel engine may be much higher than the 18 percent average. Therefore, a 20 percent variance is reasonable, and anything less than 18 percent is unreasonable. [EPA-HQ-OAR-2014-0827-1467-A2 p.2]

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<sup>8</sup>A POP Diesel-equipped engine starts and shuts down on No. 2 petroleum-based diesel fuel, but runs on 100% jatropha plant oil in the interim. The portion of a test protocol on which the engine operates on No. 2 petroleum-diesel versus 100% jatropha plant oil will depend on the test protocol and the fuel mapping programmed into the engine's power control module.

**Organization:** Volvo Group

### **No Provision for Lower Carbon Fuels**

Although EPA is charged with administering the federal Renewable Fuels Program, this NPRM makes no provision to provide credits for vehicles that are developed to run on lower carbon alternative fuels. While it is not clear what fuels may become available during the next 15 years, it is clear that the proposal creates a disincentive to develop vehicles to utilize such fuels unless they provide lower tailpipe GHG emissions, regardless of the well-to-wheel life cycle emissions. [EPA-HQ-OAR-2014-0827-1290-A1 p.32]

#### **Response:**

We provide credit for renewable fuels under the Renewable Fuels Standard (RFS) program. We thank the commenters for the information provided on the use of renewable biofuels in heavy-duty vehicles; however, these comments are germane to the Renewable Fuels Standard (RFS) program, which appropriately addresses renewable fuels. Biofuels that are demonstrated to meet specified GHG emission reductions on a lifecycle basis, and which meet all other requirements including the definition of renewable biomass, have an opportunity to generate RINs under the RFS program after approval by EPA. With respect to comments from POP Diesel, manufacturers can request certification of an alternative fuel vehicle running on POP Diesel under 40 CFR 1065.701(c).

### **15.10.4 Comments Related to the 2007/2010 Criteria Pollutant Standards**

**Organization:** Corwin, Michael

I currently work for a small trucking company that has 26 trucks running the US & Canada. We currently have 3 of our trucks down due to major DPF issues, and this has been pretty constant for the last 1.5 – 2 yrs, so what worries me is we are contemplating more regulations before we even figure out what is wrong with the currently mandated technology. [EPA-HQ-OAR-2014-0827-0730-A1 p.1]

**Organization:** Competitive Enterprise Institute et al.

Small and midsize trucking companies are finding they are ill-equipped to adapt [to the new regulations]. Hundreds of these firms, with an average fleet size of about a dozen vehicles, have gone out of business in the past two years, according to Avondale Partners LLC. Others have sold out to larger competitors, which are more likely to have cash reserves or access to financing to weather changes in the industry.<sup>4</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.3]

A chart from the article shows how the cost of new trucks has increased since 2009: [EPA-HQ-OAR-2014-0827-1251-A2 p.3]

[Chart can be found on p.3 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

A study prepared for American Truck Dealers (a division of the National Automobile Dealers Association) finds that EPA emission standards adopted in 1997, 2000, and 2001, which phased in between 2004 and 2010, increased the inflation-adjusted cost of new semis by more than \$21,000. For each phase of the regulations, the study compares the actual costs with the costs projected in EPA's regulatory impact analyses. Cumulative actual costs were more than four times bigger than EPA's estimate.<sup>5</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.4]

[Figure 7, 'Cumulative Surcharges for Heavy Heavy-Duty Trucks', can be found on p.4 of docket number EPA-HQ-OAR-2014-0827-1251-A2]

From January 2000 to January 2015, the CPI increased by roughly 38% while small owner-operator net income increased by 11%. The typical independent owner-operator incurred a loss of \$11,260 in purchasing power.<sup>6</sup> Thus, small truckers have been losing ground under existing regulatory burdens. [EPA-HQ-OAR-2014-0827-1251-A2 p.4]

We urge the agencies to proceed with special consideration for the rule's impacts on small trucking companies. The agencies claim the rule's fuel savings will more than offset the higher cost of compliant vehicles. However, even if realized, the projected fuel savings will be of no benefit to firms that go out of business because they can't afford to buy compliant trucks. [EPA-HQ-OAR-2014-0827-1251-A2 p.4]

The agencies also show no awareness of the comparatively greater risks small truckers incur from regulation-induced maintenance problems. A large firm with hundreds of vehicles will not lose business when a mandated new technology malfunctions and one or more trucks must be sent to the shop for repairs. But in small firms, such unanticipated downtime can cut weekly income and damage reputations. Consider the experience of owner-operator Tilden Curl, who testified at an EPA/NHTSA listening session in Olympia, Washington: [EPA-HQ-OAR-2014-0827-1251-A2 p.4-5]

Curl detailed his truck ownership and fuel economy starting with a 1995 Peterbilt he bought for \$65,000. After 10 years with the truck, Curl had invested just less than \$95,000 in maintenance and repairs, including a rebuild and transmission. The last year he owned the truck he averaged 6.58 mpg. [EPA-HQ-OAR-2014-0827-1251-A2 p.5]

In October 2008, Curl purchased a new aerodynamic, emission-compliant 2009 Kenworth for \$140,000. In seven years of ownership, Curl drove the truck more than 752,000 miles and had \$105,000 in maintenance and repairs. He suffered significant downtime that hurt his income and reputation as a reliable carrier, he told the panel. And, in the end, the truck was only able to achieve 6.15 mpg. [EPA-HQ-OAR-2014-0827-1251-A2 p.5]

Finally giving up on the '09 truck, Curl bit the bullet and bought a 2016 Kenworth earlier this year for \$167,000. He had originally planned to pay off the 2009 Kenworth and sock away what was the truck payment toward his retirement, he told the panel. [EPA-HQ-OAR-2014-0827-1251-A2 p.5]

“As I see it, these regulations, and a rush to push technology beyond tested capabilities, have cost me my retirement. There is no mechanism in place to compensate small-business truckers for the costs of these mandates,” he said. “We cannot afford for this to happen again.”<sup>7</sup> [EPA-HQ-OAR-2014-0827-1251-A2 p.5]

Nowhere in the proposal do the agencies acknowledge EPA's penchant for low-balling regulatory costs, the precarious economics of small-business trucking, and the existential risks small truckers face when technology mandates impair vehicle reliability. We have been told that EPA consulted OOIDA to

address small trucker concerns. However, to all appearances, the rule is a bull in a china shop. [EPA-HQ-OAR-2014-0827-1251-A2 p.5]

The proposed rule is silent about the potential impacts of new GHG and fuel economy standards on small trucking firms. History suggests the standards will increase equipment costs, operating expenses, and engine malfunctions by more than the agencies anticipate. The rule evinces no awareness that small firms already struggle to cope with existing regulations, and that additional regulatory burdens may drive many small owner-operators out of business. [EPA-HQ-OAR-2014-0827-1251-A2 p.24]

5 Patrick Calpin and Esteban Plaza-Jennings, A Look Back at EPA's Cost and Other Impact Projections for MY 2004-2010 Heavy Duty Truck Emission Standards, American Truck Dealers, February 2012, p. 12, <http://www.nadafrontpage.com/upload/wysiwyg/NADA-ATDA%20Look%20Back%20at%20EPA%E2%80%99s%20Cost%20and%20other%20Impact%20Projections%20for%20MY%202004-2010%20Heavy-Duty%20Truck%20Emissions%20Standards.pdf> (hereafter Calpin and Plaza-Jennings)

6 Personal communication from OOIDA regulatory affairs director Scott Greneth to Marlo Lewis, September 28, 2015

7 Jami Jones, "OOIDA members deliver dose of reality to EPA, NHTSA," Land Line, August 18, 2015, <http://m.landlinemag.com/Story.aspx?StoryID=29618#.VgqwVItOVZR>

**Organization:** Curl, Tilden

[The following comments were submitted as testimony at the Long Beach, California public hearing on August 18, 2015. See Docket Number EPA-HQ-OAR-2014-0827-1420, p. 186.]

Small business truckers that purchase this equipment to start up will be challenged to exist if this regulation proceeds without a reality check. The agencies are seemingly using facts they prefer, with little regard for the actual burdens it places on small business operations.

**Organization:** Schneider National Inc.

In the past, the costs of compliance have been underestimated and the benefits overstated. By way of illustration, since 2002, tractor cost increases directly attributed to emission regulations have increased the cost of a semi-tractor by 30% while increasing fuel consumption by 5% from 2003-2010. EPA estimates did not recognize the fuel consumption increase and the cost estimates were a small fraction of the actual costs incurred. [EPA-HQ-OAR-2014-0827-1201-A1 p.3]

**Response:**

These comments appear to be with respect to EPA's 2004/2007/2010 criteria pollutant standards and therefore are not germane to this rulemaking. We strongly disagree with claims that the rule does not consider the potential impacts of new GHG and fuel economy standards on small business, and we refer the commenter to Chapter 12 of the RIA which includes the agencies' analysis of the impacts of the standards on small entities and to Section 15.4 of this RTC.

The agencies have also devoted considerable attention to the issue of technology reliability. See, e.g. RIA chapter 2.3.9. Indeed, this is a primary reason the agencies are not adopting standards reflecting



Alternative 4. For each standard, the agencies have explained why there is adequate lead time not only to develop and deploy control technology, but also to assure its reliability.

### **15.10.5 Trailer Clearance/Identification Lamps 2123**

**Organization:** STEMCO

- STEMCO requests a written confirmation from NHTSA allowing the placement of rear identification and clearance lamps on the lower frame rail of long van trailers. This facilitates an additional 0.14 delta  $C_D A$  aerodynamic improvement from boat tails at no additional cost or complexity. [EPA-HQ-OAR-2014-0827-1259-A1 p.2]

NHTSA written support of optimized boat tails in relation to “49 CFR 393.11 Lamps and reflective devices”

As part of the final regulation, STEMCO requests that NHTSA include a clear written guidance confirming that trailer manufacturers may locate both the rear identification and clearance lamps on the lower frame rail for all box trailers, such that the entire rear lighting package may be located at the lower regulatory location (see Figure 1 in the Appendix for illustration). These lower clearance and identification lamp locations will pave the way for both higher-efficiency boat tails for swing door box trailers and the 2016 commercial launch of boat tails for roll door box trailers. [EPA-HQ-OAR-2014-0827-1259-A1 p.3]

To date, STEMCO has sold TrailerTails® into both the new trailer and retrofit markets without requiring that any modifications be made to the trailer design itself. This has forced the top panels of TrailerTails® to be inset 2-3” below the roof of the trailer (Figure 2) to satisfy the DOT visibility requirements of the rear identification and clearance lamps installed along the rear header of the trailer [23 CFR 658.16(b) (4)]. This inset creates an un-aerodynamic gap as airflow transitions from the trailer roof onto the TrailerTail® panels and has prevented TrailerTails® from delivering maximum environmental benefit. Wind tunnel flow visualization<sup>1</sup> highlights the contrast in airflow between flush and inset panels and our own internal testing estimates an additional 0.14 delta CDA (measured drag area) gain<sup>2</sup> can be achieved simply by installing a TrailerTail® flush with the trailer roof. [EPA-HQ-OAR-2014-0827-1259-A1 p.4]

We believe that no modification is needed to 49 CFR 393.11 because these lower mounting locations for rear identification and clearance lamps already satisfy the “as high as practicable” definition. Additionally, flat bed and container chassis trailers currently use these lower mounting locations as their standard (see Figures 3 and 4 in the Appendix). However, a written confirmation letter from NHTSA to all trailer manufacturers would eliminate any confusion due to the subjective “as high as practicable” verbiage. This NHTSA confirmation letter would also eliminate uncertainty for highway patrol officers during trailer inspections in the same way that FHWA’s 2008 letter to ATDynamics (now STEMCO) regarding the TrailerTail’s® length exclusion was used by early adopting TrailerTail® fleets as a valuable education tool at weigh stations. [EPA-HQ-OAR-2014-0827-1259-A1 p.4]

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1 Kehs, J., Visser, K., Grossmann, J., Niemiec, J. et al., “A Comparison of Full Scale Aft Cavity Drag Reduction Concepts With Equivalent Wind Tunnel Test Results,” SAE Int. J. Commer. Veh. 6(2):2013, doi:10.4271/2013-01-2429.

## 2 Assumptions & Calculations:

- 1) Current TrailerTail® (with top panel inset) is verified as 5% fuel savings device by EPA SmartWay
- 2) Table IV-9 correlates 5% fuel savings to 0.7 delta CDA
- 3) Internal STEMCO aerodynamic testing has shown that a TrailerTail® mounted flush to the trailer roof achieves 20% higher aerodynamic gains than a TrailerTail® that is inset below the identification and clearance lamps on the rear header
- 4)  $0.7 \text{ delta CDA} \times 20\% = 0.14 \text{ delta CDA}$  additional gain when a TrailerTail® is mounted flush to the trailer roof

### **Response:**

This comment is out of the scope of this rulemaking. However, this commenter and others who are interested in reading or seeking interpretations of NHTSA regulations are encouraged to visit <http://isearch.nhtsa.gov/>. On that website, users will find instructions on how to search for interpretations, how to use letters of interpretation, and how to submit requests for interpretation.

## **15.10.6 Nonroad Engine Credits**

**Organization:** California Air Resources Board (CARB)

On a separate but related topic, CARB staff recommends that U.S. EPA and NHTSA adopt provisions to set a reasonable timeframe for the compulsory expiration of Tier 4 non-road compression ignition emission credits, and codify the terms for expiration in 40 CFR 1039.740. California is a participant in the federal ABT program and is therefore dependent on U.S. EPA and NHTSA for action regarding this request. Our concern is the delay in the full implementation of engines in California equipped with advanced exhaust aftertreatment controls for both PM and NOx. More manufacturers than anticipated are certifying off-road compression ignition engine families in California to Tier 4 final standards without simultaneously employing both PM and NOx aftertreatment devices, and this is due in part, we believe, to manufacturers' use of banked emission credits. We recognize that other factors may contribute to this situation as well, but addressing the expiration of emission credits would help California to more quickly achieve its much needed PM and NOx emission reduction goals. [EPA-HQ-OAR-2014-0827-1265-A1 p.128]

### **Response:**

EPA did not propose such restrictions and considers them to be outside of the scope of this rulemaking. However, we are willing to work with CARB and other interested stakeholders in this area.

## **15.10.7 Black Carbon Emissions**

**Organization:** Advanced Engine System Institute (AESI)

Finally, though the agencies' proposal does not seek to place limits on black carbon emissions from medium- or heavy-duty vehicles or engines, it is worth noting that the global warming potential of this pollutant is very significant, particularly in the short term. According to EPA's 2012 report to Congress

on black carbon, the pollutant's 20-year global warming potential could be around 4,470 times that of carbon dioxide. While existing EPA vehicle regulations are on track over the next two decades to gradually reduce particulate matter pollution, a sizable fraction of which is black carbon, EPA could shrink heavy-duty vehicles' and engines' carbon footprint almost immediately and very cost effectively by application of high-efficiency diesel particulate filters that eliminate 99.9% of black carbon emissions. The Agency may want to consider incentives in the final rule for the rapid installation of such filters on vehicles/engines not already required to have them. [EPA-HQ-OAR-2014-0827-1152-A1 p.3]

**Organization:** Manufacturers of Emission Controls Association (MECA)

### **Control of Black Carbon with Particulate Filters**

Black carbon is a major component of particulate matter emissions from mobile sources and is believed to have a significant net atmospheric warming effect by enhancing the absorption of sunlight. Black carbon is a mix of elemental and organic carbon, in the form of soot, emitted by fossil fuel combustion, bio-mass burning, and bio-fuel cooking. Black carbon is a dominant absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon are transported over long distances and are most concentrated in the tropics where solar irradiance is highest. Because of the combination of high absorption, a regional distribution roughly aligned with solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are thought to be the second strongest contribution to current climate change, after CO<sub>2</sub> emissions. The glacier retreat has accelerated since the 1970s and several scientists have speculated that solar heating by soot in atmospheric brown clouds and deposition of dark soot over bright snow surfaces may be an important contributing factor for the acceleration of glacier retreat. A study published in a 2009 issue of *Nature Geoscience* (vol. 2, 2009) by researchers from the NASA Goddard Institute and Columbia University found that black carbon is responsible for 50% of the total Arctic warming observed from 1890 to 2007 (most of the observed Arctic warming over this timeframe occurred from 1976 to 2007). [EPA-HQ-OAR-2014-0827-1210-A3 p.10]

It is estimated that 70% of the black carbon emissions from mobile sources are from diesel-fueled vehicles, with the assumption that 40% of gasoline PM is black carbon and 60% of diesel PM is black carbon. The black carbon concentration and its global heating will decrease almost immediately after reduction of its emission. Black carbon from diesel vehicles can be significantly reduced through emission control technology that has been required on every U.S. heavy-duty diesel truck manufactured since 2007. The basis for the design of wall-flow particulate filters is a ceramic honeycomb structure with alternate channels plugged at opposite ends. As the gases pass into the open end of a channel, the plug at the opposite end forces the gases through the porous wall of the honeycomb channel and out through the neighboring channel. The porous wall and the filter cake of particulate matter that forms within and on the surface of the wall serve as the filter media for particulates. Since the filter can fill up over time by developing a layer of retained particles on the inside surface of the porous wall, the accumulated particles must be burned off or removed to regenerate the filter. This regeneration process can be accomplished with a variety of methods including both active strategies that rely on generating external sources of heat (e.g., fuel burners, fuel dosing strategies that utilize fuel combustion over a catalyst, electrical elements, intake air throttling) and passive strategies that utilize catalysts that are displayed directly on the filter element or upstream of the filter. During the regeneration of DPFs, captured carbon is oxidized to CO<sub>2</sub> but this filter regeneration still results in a net climate change benefit since the global warming potential of black carbon has been estimated to be as high as 2,200 times higher than that of CO<sub>2</sub> on a per gram of emission basis. It is estimated that the installation of DPFs has reduced PM emissions from U.S. heavy-duty diesel vehicles by 110,000 tons per year. The

ACES Phase 2 study that evaluated the PM emissions from 2010 technology heavy-duty engines showed that DPF equipped engines emit PM at one to two orders of magnitude below the current standard of 0.01 g/bhp-hr and deliver over 99% PM capture efficiency over their lifetime. MECA encourages EPA to develop policies and/or incentives that reward vehicle and engine manufacturers for employing technologies such as particulate filters that provide significant reductions in mobile source black carbon emissions. [EPA-HQ-OAR-2014-0827-1210-A3 p.10-11]

Diesel particulate filters are extremely effective at removing black carbon emissions from diesel engines. Effective climate change policies should include programs and incentives aimed at reducing black carbon emissions from unfiltered new off-road engines and existing diesel engines through effective retrofit programs that implement filters on the full range of in-use diesel engines operating in the U.S. [EPA-HQ-OAR-2014-0827-1210-A3 p.14]

**Response:**

In this rulemaking, the agencies are addressing reduction of GHG emissions from new heavy-duty vehicles starting in the MY 2021 time frame. These vehicles utilize engines that are already regulated to very low particulate matter levels, of which black carbon is a component. The agencies appreciate the comment on retrofit initiatives to further reduce black carbon and particulate matter from the existing (pre-2007) fleet, however we do not intend to address retrofitting of diesel particulate filters to these engines in this rulemaking, as fleet changeover already has, and will continue to remove non-DPF equipped vehicles from the in-use fleet.

The agencies appreciate the comment on reduction of black carbon and particulate matter from nonroad fleet by further reducing standards to a level that would force the use of diesel particulate filters, however we are not addressing GHG, black carbon, or particulate matter emissions from these nonroad engines in this rulemaking action. It is worth noting, however, that we are finalizing provisions that will achieve reductions in PM emissions from tractor APUs and from glider vehicles.

### **15.10.8 Defeat Devices**

**Organization:** Center for Biological Diversity

The Center requests that the EPA address the potential for “defeat devices” to be used during engine testing, such as those recently discovered connection with several models of Volkswagen passenger vehicles.<sup>31</sup> Software algorithms appear to have been used to engage certain NO<sub>x</sub> controls only during testing conditions, not during normal driving. The Center requests that EPA delineate what preventative measures will be implemented to strengthen its testing protocol and detect any defeat devices. [EPA-HQ-OAR-2014-0827-1460-A1 p.8]

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31 US EPA, Notice of Violation to Volkswagen AG, Audi AG and Volkswagen Group of America, <http://www3.epa.gov/otaq/cert/documents/vw-nov-caa-09-18-15.pdf>.

**Organization:** Houston-Galveston Area Council (H-GAC)

The final rule should stress the importance of operator compliance and deter the disabling of vehicle pollution controls. [EPA-HQ-OAR-2014-0827-1142-A2 p.1]

**Response:**

EPA is requiring that NO<sub>x</sub> emission be measured for all testing to measure GHG emissions to verify that NO<sub>x</sub> and GHGs are both being controlled. In addition, we plan to continue our efforts to find appropriate ways to enhance our compliance program and will likely consider such enhancements in any future NO<sub>x</sub> rules.

**Organization:** FedEx Corporation

In addition to the provisions of the proposal referenced above, FedEx is also advocating for new efficiencies in Less-than-Truckload (LTL) freight movement by extending the length of twin 28-foot trailers to 33 feet. This would enable approximately 18 percent more freight to be hauled on the same trip, improving road safety and reducing emissions by significantly reducing the number of trucks on the road. Just five more feet in for these twin trailers would: [EPA-HQ-OAR-2014-0827-1302-A1 p.4]

- Prevent 912 accidents per year [EPA-HQ-OAR-2014-0827-1302-A1 p.4]
- Reduce congestion by 6.6 million truck trips per year [EPA-HQ-OAR-2014-0827-1302-A1 p.5]
- Reduce truck traffic by 1.3 billion miles per year [EPA-HQ-OAR-2014-0827-1302-A1 p.5]
- Reduce carbon emissions by 4.4 billion pounds per year [EPA-HQ-OAR-2014-0827-1302-A1 p.5]

**Response:**

This issue is not within the scope of this rulemaking.